

Unit 6: Investigative Project

Level: **3**

Unit type: **Internal**

Guided learning hours: **90**

Unit in brief

This unit enables learners to gain an understanding and the skills required to undertake an investigative project.

Unit introduction

In this unit, you will carry out an investigative project that you have chosen in collaboration with your teacher.

You will choose one topic area that interests you and this will form the basis of your investigative project. You will carry out a scientific literature search and review, considering the project's aims and objectives, then produce a realistic plan and carry out the project safely using your scientific investigation skills, project management skills and what you have learnt from the other units. Finally, you will prepare an evaluative report that will consider the project outcomes and suggest amendments that may have improved those outcomes. To complete the assessment task within this unit, you will need to draw on your learning from across your programme.

Completing an investigative project is an excellent way for you to develop an understanding of the science-related workplace. The skills developed in this unit will be of considerable benefit for progression to higher education in a variety of science and science-related courses and to employment in the science or applied science sector.

Learning aims

In this unit you will:

- A** Undertake a literature search and review to produce an investigative project proposal
- B** Produce a plan for an investigative project based on the proposal
- C** Safely undertake the project, collecting, analysing and presenting the results
- D** Review the investigative project using correct scientific principles.

Summary of unit

Learning aim	Key content areas	Recommended assessment approach
A Undertake a literature search and review to produce an investigative project proposal	A1 Literature review A2 Investigative project proposal	Present a project plan proposal supported by a logbook.
B Produce a plan for an investigative project based on the proposal	B1 Schedule B2 Plan B3 Health and safety and ethical considerations	Present a project plan proposal supported by a logbook.
C Safely undertake the project, collecting, analysing and presenting the results	C1 Experimental procedures and techniques C2 Collect, collate and analyse data C3 Data presentation	Present an evaluative report of the final project outcomes. Outcomes could then be presented to a class and observation sheets could also be used to assess element of self-reflection. Alternatively, this could be an additional written piece alongside the report.
D Review the investigative project using correct scientific principles	D1 Scientific report for the investigative project D2 Scientific evaluation of findings D3 Skill development within project work	

Content

Learning aim A: Undertake a literature search and review to produce an investigative project proposal

Learners must select a relevant area of study linked to chemistry, physics or biology, or a combination of different fields.

A1 Literature review

- Identification of criteria, e.g. how many sources, what is the oldest date that will be looked at, which types of source will be excluded.
- Nature of study, which could include field work, laboratory-based work, sports facility, workshop.
- Sources of information:
 - identification and location of relevant and reliable sources of information, e.g. journal articles, textbooks, websites
 - extraction – how to obtain the information from libraries, resource centres, organisations, government organisations, charities
 - recognising and using protocol for referencing of information sources, to include use of the Harvard referencing system.

A2 Investigative project proposal

- Rationale for area of study – suitable for interest/based on literature review.
- Background.
- Hypothesis.
- Aims and objectives.
- Identification of potential limitations of the project, e.g. implications for resources, time constraints, use of facilities.

Learning aim B: Produce a plan for an investigative project based on the proposal

B1 Schedule

Timeline for the project, to include:

- start date
- completion date
- milestones.

B2 Plan

- Relevant methods for processes/procedures.
- Use of resources, e.g. participants, equipment and instrumentation, materials.
- Contingency planning and remedial actions, e.g. extra resources, schedule revision.

B3 Health and safety and ethical considerations

- Identification of hazards, personal protective equipment (PPE) and Control of Substances Hazardous to Health (COSHH) Regulations 2002 requirements, health and safety legislation.
- Risk assessment, including type of hazard, level of risk, prevention and minimising of hazards.
- Ethical considerations, e.g. obtaining consent, maintaining confidentiality.

Learning aim C: Undertake the project, collecting, analysing and presenting the results

C1 Experimental procedures and techniques

- Assembly of relevant equipment and materials.
- Adhering to health and safety risk analysis, and PPE and COSHH requirements during practical investigation.
- Skills of transferring, handling and using equipment and materials.
- Use of equipment, instruments, sensors and techniques for taking measurements.
- Observation skills.
- Adhering to relevant legislation:
 - Good Laboratory Practice (GLP)
 - Good Manufacturing Practice (GMP)
 - Good Clinical Practice (GCP).

