

# Unit 32: Forensic Evidence Collection and Analysis

<b>Unit code:</b>	<b>A/502/5577</b>
<b>QCF Level 3:</b>	<b>BTEC National</b>
<b>Credit value:</b>	<b>10</b>
<b>Guided learning hours:</b>	<b>60</b>

## ● Aim and purpose

The aim of this unit is to enable learners to develop skills in using chemical, physical and biological techniques in the collection, analysis and reporting of forensic evidence. The unit also gives an overview of the methods used to present results.

## ● Unit introduction

This unit is a practical approach to a very important aspect of forensic investigation. Learners will experience and develop their knowledge and skills first-hand by taking part in a simulated crime scene investigation, from collecting the evidence, through the analysis and finally presenting their results in a variety of formats for use in the Criminal Justice System (CJS).

The collection and packaging of evidence at a crime scene is a vital process. A forensic scientist is not routinely present at a crime scene so this unit enables learners to develop an understanding of the importance of being objective in the approach to the identification of evidence and also an appreciation of the processes employed to collect and package the material, which can be vitally important when providing a comprehensive analysis.

Learners will use some sophisticated equipment and techniques such as spectrophotometers, chromatography, microscopy and photography. They will practically explore much of the science that supports these techniques and learn how they are carried out.

The investigation of crime scene samples frequently involves the use of biology and its applications, including fingerprint analysis, DNA testing and the identification of hairs and fibres. In this unit learners can explore the science that supports these techniques and how they are carried out, thereby enhancing understanding and skills. This unit also provides an opportunity to learn more about some topical issues such as DNA analysis and its use in profiling.

The forensic scientist must also be able to present the results of the examination of evidence. Different methods of presentation are explored – written, verbal and visual – and learners are given the opportunity to make their own presentations in an appropriate manner for a forensic scientist.

## ● Learning outcomes

### On completion of this unit a learner should:

- 1 Be able to gather forensic evidence from a simulated crime scene using appropriate methods
- 2 Be able to use chemical techniques to analyse evidence from a simulated crime scene
- 3 Be able to use physical techniques to analyse evidence from a simulated crime scene
- 4 Be able to use biological techniques to analyse evidence from a simulated crime scene
- 5 Be able to report the analysis of evidence from a simulated crime scene.

# Unit content

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## 1 Be able to gather forensic evidence from a simulated crime scene using appropriate methods

*Evidence:* targeting, documenting and recovery of trace materials; characterisation and comparison; marks and impressions

*Health and safety:* Health and Safety Act 1974; Control of Substances Hazardous to Health (COSHH) Regulations 1996; Management of Health and Safety at Work Regulations 1992; use of disposable Personal Protective Equipment (PPE)

*Preservation of scene and sampling:* observation and recording of the scene; restriction of access; search for material of potential evidential value; packaging and labelling; storage and transmission to laboratory; continuity and chain of evidence

*Analysis and evaluation:* prevention of contamination; security; records; full documentation of procedures and methods

## 2 Be able to use chemical techniques to analyse evidence from a simulated crime scene

*Spectrometry:* instrumental techniques; mass spectrometry; infrared; ultraviolet; colorimetry

*Chromatography:* separation of mixtures eg paper, column, thin layer (TLC), gas (GC), high performance liquid (HPLC)

*Chemical enhancement:* fingerprints (ninhydrin, silver nitrate, iodine, amido black, and cyanoacrylate fuming).

*Chemical presumptive tests:* bodily fluids (blood, semen, saliva); poisons

*Toxicology:* science of poisons (anions, corrosive poisons, gaseous and volatile poisons, metal and metalloid poisons, pesticides, toxins, and drugs of abuse); instrumental analysis; effects; antidotes; specimen collection (ante and post mortem)

## 3 Be able to use physical techniques to analyse evidence from a simulated crime scene

*Images/photography:* traffic; surveillance; public order offences; support team at major incidents; crime scene; high quality record of exhibits, eg taking devices apart

*Ballistics:* firearms (hand guns, rifles and shotguns; rifling, ballistic fingerprinting, propellants, micro stamping); bullets and cartridges; calibre; discharge residue; wound patterns; trajectory

