



National Unit specification

General information

Unit title: Experimental Procedures: Science (SCQF level 6)

Unit code: HN8D 46

Superclass: RA

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Unit purpose

This unit is designed to enhance the practical skills of learners in performing scientific experimental procedures and processing the results obtained. The unit is suitable for learners studying at NC level, and will provide the necessary underpinning knowledge and skills to enable progression to further study of experimental procedures at HNC level.

Outcomes

On successful completion of the unit the learner will be able to:

- 1 Perform experimental procedures and record experimental results.
- 2 Process experimental results.
- 3 Plan, organise and complete a laboratory based project.

Credit points and level

1 National unit credit at SCQF level 6: (6 SCQF credit points at SCQF level 6)

Recommended entry to the unit

Entry is at the discretion of the centre, however it is recommended that learners should have completed the NQ Unit F3TC 10 *Science Practical Skills* or equivalent, or have experience of Biology, Chemistry or Physics at SCQF level 5.

National Unit specification: General information (cont)

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Core Skills

Achievement of this unit gives automatic certification of the following:

Complete Core Skill	Numeracy at SCQF level 5
	Problem Solving at SCQF level 6

There are also opportunities to develop aspects of Core Skills which are highlighted in the support notes of this unit specification.

Context for delivery

If this unit is delivered as part of a group award, it is recommended that it should be taught and assessed within the subject area of the group award to which it contributes.

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

National Unit specification: Statement of standards

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Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Outcome 1

Perform experimental procedures and record experimental results.

Performance criteria

- (a) Set up appropriate equipment to perform an experimental procedure.
- (b) Work in a safe manner regarding current health and safety regulations.
- (c) Make and record observations/measurements in an appropriate format.

Outcome 2

Process experimental results.

Performance criteria

- (a) Assess the reliability of the results with respect to the degree of accuracy of the procedure.
- (b) Present the observations/measurements made in an appropriate format.
- (c) Analyse and interpret results correctly from the presented information.
- (d) Perform correct calculations from the measurements made.

Outcome 3

Plan, organise and complete a laboratory based project.

Performance criteria

- (a) Devise an appropriate plan to carry out the laboratory based project.
- (b) Identify and obtain the resources required for the laboratory based project.
- (c) Work in a safe manner regarding current health and safety regulations
- (d) Review and evaluate the results obtained and draw valid conclusions.
- (e) Evaluate the effectiveness of the initial plan devised.
- (f) Evaluate the learner's own performance in the laboratory based project.

National Unit specification: Statement of standards (cont)

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Evidence requirements for this unit

Evidence is required to demonstrate that learners have achieved all outcomes and performance criteria.

Outcome 1

Written and/or oral recorded evidence for Outcome 1 should be assessed using a suitable format. Learners must perform a minimum of six different experimental procedures which must cover at least two of the following science disciplines: biology, chemistry or physics. Learners may cover all three disciplines should they wish.

A learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ set up equipment correctly for six experimental procedures.
- ◆ carry out six experimental procedures correctly and safely.
- ◆ record observations/measurements for six experimental procedures in an appropriate format.

An assessor observation checklist will be used to record the learner's performance of the practical work in line with given instructions and health and safety requirements.

Learners will record all results and relevant observations/measurements relating to the experimental procedures in a laboratory diary, pro forma or laboratory report.

Where a learner does not perform an assessed experimental procedure to the required standard, they will be given the chance to either reattempt the same experimental procedure, or to undertake a different experimental procedure of similar complexity.

Outcome 2

Written and/or oral recorded evidence for Outcome 2 should be assessed by production of two full laboratory reports. The laboratory reports must cover two of the following science disciplines: biology, chemistry or physics.

A learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ assess the reliability of results correctly with respect to the degree of accuracy of the procedure.
- ◆ present observations/measurements in an appropriate format for the results, which on a minimum of one occasion should entail use of a graphical method. The learner must select the most appropriate way of presenting information graphically which may be in the form of a graph, bar chart or histogram.
- ◆ analyse and interpret results correctly from the presented information. The learner must be able to interpret when presented with information in a number of related but straightforward forms.

National Unit specification: Statement of standards (cont)

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- ◆ perform calculations from measurements correctly. Learners are required on at least one occasion to perform calculations which involve at least three different steps and require either the use of mathematical equations or the handling of statistical data.

Outcome 3

Written and/or oral recorded evidence for Outcome 3 should be assessed using a suitable format.

A learner's response will be judged satisfactory where the evidence shows that the learner can:

- ◆ devise an appropriate plan to carry out a laboratory based project.
- ◆ identify and obtain the resources required for a laboratory based project.
- ◆ work in a safe manner regarding current health and safety regulations.
- ◆ review and evaluate the results obtained and draw valid conclusions.
- ◆ evaluate the effectiveness of the initial plan.
- ◆ evaluate their performance in the laboratory based project.

An assessor observation checklist will be used to record the learner's performance of the practical work in line with given instructions and health and safety requirements.

