Unit 38: Traffic Accident Investigation

Unit code: L/502/5583
QCF Level 3: BTEC National
Credit value: 10
Guided learning hours: 60

Aim and purpose

The aim of this unit is to enable learners to develop an understanding of the factors that can lead to a road traffic accident, how to reconstruct events to determine the cause and road safety legislation.

Unit introduction

Traffic accident investigation is a specialist branch of forensic science. This unit examines the role of the traffic accident investigator focusing, primarily, on road accidents.

An accident is an unexpected event which occurs without apparent or deliberate cause but with marked effects. The investigator will gather evidence from the site of the crash which will enable them to piece together the sequence of events that led to the accident. From this they are able to say how the accident happened, what caused it and whether anyone is to blame. They may be called to give evidence in court, to act as an expert witness, or to advise on ways of improving safety.

In this unit learners will examine the factors (human, environmental and vehicle) that relate to traffic accidents and develop an appreciation of the relationship between them. An understanding of the physics of forces and motion is also essential for any accident investigator. In this unit learners will study how the evidence left at a crash scene can be related to the momentum of the vehicles involved and how this information can then be used in the reconstruction of events. Learners will also gain an appreciation of the extent and nature of the damage that can be done to vehicles, their occupants and pedestrians in an accident.

Learners will study and practise the techniques of identifying, recording and gathering evidence as part of the investigation process. They will also review how this information is then used in an accident reconstruction.

The data gained from crash investigations is used to identify the factors that cause accidents. A knowledge of these factors allows cars and roads to be designed with safety in mind. The unit also covers the legislation associated with road safety.

Learning outcomes

On completion of this unit a learner should:

1 Know the major factors that cause road traffic accidents and injury

2 Know how science is used in the road traffic accident investigation process

3 Be able to investigate a simulated crash scene

4 Know which legislation applies to road traffic accident investigations.

Unit content

1 Know the major factors that cause road traffic accidents and injury

Human factors: behaviour or inexperience, eg driver error, lack of training and experience, speeding or other injudicious action, stress, driver rage; impairment or distraction, eg defective vision or other disability, drugs, alcohol, fatigue, mobile phone use; attitudes to drinking; education; pedestrians; typical injuries sustained

Environmental factors: weather conditions; traffic control; safety cameras; signs; congestion; state of, design and use of roadways

Vehicle factors: type and condition of vehicle; braking system; steering system; tyres (types and defects); seat belts; air bags; crumple zones; distribution of loads; overloading; maintenance; typical damage sustained

2 Know how science is used in the road traffic accident investigation process

Physics of movement and collision: Newton's laws of motion; conservation of momentum; conservation of energy; kinetic energy; principles of velocity; dynamic and static forces; coefficient of friction between road surface and tyres; the effect of impact on vehicles, pedestrians and property

Driver's reaction: reaction time; factors affecting it, eg environmental conditions, visibility, alcohol (blood alcohol concentration calculation, Widmark factor), drugs, alertness, hazards; cognitive psychology

Investigative techniques: accident reconstruction, eg manual and computer models; documentation; comparative methods; Naismith's rule; vehicle damage; personal injuries; road marks and their measurement; vehicle or human rest position

3 Be able to investigate a simulated crash scene

Investigative techniques: skid test; sled test; projectile analysis; interview; accident scene preservation and records (photography, sketch plans, measurement, casts of tyre prints); data gathering (road surface data, coefficient of friction, skid marks – types and measurement, tachographs); other evidence at scene, eg trace evidence; health and safety (codes of practice, proper clothing, head and foot wear, risk assessment, protocols)

Equipment and materials: camera; tripod; metrology instruments; manometer; thermometer; wax crayons; tracing paper; scapulas; tweezers; tapings; crime seal tapes; engineering tools; magnifier and microscope; roadside tests; alco-meters; intoximeters (gas chromatography); weight and force measuring devices; artificial light (torches); casting tools and plaster; exhibit vials, bags, packaging and labels; scientific calculator; measurements (tape and scales); scene of crime kits; video; dummies; trace evidence techniques, eg glass refractive index measurement (GRIM)

Investigation aids: communication aids; crime investigation aids; scientific data manuals; vehicle manufacturer data manuals; claims forms; forensic science reports; forensic databases

Cost: physical injury; emergency services; community; family; repair costs for vehicle; road and property; environmental; insurance

4 Know which legislation applies to road traffic accident investigations

Road traffic acts: construction and use, eg the Road Safety Act 1967 (the Barbara Castle Act); laws of contract; criminal law; documentation (ages to drive, carry passengers and loads); local bylaws; tachograph instruments; laws on speeding; legal limits for alcohol in body fluids; drug laws, eg Police and Criminal Evidence (PACE) Act 1984

Criminal justice system referral: reports; expert witness; giving evidence under oath; county magistrate and higher courts