*Document examination:* handwriting (cursive, printing and signatures); printed documents (typewriters, photocopiers, laser printers, ink jet printers); paper; ink

## 4 Be able to use biological techniques to analyse evidence from a simulated crime scene

*Biological evidence:* blood group analysis; genetics (DNA sequencing, genetic fingerprints); fingerprints (four basic patterns, minutiae and ridge counting); hair and fibre identification and analysis; bone and skeleton physiology

*Microscopy:* measurement and comparative microscopy

## 5 Be able to report the analysis of evidence from a simulated crime scene

*Documentation:* case file; scene of crime documentation (crime scene sketches, evidence labels, cordon log, photographs); laboratory analysis forms; expert witness statement

*Individualisation of evidence:* types of evidence that will allow a perpetrator to be individualised

*Interpretation of evidence:* draw rational and balanced conclusions from observations of circumstances of the crime scene; test results and measurements; probability of validity; reconstruction of events

*Presentation of evidence:* court case preparation and verbal presentation of evidence; expert witness statement (written); expert opinion (verbal)

## Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:	To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:
<b>P1</b> carry out a forensic examination of a simulated crime scene, using appropriate methods to gather biological, physical and chemical evidence [TW1,3]	<b>M1</b> describe the procedures used to gather evidence from a simulated crime scene	<b>D1</b> justify the procedures used to gather evidence from a simulated crime scene
<b>P2</b> outline the main techniques used to analyse chemical evidence [IE1,2]	<b>M2</b> explain the main techniques used to analyse chemical evidence	<b>D2</b> evaluate the techniques used to analyse chemical evidence
<b>P3</b> carry out practical work to analyse chemical evidence gathered from a simulated crime scene [TW1,3]	<b>M3</b> present valid conclusions drawn from the analysis of chemical evidence gathered from a simulated crime scene	<b>D3</b> justify the choice of techniques used to analyse the chemical evidence gathered
<b>P4</b> outline the main techniques to analyse physical evidence [IE1,2]	<b>M4</b> explain the main techniques to analyse physical evidence	<b>D4</b> evaluate the techniques used to analyse physical evidence
<b>P5</b> carry out practical work to analyse physical evidence gathered from a simulated crime scene [TW1,3]	<b>M5</b> present valid conclusions drawn from the analysis of physical evidence gathered from a simulated crime scene	<b>D5</b> justify the choice of techniques used to analyse the physical evidence gathered
<b>P6</b> outline the main techniques used to analyse biological evidence [IE1,2]	<b>M6</b> explain the main techniques used to analyse biological evidence	<b>D6</b> evaluate the techniques used to analyse biological evidence
<b>P7</b> carry out practical work to analyse biological evidence gathered from a simulated crime scene [TW1,3]	<b>M7</b> present valid conclusions drawn from the analysis of biological evidence gathered from a simulated crime scene	<b>D7</b> justify the choice of techniques used to analyse the biological evidence gathered
<b>P8</b> report on a chemical, physical and biological forensic examination [EP2,6].	<b>M8</b> justify the conclusions drawn in the report.	<b>D8</b> evaluate their findings, including aspects of probability.

**PLTS:** This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

# Essential guidance for tutors

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## Delivery

A visit to a state-of-the-art forensic laboratory is strongly recommended. If this is not possible for all learners, then tutors are strongly advised to take any opportunity to visit one themselves. This would give tutors an appreciation of the differences between industrial laboratories and centre-based laboratories to enable them to better deliver the unit. These differences include the clear demarcation of 'clean' and 'contaminated' areas (not only in biological and animal laboratories, but even in many chemistry ones), and the separate space for computers, desks etc that learners may not be aware of.

This unit is intended to develop the learners' understanding of chemistry, biology and physical science in respect to their applications in forensic investigations. The emphasis should be on the scientific investigation of evidence and the techniques involved, rather than merely evidence gathering. Recent advances in methods and applications can be investigated by learners during the course, and could usefully be presented to the class.