Learners will record all results and relevant observations in a laboratory diary, pro forma or project report.

The evidence must show that the learner can formulate an experimental plan, devise an effective strategy and then carry out the project. Learners should justify the choice of strategy with respect to the different factors involved, as well as the resources and time available. Learners may share their results with team members, where applicable.



National Unit Support Notes

Unit title: Experimental Procedures: Science (SCQF level 6)

Unit support notes are offered as guidance and are not mandatory.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this unit

This unit is intended as part of the framework for the SCQF level 6 NC Applied Sciences group award but may be suitable for inclusion in other science awards. It is designed to provide learners with an opportunity to extend their practical abilities in performing scientific experimental procedures and processing the results obtained.

Outcome 1

In this outcome learners should perform a range of experimental procedures covering at least two of the following science disciplines: biology, chemistry or physics. Some suggested laboratory procedures are given below for each discipline.

Biology

- ◆ Setting up a microscope to view a prepared slide
- ◆ Slide preparation of living/biological material
- ◆ Separating biological material by centrifuging
- ◆ Preparation of sterile equipment and media
- ◆ Transferring living material from different containers without contamination or loss of material
- ◆ Chromatography to identify an unknown substance
- ◆ Use of dissection instruments with plants
- ◆ Use of probes and/or meters to monitor one or more of the following variables: pH, temperature, oxygen concentration, light

National Unit Support Notes (cont)

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Chemistry

- ◆ Preparation of a standard solution to a calculated molarity in the order of 0.1 M (0.1 mol l^{-1}) or 0.05 M (0.05 mol l^{-1})
- ◆ Titration (concordant to 0.1 cm^3)
- ◆ Measurement of pH of a series of solutions using a pH meter
- ◆ Identification of an unknown substance using simple melting point measurement
- ◆ Chromatography to identify an unknown substance
- ◆ Refluxing and distillation
- ◆ Experimental determination of the percentage yield of a product
- ◆ Solvent extraction
- ◆ Recrystallisation
- ◆ Quantitative analysis using a spectrometer

Physics

- ◆ Use of a multimeter or ammeter/voltmeter (analogue or digital scales) in ac/dc circuits with only resistive components
- ◆ Use of a cathode ray oscilloscope for measurements of time intervals and voltage
- ◆ Use of a spectrometer with prisms/diffraction gratings
- ◆ Op-amp applications
- ◆ Use of a transistor as a switch and/or measuring device
- ◆ Use of thermistors/thermocouples to measure temperature
- ◆ Null deflection methods in electrical circuits

The list of experiments given above is not prescriptive, and other laboratory procedures of similar complexity may be used by the centre.

In this outcome learners should also be shown how to record observations/measurements in appropriate formats.

Outcome 2

Learners should be given adequate instruction on how to assess the reliability of results with respect to the degree of accuracy of the procedure and how to present data in different graphical formats, including graph, bar chart and histogram. Learners should also be taught how to analyse and interpret data from different types of graphical representations.

Learners will also carry out calculations based on the measurements they have taken during different experimental processes. Learners are required on at least one occasion to perform calculations which involve at least three different steps and require either the use of mathematical equations or the handling of statistical data.

Observations/measurements recorded in Outcome 1 could be used for Outcome 2.

The laboratory reports must cover two of the following science disciplines: biology, chemistry or physics.

National Unit Support Notes (cont)

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Outcome 3

In this outcome learners will be given the opportunity to plan and carry out a laboratory based project on a subject of their choice. Learners could work in small groups during the practical stage of the project however they should produce their own plan, project report and evaluate their own performance in the task.

Examples of suitable projects are given below:

Biology

- ◆ Induction of β -galactosidase gene expression by lactose in E.coli
- ◆ The antimicrobial effect of honey
- ◆ Investigating bacterial motility and chemotaxis
- ◆ Investigating the composition of infant formula milk powders
- ◆ Investigating factors that affect plant growth

Chemistry

- ◆ Chemistry of sunscreens
- ◆ Extraction and analysis of essential oils/active ingredients from sources (eg clove oil)
- ◆ Food analysis: eg analysis of 'healthy option' vs standard crisps (eg fat, moisture, fibre, salt)
- ◆ Fuel chemistry: comparison of fuels, eg biodiesel vs diesel
- ◆ Kinetics: study of factors affecting rates of reaction

Physics

- ◆ Young's modulus of an elastic band
- ◆ Wavelength of light
- ◆ Internal resistance of a battery
- ◆ How does the current in a LED affect the brightness?
- ◆ Specific heat capacity

Guidance on approaches to delivery of this unit

It is recommended that the outcomes are delivered in numerical order.

Laboratory practical work is one of the essential features of this unit. A series of practical exercises should be carried out in order to give learners experience of basic procedures before they are assessed.

All practical procedures must be approved by the teacher/lecturer and due consideration must be given to ensure all practical work is carried out in a safe manner regarding current health and safety regulations. Learners should follow Good Laboratory Practice (GLP) on all procedures undertaken.