C2 Collect, collate and analyse data

- Recording results with, accuracy, integrity, precision.
- Maintenance of working laboratory logbooks and record keeping.
- Organisation of practical data in class intervals, tallying.
- Methods and uses of data processing and analysis, e.g. standard deviation, student's t-test, chi-square test.
- Correct units of experimental quantities used.
- Assessment of experimental accuracy, reliability and precision.
- Validation of method and results:
 - fitness for purpose of methods used
 - repeatability
 - sources and magnitudes of errors in readings taken.

C3 Data presentation

- Range of appropriate data presentation used.
- Choice of data presentation explained.
- Correct presentation of chosen data format explained.

Learning aim D: Review the investigative project using correct scientific principles

D1 Scientific report for the investigative project

- Correct scientific principles:
 - structure and format
 - use of correct scientific terminology
 - past tense, including third person.
- References and bibliography:
 - correctly written
 - included in appendix
 - correct use of the Harvard referencing system.

D2 Scientific evaluation of findings

- Evaluation of statistical results.
- Conclusions drawn from primary and secondary data using scientific principles.
- Limitations of investigative project and areas for improvement.
- Assessment of information sources used and relevance to investigation experimental and literature investigations.
- Evaluation of proof, or otherwise, of hypothesis stated.
- Recommendations for further research.

D3 Skill development within project work

- Time management and organisation.
- Adhering to and following appropriate standards and protocols.
- Taking responsibility for completing tasks/procedures.
- Making judgements within defined parameters.
- Application of safe working practice.
- Give and receive constructive feedback.
- Identify, organise and use resources effectively to complete tasks.
- Utilising channels of communication.
- Resourceful and using initiative.

Assessment criteria

Pass	Merit	Distinction
Learning aim A: Undertake a literature search and review to produce an investigative project proposal		A.D1 Evaluate the different methods of investigation considered for the investigative project proposal, justifying the hypothesis chosen.
<p>A.P1 Carry out a literature search and review into a chosen scientific area.</p> <p>A.P2 Produce an appropriate project proposal for an investigative project proposal, to include hypothesis.</p>	<p>A.M1 Analyse a literature search and discuss its relevance to inform the investigative project proposal.</p> <p>A.M2 Produce a project proposal for a scientific investigation, to include hypothesis and potential limitations.</p>	
Learning aim B: Produce a plan for an investigative project based on the proposal		B.D2 Analyse the effectiveness of the working plan, justifying changes made.
<p>B.P3 Produce a realistic working plan for the project, including health and safety and risk assessments.</p>	<p>B.M3 Produce a realistic working plan for the project, including health and safety and risk assessments and contingency planning.</p>	
Learning aim C: Safely undertake the project, collecting, analysing and presenting the results		CD.D3 Evaluate the conclusions of the investigative project and its practical aspects, discussing limitations, improvements and recommendations for further study. CD.D4 Evaluate the skills developed in the investigative project undertaken and suggest areas for improvement.
<p>C.P4 Demonstrate practical skills to assemble relevant apparatus/equipment and materials, and carry out the project using safe working practices.</p> <p>C.P5 Accurately collect, analyse and present the results obtained.</p>	<p>C.M4 Justify the choice of experimental and data-analysis techniques used as a means of increasing accuracy, reliability and validity.</p>	
Learning aim D: Review the investigative project using correct scientific principles		
<p>D.P6 Produce a report using findings, scientific terminology and protocol appropriately and drawing conclusions.</p> <p>D.P7 Summarise skills developed in the investigative project undertaken.</p>	<p>D.M5 Produce a report using findings, correct scientific terminology, protocol and formatting and drawing valid conclusions.</p> <p>D.M6 Discuss the importance of skills developed in the investigative project undertaken to achieve aims.</p>	

Essential information for assignments

The recommended structure of assessment is shown in the unit summary along with suitable forms of evidence. *Section 6* gives information on setting assignments and there is further information on our website.

There is a maximum number of three summative assignments for this unit. The relationship of the learning aims and criteria is:

Learning aim: A (A.P1, A.P2, A.M1, A.M2, A.D1)

Learning aim: B (B.P3, B.M3, B.D2)

Learning aims: C and D (C.P4, C.P5, D.P6, D.P7, C.M4, D.M5, D.M6, CD.D3, CD.D4)

Further information for teachers and assessors

Resource requirements

For this unit, learners must have access to:

- a well-equipped laboratory (and maybe a fume cupboard or access to suitable environments to carry out field work)
- materials/equipment and/or laboratory instruments/sensors that will enable them to carry out practical work
- appropriate science and maths software packages to help them present their data in the most appropriate way.