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:**
P1 describe the major factors that cause road traffic accidents [IE1,2]	**M1** assess the relationship between the major causal factors in road traffic accidents	**D1** evaluate the relative importance of the various factors as the cause of road traffic accidents
P2 describe how science is used in the investigation of road traffic accidents [IE1,2]	**M2** explain the scientific factors associated with road traffic accidents	**D2** evaluate the relationship between scientific factors in road traffic accident investigations
P3 carry out an investigation on a simulated crash scene using appropriate techniques [CT2,3; TW1,2,3]	**M3** explain the collection, analysis and use of evidence from a simulated accident investigation	**D3** evaluate the evidence collected from a simulated accident investigation
P4 identify the legislation that applies to road traffic accidents. [SM3]	**M4** comment on the effectiveness of the legislation that applies to road traffic accidents.	**D4** relate legislation to road traffic accidents.

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.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Tutors delivering this unit have the opportunity to use a wide range of techniques. These include practicals, lectures, discussions, role playing, seminars, presentations, site visits, guest speakers, internet research and use of library resources. The aim should be to stimulate and educate the learners so they will be in a position to understand the main concepts in accident investigation and its importance in improving safety.

Health and safety issues relating to laboratory work at the centre or site work must be emphasised. Personal protective equipment, risk assessments, the use of COSHH, Approved Codes of Practice (ACoP), safety rules and the Health and Safety at Work Act and other regulations in place in any laboratory or site must be adhered to.

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

Learning outcome 1 covers the knowledge of the main factors that cause car crashes and injury. This learning outcome will probably involve formal lectures and learner research. It could also lend itself to peer learning with group discussions, learner presentations and role playing. Videos, DVDs, drink-driving advertisements, road and vehicle safety information, local councils, documentaries and case studies could provide additional sources of material.

Learning outcome 2 covers how science is used in the investigation process. This learning outcome should involve formal lectures and learner research. It also lends itself to some experimental project work, and some practical/model work could be carried out in a laboratory to illustrate the science involved. Education videos and resources could also be used.

Learning outcome 3 covers the skills needed to investigate a crash scene. This could be achieved in a variety of ways. The aim is for learners to conduct an accident investigation and collect a variety of evidence at the scene using appropriate techniques. They should assess their findings and draw conclusions as to the cause of the accident, whilst evaluating the reliability of the evidence. Learners could investigate an accident and formulate a report of their work. This learning outcome will probably involve formal lectures and learner research. Learners could visit a vehicle site or use a vehicle to carry out their investigation. As mentioned previously, health and safety issues must be strictly adhered to. Documentation of the scene, the collection, packaging, preservation and transportation of evidence must be explained, as well as the chain of continuity and report writing. Owing to the difficulty in obtaining a vehicle, a crash scene could be simulated with a 'skeleton' of a vehicle with appropriate props. Additionally or alternatively, road measurement data and exhibits from the scene could be assessed and processed in a laboratory using appropriate techniques.

For especially difficult evidence, a variety of expert witness statements of this evidence from an accident could be compiled as extra information for the learner's case in order for them to assess their accident. Alternatively, learners could formulate their own statements and reports to be assessed later or in a mock court situation through role play. Computer simulations and videos could also be used to show scene data. Local car pounds or local police could be approached to obtain resources, such as photographs and videos. Specialist guest speakers would be particularly useful.

Learning outcome 4 covers the legislation that applies to vehicles and crash investigations, and the crash investigator's role in the Criminal Justice System. This learning outcome should mainly involve formal lectures and learner research. It could also involve case studies, report writing and role playing. Guest speakers would be particularly useful.

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 *Unit content* and structure of assignments.
Series of formal lectures on human factors, class discussions on drink driving advertisements, role play on 'in car' distractions.
Series of formal lectures on vehicle factors; visits to MOT centres, scrap yards and auto recovery establishments.
Series of formal lectures on environmental factors; types and use of speed cameras – associated statistics, effect of weather on driving conditions – visit to skid pan, laboratory investigation of stopping distances on ice (use model cars or weights).
Assessment 1 – Factors Involved in Road Accidents (P1, M1, D1) Learners describe the major factors involved in an accident – could be based on newspaper report of actual case.
Physics of movement and collision: Series of formal lectures to cover theoretical aspects, practical investigations using trolleys for kinetic energy, speed, velocity, conservation of momentum etc. Revisit laboratory investigation of stopping distances on ice as part of coefficient of friction. Crash test videos to show the effect of impact on vehicles etc.
Driver's reaction: Learners investigate reaction times and factors affecting it – internet resources are extensive for reaction time tests. Effect of drugs and alcohol – learners complete BAC calculations and discuss the reasons why the same amount of alcohol can affect people differently.
Investigative techniques: Formal lecturers and learner-centred research. Learners would benefit from practical exercises measuring road marks. Demonstration of computer modelling would be beneficial.
Assessment 2 – Science of Road Traffic Accidents (P2, M2, D2) Learners explain the how science is used in an accident investigation – could be based on newspaper report of actual case or perhaps desktop mock-up, using Lego etc.
Investigative techniques: Formal lectures should play a very small part in this section and practical exercises should dominate; to include recording the scene; photographs, plan drawing, notes and use of computer packages etc. Importance of detailed recording of position of trace evidence. Data gathering would involve learners in putting theory of previous outcomes into practice. Practical session on reading of tachograph charts.
Equipment, materials and investigative aids: Formal lectures, demonstrations of equipment and where possible practical application especially in metrology instruments and analysis of trace evidence.
Assessment 3 – Traffic Accident Investigation (P3, M3, D3) Investigation of crash scene – combination of methods.
Legislation: Formal lectures, visit to court for vehicle accident related cases, role play – expert witness in court.
Assessment 4 – Traffic Accidents and the Law (P4, M4, D4) Learner-centred research on legislation that applies to vehicular accidents.
Review of unit and programme of assignments.