National Unit Support Notes (cont)

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Learners must be able to select appropriate methods to communicate information as well as interpret graphical information. In Outcome 2 learners must perform calculations involving at least three steps.

Suitable experiments must be chosen to ensure that all the performance criteria can be achieved.

Guidance on approaches to assessment of this unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

In Outcome 1 learners will perform six experimental procedures covering at least two of the following science disciplines: biology, chemistry or physics. Learners should be assessed on their ability to perform laboratory work to an appropriate and safe standard. Learners will also record all measurements/observations in an appropriate format.

In Outcome 2 learners will process their experimental results. Laboratory reports should be clear and concise, with all results and calculations reported in an appropriate format. The laboratory reports must cover two of the following science disciplines: biology, chemistry or physics. Learners should include interpretation and analysis where required.

In Outcome 3 learners will plan, organise and complete a laboratory based project. Examples of suitable laboratory based projects are given elsewhere in this document.

Where a learner does not perform an assessed practical experiment to the required standard, they can be given the chance to either reattempt the same practical experiment, or to undertake different practical experiments of similar complexity.

Where a laboratory report does not meet the required standard, then the learner can be given a single opportunity to re-draft. If the required standard is still not attained, then an alternative practical experiment should be set.

Assessed practical experiments will usually be performed individually. However, there may be some practical experiments that may be suitable to be undertaken in pairs or small groups. If this is the case then the assessor should ensure that all participants are actively involved and are able to adequately demonstrate the required skills.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

National Unit Support Notes (cont)

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Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the evidence requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Opportunities for developing Core and other essential skills

This unit has the Core Skills of Numeracy at SCQF level 5 and Problem Solving at SCQF level 6 embedded in it. This means that when learners achieve the unit their Core Skills profile will also be updated to show they have achieved Numeracy at SCQF level 5 and Problem Solving at SCQF level 6.

The delivery and assessment of this unit will also provide learners with the opportunity to develop the Core Skills of Working with Others at SCQF level 5 and Information and Communication Technology (ICT) at SCQF level 4.

Working with Others — Working Co-operatively with Others at SCQF level 5

Learners may be required to carry out laboratory practical work as part of a team. During these exercises, learners will need to plan and execute tasks in a co-operative manner.

Information and Communication Technology (ICT) — Accessing Information and Providing/Creating Information at SCQF level 4

Learners may be required to make effective use of a computing system in order to research information for a laboratory based project. Learners will select the relevant information from searches they conduct on their given topic. Learners may also use ICT in order to prepare laboratory reports, including presenting graphical data.

Sustainability

Sustainability may be embedded in the delivery of this unit in a variety of ways. For example, in the laboratory, minimum usage of chemicals should be encouraged and correct disposal procedures must be followed. Any opportunity to recycle during a practical activity should also be utilised.

History of changes to unit

Version	Description of change	Date

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General information for learners

Unit title: Experimental Procedures: Science (SCQF level 6)

This section will help you decide whether this is the unit for you by explaining what the unit is about, what you should know or be able to do before you start, what you will need to do during the unit and opportunities for further learning and employment.

This is a 1 credit unit at SCQF level 6, which you are likely to be studying as part of a NC Applied Sciences programme. Before progressing to this unit it would be beneficial to have completed the NQ Unit F3TC 10 *Science Practical Skills* or have prior knowledge of Biology, Chemistry or Physics at SCQF level 5. The unit is designed to develop your practical skills in performing scientific experimental procedures and processing the results obtained.

On completion of this unit you should be able to:

- 1 Perform experimental procedures and record experimental results.
- 2 Process experimental results.
- 3 Plan, organise and complete a laboratory based project.

Outcome 1

In this outcome you will enhance your practical laboratory skills by performing a series of experiments. These practical experiments will cover at least two of the following science disciplines: biology, chemistry or physics. You will have to follow procedures to set up the experiments and carry them out in a safe manner. You will also record any observations/measurements.

Outcome 2

In this outcome you will process your observations/measurements. This will include the use of appropriate graphical representations which you will then use to evaluate your data. You will also carry out calculations based on the results gathered during the experimental procedures.

Outcome 3

In this outcome you will plan, carry out and evaluate a laboratory based practical project.

Assessment

Outcomes 1 and 3 will be assessed using checklists to record your practical skills. You will also keep a laboratory diary or pro forma. For two of your experiments you will also write a full laboratory report. These will cover two different science subjects from biology, chemistry or physics.

Core Skills

This unit has the Core Skills of Numeracy at SCQF level 5 and Problem Solving at SCQF level 6 embedded in it. This means that when you achieve the unit your Core Skills profile will also be updated to show you have achieved Numeracy at SCQF level 5 and Problem Solving at SCQF level 6. You may also have the opportunity to develop the Core Skills of Working with Others at SCQF level 5 and Information and Communication Technology (ICT) at SCQF level 4.