Essential information for assessment decisions

Learning aim A

For distinction standard, learners will show that they have considered in detail, more than one appropriate investigative method of approach to tackling the hypothesis and explain why their chosen approach is suitable. Once they have established their plan, they will justify their choice of project and the hypothesis they are going to test. Learners will justify their method of approach to the method used in their project proposal, using evidence from their literature review.

For merit standard, learners will show that they can use the material to help them plan their work and indicate its relevance to the investigative work they have in mind. Teachers should look for evidence of the search material being analysed. It is expected that this analysis will influence learners' hypothesis and the research project proposal. Learners will include any potential limitations of the project proposal, such as the accuracy of any graduated apparatus or limitations of instruments/sensors.

For pass standard, learners will be informed that when they are carrying out their search on the scientific topic, they are expected to give a comprehensive bibliography and list of references using a standard protocol, such as the Harvard system. Teachers should also look for the use of more than one source in order to confirm statements made by learners. They should review the information they have gathered and ensure confirmation of information from different sources. This information will be used to form the basis of their project proposal. Learners will produce an appropriate research project proposal for an investigation.

Learning aim B

For distinction standard, learners will reflect on their working plan and justify any changes made, such as a change in their timeline that affects milestones or internal/external factors requiring different equipment/instrumentation.

For merit standard, learners will include contingency planning (for example if they did not have enough time to complete the experiment or if a sensor/instrument stopped working).

For pass standard, learners will produce a realistic working plan taking into account possible constraints. Teachers will be able to follow the information and carry out the experiment without reference to learners. The relevant health and safety and risk assessments will be carried out for practical experiments and adhered to.

Learning aims C and D

For distinction standard, learners will review the information they have obtained from their search and practical work, and decide on its validity, reliability and accuracy, and whether the original hypothesis has been met. They will include an evaluation of alternative experimental approaches, the modification or rewriting of their hypothesis and the strengths and weaknesses if alternative approaches were used. Learners will also evaluate the effectiveness of their choice of statistical methods or graphs/calculations and the validity and usefulness of their research data, as well as considering how their experimental data compares to any published information and discussing the limitations of their project. Learners will draw on all areas of project work carried out to critically reflect on the strengths and weaknesses of their own performance and skill development, drawing on feedback. Learners will demonstrate how self-reflection and feedback (which could be through collaborative working) has aided their project work, and also suggest areas for improvement and the steps necessary to achieve them.

For merit standard, learners will have previously run through the experimental and data analysis techniques they are using with their teacher and justified their choice. Teachers can question learners about the experimental techniques used, but there must be evidence for this so that it can be assessed and verified. Learners may refine their experimental techniques after discussion with their teacher, but this must also be recorded in some way so that it can be assessed and verified. Whatever approach is taken, learners will record their review, evaluate the effectiveness of experimental procedures and suggest how these could be improved.

Learners will demonstrate accuracy in their observational skills, recording the results in an appropriate format, including noting approximations, decimal point accuracy, etc. Learners will justify, for example, why an approximation was used or why only two decimal points were recorded.

Learners will be in a position to support (or not) their original hypothesis and justify their opinion based on both their collected primary data and any researched secondary data. Learners will be able to succinctly interpret their statistical data and draw valid conclusions from this.

Learners will need to explain how specific skills developed within their project have enabled them to meet project aims. Learners may demonstrate limited awareness of areas of improvement and the steps to achieve them.

For pass standard, learners will be observed assembling the apparatus/equipment effectively and efficiently, and selecting the correct materials before carrying out the experiment safely. Teachers should regularly check the laboratory logbook and diary of each learner and sign and date the section seen.

Learners will use the results of their experiment, stating if their original objectives or hypothesis has been met and making appropriate conclusions from statistical data, as well as drawing together scientific using correct principles.

Learners will produce their report in the correct scientific format and in a formal manner, using the information and data they have collected throughout the project. The report will be written using accepted scientific terminology and protocol, such as impersonal, third party and past tense. The presentation can be made to a group or to their project teacher.

Learners will outline the key skills developed in their investigative project and may identify areas of improvement.

Links to other units

This assessment for this unit should draw on knowledge, understanding and skills developed from:

- Unit 1 Principles and Applications of Science
- Unit 2 Practical Scientific Procedures and Techniques
- Unit 3 Science Investigation Skills
- Unit 4 Laboratory Techniques and their Application
- Unit 5 Principles and Applications of Science II.

Employer involvement

Centres may involve employers in the delivery of this unit if there are local opportunities. There is no specific guidance related to this unit.