Assessment

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

For P1, learners must describe the major factors that cause road accidents. For M1, learners must assess the relationship between major causal factors in road accidents. They must comment on how these factors (whether on their own or combined) can cause road accidents. For D1, learners must evaluate the relationships between the major causal factors in road accidents, and the relative importance of each factor in causing road accidents. They must use their knowledge and comment on how these factors could be avoided (if at all) or used to improve road safety.

For P2, learners must discuss how science is used in the investigation of car crashes. This could be in the form of a portfolio outlining the more common techniques used by traffic accident investigators. Learners must understand the concepts of appropriate scientific principles and their use in car crash investigations. For M2, learners must explain, in more detail, the scientific factors associated with road accidents. For example, the coefficient of friction of a surface, the environmental conditions and the reaction time of the driver. For D2, learners must evaluate the relationships between scientific factors and how this information can be used in road accident investigations. For example, the speed of vehicle at impact can be calculated using known variables and scientific principles.

For P3, learners must conduct a simulated accident investigation ensuring that information is gathered in a systematic way, paying attention to all relevant details. Learners must produce a detailed accident investigation, including notes and descriptions of the site, state of the road, the vehicle(s), photographic documentation, measurements, sketches and plans. Sketches and plans should include a key with directional information, measurements and scales. Positions of vehicle(s), the surroundings, debris, victims, trace evidence positions and damage should all be recorded. Techniques can also include photographic evidence of tyre marks, swabbing of biological evidence and subsequent appropriate packaging. If the tutor is dealing with a mainly laboratory-based investigation, some of these details could be worked on using data and photographic images or using a skeleton layout scene (see *Delivery notes*) or computer/video reconstruction. However, learners are still required to carry out suitable investigations. For example, analysing trace evidence such as paint, or larger items such as a car headlamp or tyre, or measurement of blood alcohol with gas chromatography. At accident scenes, many other agencies such as the emergency services attend, so teamwork and good communication skills are paramount. Learners should exhibit such skills at the scene. For M3, learners must explain the methods used to collect evidence at the scene, how this evidence is analysed and how it is used to help determine the cause of an accident. For example: Why should broken glass found at an accident scene be packaged in solid plastic containers? For D3, learners must draw appropriate conclusions from the practical investigations as to the cause of the accident. They must evaluate their findings and assess the reliability of their evidence. For instance, have the emergency services affected the evidence in any way? This could be formulated in a report format and/or expert witness statement. The report should be of a high standard, acceptable for court purposes, with accurate notes, plans, photographs, diagrams, etc.

For P4, learners must identify the legislation that applies to car crashes. For M4, learners must evaluate the legislation that applies to car crashes. Learners must assess why these laws have been formulated, and how effective they are. For D4, learners must relate road traffic accidents to the applicable legislation. Learners should be able to classify accidents and the vehicles involved through the applicable legislation. For example, an accident caused by overloading. Learners must evaluate the role of the applicable laws and their contribution to preventing road traffic accidents.