The hands-on crime scene investigation should allow learners to demonstrate chemical, physical and biological forensic examination techniques. This deals with the crime scene in its entirety rather than artificially dividing up the type of evidence collected. The assessment will follow this example.

Wherever possible the *Unit content* should be reinforced with practical work and scientific analytical techniques used to develop learners' skills and understanding.

Where specific acts and regulations are referred to in this unit, the latest versions should always be considered.

Learning outcome 1 introduces learners to the processes of evidence gathering from a physical viewpoint, and develops the objective and rigorous skills needed for the presentation of evidence by report, video or verbally. The practical aspects of this should be emphasised and focused on in this unit. It is important that learners are given every opportunity to practise the gathering of evidence themselves in the context of chemical and physical science.

Learning outcome 2 should introduce the basics of chemistry and enable learners to understand the chemical background and procedures used in forensic analysis. The theoretical aspects should always be delivered along with the practical applications.

Learning outcome 3 should enable learners to understand the physical background and procedures used in forensic analysis. The theoretical aspects should always be delivered along with the practical applications.

Learning outcome 4 enables learners to understand the biological background and procedures used in forensic analysis. The theoretical aspects should always be delivered along with the practical applications.

Learning outcome 5 brings the previous 4 outcomes together, enabling learners to follow the process through from the crime scene to preparation of the case for court. Learners need to understand how comprehensive documentation from the evidence gathering and scientific analysis process can be brought together, interpreted and compiled in a case file.

## Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to <i>Unit content</i> and structure of assignments.
Evidence: Series of lectures followed by practical activities to include: Identification of trace evidence, documentation of position of evidence: sketches and photographs. Collection: contamination issues, types of powders and brushes for fingerprints, lifting fingerprints. Packaging: use of correct materials, evidence labels, continuity, storage.
Health and safety: Lectures on regulations, use of disposable PPE, risks of infection and need for immunisation, eg hepatitis C.
Preservation of scene: Series of lectures on cordons (inner and outer perimeter), search patterns, security.
Analysis and evaluation: Methods of recording information at scene, construction of a case file.
<b>Assignment 1: Collection of Evidence (P1, M1, D1)</b>
Processing of a simulated crime scene. Small groups to process the scene, from 'first walk through' to the identification, collection and packaging of the evidence.
Chemical techniques: Series of lectures on the instrumentation, followed by practical sessions where possible. Links with industry and universities should enable learners to make the link between the theoretical aspects and practical applications.
Chemical enhancement: This lends itself to practical investigation, which chemicals work best in which situations? Learners could research them, suggest applications and confirm them practically where possible. Health and safety issues should be highlighted.
Presumptive tests: Lectures to include the reasons for performing presumptive tests and what a positive result means in terms of further analysis. Health and safety considerations in practical work. Drug testing solutions have significant health and safety issues and should perhaps be restricted to demonstrations for large groups.
Toxicology: Structured lectures on science of poisons. Opportunity for learner research on criminal cases involving poisons.
Photography: Brief introduction to equipment available for recording images. Use of images recorded. Practical exercise could involve photographing evidence recovered from the crime scene.
Ballistics: Lectures from guest speakers from local gun club, territorial army, or firearms officers within the police. Desktop sessions on ballistic fingerprinting. Microscopic examination of bullet casings if possible.
Document examination: Brief introduction to profiling based on graphology. Lectures on the identifying features left by printers etc on printed documents with desktop analysis of prepared examples. Microscopic examination of paper types. Chromatography of inks.
Biological evidence: Lectures and practical sessions on main topics. Practical sessions should include analysis of evidence recovered from crime scene.
Microscopy: Practical applications covered in biological evidence. Theory in Fundamentals unit on design and use of electron and light microscopes could link here.
<b>Assignment 2: Portfolio of Techniques (P2, P4, P6, M2, M4, M6, D2, D4, D6)</b>
Learners could build a portfolio on the theoretical aspects of the techniques studied.
<b>Assignment 3: Analysis of Evidence (P3, P5, P7, M3, M5, M7, D3, D5, D7)</b>
Learners could build a portfolio on the analysis performed on the evidence they collected from the simulated crime scene.