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	Factors Involved in Road Accidents	Working with the Department for Transport on a national campaign to promote road safety awareness, you have been asked to produce a poster/leaflet on factors involved in road accidents.	Poster/leaflet.
P2, M2, D2	Science of Road Traffic Accidents	Working within the traffic accident investigation department you have been asked to produce a portfolio for training purposes of the main scientific techniques an investigator might use during an investigation. Alternatively, you can use an actual accident on which to base the portfolio.	Portfolio.
P3, M3, D3	Traffic Accident Investigation	As a traffic accident investigator you are required to produce a report of an accident investigation.	Report produced following practical investigation.
P4, M4, D4	Traffic Accidents and the Law	As an expert witness in court you are required to identify the legislation that applies to vehicular accidents for the benefit of the jury.	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 in Applied Science sector suite. This unit has particular links with the units shown below in the BTEC Applied Science suite of qualifications:

Level 1	Level 2	Level 3
Crime Scene Investigation (FLT)	Investigating a Crime Scene	Mathematical Calculations for Science
		Using Statistics for Science
		Practical Chemical Analysis
		Forensic Evidence Collection and Analysis
		Forensic Photography
		Criminal Investigation Procedures
		Criminal Investigations in Practice

Essential resources

Learners need access to simulated car crash scenes, a forensic science laboratory, a learning resource centre equipped with accident investigation and forensic books, periodicals, journals, CD ROMs, computers, scanners, printers and other associated ICT equipment and software.

Employer engagement and vocational contexts

Centres should develop links with local vehicle recovery companies and scrap yards. The Institute of Traffic Accident Investigators has a list of private practitioners who may consider being a guest speaker.

Indicative reading for learners

Textbooks

Burke M P – *Forensic Medical Investigation of Motor Vehicle Incidents* (CRC Press, 2006) ISBN 9780849378591

Cooper S and Orme M – *Road Policing 2008: Volume 3 (Blackstone's Police Manuals)* (Oxford University Press, 2007) ISBN 9780199229260

James S H and Nordby J J (editors) – *Forensic Science: An Introduction to Scientific and Investigative Techniques* (CRC Press, 2002) ISBN 9780849312465

Meloan C E and Saferstein R – *Criminalistics: An Introduction to Forensic Science, 8th Edition* (Prentice Hall, 2004) ISBN 9780131126817

Noon R K – *Forensic Engineering Investigation* (CRC Press, 2000) ISBN 9780849309113

Van Kirk DJ – *Vehicular Accident Investigation and Reconstruction* (CRC Press, 2000) ISBN 9780849320200

Websites

www.bigsums.co.uk	Free software for traffic accident calculations
www.dft.gov.uk	Department for Transport
www.dft.gov.uk/think	The THINK! Road Safety website
www.en.wikipedia.org/wiki/Road-rule_enforcement_camera	Wikipedia definition of traffic enforcement camera
www.en.wikipedia.org/wiki/Safety_Camera_Partnership	Wikipedia definition of safety camera partnership
www.howstuffworks.com/breathalyzer.htm	How Breathalysers work
www.hse.gov.uk/research/crr_pdf/2001/crr01344.pdf	Health and Safety Executive research report: Accident investigation – The drivers, methods and outcomes
www.itai.org	Institute of Traffic Accident Investigators
www.lawontheweb.co.uk/roadlaw.htm	legal information on motoring and road traffic offences
www.orsa.org.uk	Occupational Road Safety Alliance
www.pepipoo.com/Road_Traffic_Acts.htm	Road traffic legislation
www.roadpeace.org	RoadPeace, UK charity providing support for victims of road crashes
www.rospa.com/roadsafety	The Royal Society for the Prevention of Accidents
www.shu.ac.uk/schools/sci/chem/tutorials/chrom/gaschrm.htm	Introduction to gas chromatography
www.worldbank.org/transport/roads/safety.htm	Road safety around the world
www2.potsdam.edu/hansondj/drinkinganddriving.html	Information on drink driving

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 ...
Independent enquirers	[IE1,2] researching major factors in traffic accidents; researching scientific principles of techniques used to investigate traffic accidents
Creative thinkers	[CT2,3] question their own and others assumptions when investigating a crash scene
Team workers	[TW1,2,3] investigating simulated traffic accident
Self-managers	[SM3] organising time and resources to produce effective presentation on current legislation.

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 ...
Independent enquirers	[IE2,4] researching current legislation
Creative thinkers	[CT1,5] designing leaflet for factors in traffic accidents
Effective participators	[EP5,6] acting as expert witness in role-play activities.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	researching legislation that applies to vehicular accidents producing of a presentation on the legislation that applies to vehicular accidents producing scale drawing for traffic accident investigation report
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	creating and finding illustrative materials for a leaflet and adapting them for use
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	producing of leaflet/poster on factors in traffic accidents producing of a presentation on the legislation that applies to vehicular accidents producing scale drawing for traffic accident investigation report
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	
Mathematics	
Identify the situation or problem and the mathematical methods needed to tackle it	calculating speed of vehicle from length of skid mark using Widmark factor in BAC calculation selecting appropriate coefficient of friction for road surface
Draw conclusions and provide mathematical justifications	including conclusions drawn from calculations in traffic accident investigation report
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	delivering a presentation on the legislation that applies to vehicular accidents
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching the legislation that applies to vehicular accidents
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing report on investigation of a traffic accident writing portfolio on the main scientific techniques an investigator might use during an investigation.