## Topic and suggested assignments/activities and/assessment

Documentation of evidence: Case file construction – what documentation should be included and why. Lecture on use of standard forms during analysis and importance of detailed and accurate recording methods. Continuity of evidence.

Presentation of evidence: Class discussions on the individualisation of evidence and its significance. Interpreting the evidence and constructing an expert witness statement based on this interpretation. Presenting written statements and oral expert opinions.

### Assignment 4: Crime Scene to Court (P8, M8, D8)

Case file to include work from Assessment 1 and 3. Written expert witness statements also to be included. Mock court would provide the learner with the opportunity to be a witness and present their expert opinion on the information gathered.

Unit review and programme of assignments.

## Assessment

It is essential that this unit is delivered in close relationship with practical chemical and physical science. As crime scene evidence should be fully and clearly documented and presented, the assignment work produced by learners should also meet this high standard.

All the pass grade criteria must be met in order for a learner to achieve this unit.

For pass criteria any numerical values should have the correct units of measurement.

For P1, learners must examine a crime scene showing a clear understanding of the techniques and procedures that may be used by an investigator in the gathering of evidence.

For P2, P4 and P6 learners must briefly describe the major chemical, physical and biological techniques used to analyse evidence. There should be sufficient detail to cover all the main points of each type of method. Learners must show confidence with simple analytical techniques.

For P3, P5 and P7 learners must carry out the practical work required to analyse the chemical, physical and biological evidence that they have gathered. Their results must be presented accurately.

For P8, learners must report the results and conclusions from the examination of the crime scene and the laboratory analysis of the evidence in the appropriate manner. It is suggested that this report take the form of a case file where documentation from criteria 1 and 3 would be included. This would be an ideal opportunity for the learner to take the role of the expert witness and present their conclusions to the court.

For a merit grade, all the pass grade criteria and all the merit grade criteria must be met.

For M1, learners must describe fully the procedures used to gather evidence from the crime scene

For M2, M4 and M6 learners must give detailed descriptions of the major techniques and an appropriate example of their forensic application to the simulated crime scene.

For M3, M5 and M7 learners must draw valid conclusions from the results of the analysis of the evidence. They must support their conclusions with evidence and reasoning and where appropriate make suitable suggestions for further analysis.

For M8, learners must give a clear and logical justification for the conclusions drawn from the evidence collected during the forensic examination and the subsequent analysis. Learners must relate the conclusions drawn from the analysis to the crime scene and comment on its significance. This should be given as part of the presentation, and with the same level of objectivity and clarity as appropriate to the presentation of investigational results in a forensic or scientific situation.

For a distinction grade, all the pass, merit and distinction grade criteria must be met.

For D1, learners must objectively justify the procedures used to collect evidence from a simulated crime scene. They must also show how the correct application of these procedures can minimise risk of overlooking evidence.

For D2, D4 and D6 learners must evaluate the techniques used to carry out the investigation. They must also indicate what other types of evidence or situations would require use of these techniques.

For D3, D5 and D7 learners must substantiate the choice of techniques used in the analysis of the forensic evidence. It is expected that the selection of technique in many cases will be restricted to the equipment and facilities available so learners must also justify the appropriateness of the techniques used in these cases.

For D8, learners must evaluate their results. They must consider clarity of explanations of results and conclusions, ensuring that they are not ambiguous. They must also consider probability in terms of possible, probable, likely and how probability can be described quantitatively.

### Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, M1, D1	Collection of Evidence	You are a scene of crime officer, completing the processing of a simulated crime scene – identifying, collecting and packaging evidence using appropriate methods.	Witness statement for P1; collection of evidence which is clearly labelled and packaged.
P2, M2, D2 P4, M4, D4 P6, M6, D6	Portfolio of Techniques	You are a forensic scientist building up a portfolio of the main techniques used in the laboratory.	Portfolio of techniques.
P3, M3, D3 P5, M5, D5 P7, M7, D7	Analysis of Evidence	You are a forensic scientist required to analyse the evidence collected from a simulated crime scene.	Portfolio of results from analysis of evidence from simulated crime scene.
P8, M8, D8	Crime Scene to Court	You are an expert witness presenting the result and conclusions from the investigation to a mock court.	Case file. Presentation.

## Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Applied Science sector suite. This unit has particular links with the units shown below from the BTEC Applied Science suite of qualifications:

Level 1	Level 2	Level 3
Crime Scene Investigation (FLT)	Investigating a Crime Scene	Forensic Photography
		Forensic Fire Investigation
		Traffic Accident Investigation

### Essential resources

This unit aims to develop learners' skills in analytical techniques in the context of practical science. It is therefore important that learners have access to facilities to carry out practical scientific work for demonstration and practice.

It is important to introduce learners to the rigorous nature of scientific investigations and the objective reporting of results. Learners should have ample opportunity to practise and develop their skills in these areas.

### Employer engagement and vocational contexts

Centres should develop links with local police stations, universities and analytical laboratories. Specialists from these areas are usually willing to speak to learners about their work experience.

### Indicative reading for learners

#### Textbooks

Dean J et al – *Practical Skills in Forensic Science* (Prentice Hall, 2005) ISBN 9780131144002

Flanagan R J et al – *Fundamentals of Analytical Toxicology* (Wiley-Blackwell, 2008) ISBN 9780470319352

Jackson A R W and Jackson J M – *Forensic Science, 2nd Edition* (Prentice Hall, 2007) ISBN 9780131998803

Moore P – *The Forensics Handbook* (Eye Books, 2004) ISBN 9781903070352

Pepper I K – *Crime Scene Investigation: Methods and Procedures* (Open University Press, 2005) ISBN 9780335214907

White P C – *Crime Scene to Court: The Essentials of Forensic Science* (The Royal Society of Chemistry, 2004) ISBN 9780854046560

#### Journals

*Biological Sciences Review*

*Chemistry Review*

*Chemistry World*

*Journal of Forensic Sciences*

*New Scientist*

*Physics Review*

*Science and Justice*

## Websites

[www.biozone.co.uk](http://www.biozone.co.uk)

[www.chemsoc.org](http://www.chemsoc.org)

[www.fbi.gov](http://www.fbi.gov)

[www.forensic.gov.uk](http://www.forensic.gov.uk)

[www.forensic-science-society.org.uk](http://www.forensic-science-society.org.uk)

[www.hse.gov.uk/pubns/indg342.pdf](http://www.hse.gov.uk/pubns/indg342.pdf)

[www.iop.org](http://www.iop.org)

Biology resources for learners and tutors

Royal Society of Chemistry

Federal Bureau of Investigation

The Forensic Science Service

The Forensic Science Society

Health and Safety Executive guidance for employers and employees on blood-borne viruses in the workplace

Institute of Physics

## Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
<b>Independent enquirers</b>	[IE1,2] researching forensic applications of analytical techniques
<b>Team workers</b>	[TW1,3] working as a team to process a crime scene, adapting behaviour to suit different roles and situations
<b>Effective participators</b>	[EP2,6] acting as expert witness in role play activities

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
<b>Self-managers</b>	[SM3] organising time and resources to complete processing of crime scene
<b>Effective participators</b>	[EP3,4] contributing to the successful processing of a crime scene

## ● Functional Skills – Level 2

Skill	When learners are ...
<b>ICT – Use ICT systems</b>	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	researching forensic applications of analytical techniques
<b>ICT – Find and select information</b>	
Select and use a variety of sources of information independently for a complex task	creating portfolio of analytical techniques
<b>ICT – Develop, present and communicate information</b>	
Enter, develop and format information independently to suit its meaning and purpose including: <ul style="list-style-type: none"> <li>• text and tables</li> <li>• images</li> <li>• numbers</li> <li>• records</li> </ul>	building a case file on a simulated crime
Present information in ways that are fit for purpose and audience	presenting information as an expert witness
<b>English</b>	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	delivering an expert witness statement questioning the information presented by an expert witness
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reading information on analytical techniques
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing portfolio on analytical techniques used in a forensic laboratory writing expert witness statement writing conclusions on results of analytical work building case file.