Unit 16: Science for Health

Unit code: J/600/8971

QCF Level 3: BTEC Nationals

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to enable learners to develop knowledge of a range of laboratory skills and be able to use current analytical, microscopic and aseptic techniques that are used in health-related laboratories.

Unit introduction

Learners will initially examine how a health-related laboratory works, investigating its role, the processes that are carried out and how it is organised and managed, as well as health and safety requirements.

Learners will then be introduced to practical laboratory techniques, including analytical, microscopic and aseptic techniques.

Learners will need to carry out practical investigations, using a range of laboratory techniques so they can gain knowledge of how these processes work within a laboratory situation.

This unit has a practical focus, allowing learners to develop laboratory skills and become familiar with the work of a typical health laboratory. This will promote understanding of how the work of a health-related laboratory supports the diagnosis and treatment of the conditions of a variety of service users.

This unit will be useful preparation for those learners planning to progress in the field of health sciences. It will be particularly useful for learners wishing to pursue a career in nursing and associated fields and for those wishing to work in the allied health professions such as serology, haematology, histology, biochemistry and forensic sciences.

Learning outcomes

On completion of this unit a learner should:

1 Know how a health-related laboratory functions

2 Be able to use analytical techniques

3 Know how to use microscopic techniques

4 Be able to use aseptic techniques to culture micro-organisms.

Unit content

1 Know how a health-related laboratory functions

Laboratory: type of, eg hospital pathology laboratory, public health laboratory, research laboratory

Laboratory medicine: type of, eg biochemistry, haematology, histology, microbiology, immunology, molecular biology, virology, audiology

Diagnostics: in vitro diagnostics, eg blood analyses, urine analyses; in vivo diagnostics, eg X-rays, CT scans, MRI scans; immunodiagnostics

Processes: chronological process of investigation, range of investigative procedures, quantitative and qualitative analysis; value of sampling, data recording and manipulation, data presentation, valid conclusions; quality assurance; health, safety and security

Health, safety and security: legislation as appropriate to laboratory function, COSHH regulations, policies and procedures, hazards, risk assessment, safety equipment/signs, personal protective equipment and procedures, action to be taken when incidents occur; disposal of waste materials, sustainable development

Equipment: identification, selection and use for a specified task, maintenance; instrument quality; laboratory management information systems

2 Be able to use analytical techniques

Molarity: calculations involving molar quantities, calculation of concentration including use of dilution factors necessary to produce a range of standard solutions from a given stock solution of known concentration

Standard solutions: preparation of solutions of fixed concentration, appropriate titrations to determine concentration or standardise given solutions; dilution of stock solutions to give a series of related standard solutions

Health and safety: application to laboratory conditions

Techniques: underlying principles; colorimetry; chromatography, eg thin layer, gas liquid, column, high performance liquid chromatography; spectroscopy, eg ultraviolet, infrared, mass spectroscopy; electrophoresis

Practical work: investigations, eg lipid content of different types of milk, ascorbic acid content of different fruit juices, amino acid content of different proteins; health and safety as appropriate to tasks, eg use of safety equipment/protective items; scientific report

Scientific report: method; data presentation, eg tables, graphs, charts; analysis and evaluation; conclusions and recommendations

Evaluation: of methods and results: validity, eg fitness for purpose of methods, repeatability, sources and magnitude of errors

3 Know how to use microscopic techniques

Preparation of slides: fixing, staining techniques

Use of light microscope: in examination of prepared slides, different magnifications, interpretation

Microscopes: light, UV, electron, SEM, TEM; images, limitations, applications

4 Be able to use aseptic techniques to culture micro-organisms

Micro-organisms: from, eg yoghurt

Techniques: laboratory aseptic techniques; sterile techniques for collection of swabs; principles of media cultures, preparation, inoculation, incubation and microbiological transfer; counting techniques, factors affecting growth of micro-organisms; stain tests for diagnosis, eg gram stain; antibiotic sensitivity

Investigation: using practical microbiology skills, eg effectiveness of different antiseptics/disinfectants, lowest effective concentration of antiseptics/disinfectants, growth requirements of particular bacteria, effect of length of exposure to UV light, changes in the bacterial count in stored yoghurt; use of aseptic technique, culture techniques

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 functioning of a typical health laboratory [IE2; IE3]	**M1** explain the need for health, safety and security requirements in a health-related laboratory	**D1** evaluate health, safety and security requirements in a health-related laboratory
P2 describe the underlying principles in relation to the application of three different analytical techniques [IE1; IE2]	**M2** interpret the results of own analytical investigation	**D2** evaluate the strategies and precautions that may be taken when using analytical techniques to improve the reliability of results.
P3 report on own investigation using analytical techniques [IE1; IE6; SM1; SM2; SM3; SM4]		
P4 describe the safe and effective use of a microscope to view stained slides of cell preparations [IE2; SM2]		
P5 report on own investigation/s using practical microbiology skills. [IE1; IE2; IE4; IE6]	**M3** interpret the results of own microbial investigation.	

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills which are embedded in the assessment of this unit. By achieving the criteria, learners will have demonstrated 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

This unit should be delivered by appropriately qualified tutor/s. Access to laboratory facilities is needed for delivery and assessment.

Planning of the delivery for this unit needs to be in partnership with tutors responsible for delivering other scientific units within the programme. This will enable learners to apply theoretical knowledge when developing their practical laboratory techniques. For example, analytical techniques could be related to enzymatic action, measurement of the nutrient content of foods, movement of materials across cell membranes, or the composition of body fluids such as synthetic urine, all of which relate to other units in the programme.

Microscopy techniques could be related to any of the units that require an understanding of histology, such as *Unit 5: Fundamentals of Anatomy and Physiology for Health and Social Care.*

Microbiological investigations could be related to, for example, the microbiological deterioration of food in storage, or the effects of antibiotics or household/hospital cleaning agents on microbial growth. Learners should only use materials and tissue specimens appropriate for use at this level.

Ideally, visits to health-related laboratories could be organised. Learners would also benefit, if possible, from a period of work experience in such a laboratory. This could be included as part of the requirement of *Unit 6: Personal and Professional Development in Health and Social Care,* or *Unit 44: Vocational Experience for Health and Social Care.* Work experience would introduce learners to the functioning of a health laboratory, raising awareness of issues such as organisation and management, health and safety, and potential career pathways.

Visits or work experience could also facilitate observation of analytical, microscopic or microbiological techniques not available in the centre laboratory, helping learners to understand these techniques. Alternatively or additionally, a visit from a guest speaker, such as a practitioner who works in a health-related laboratory, could benefit learners.

Learners need to keep careful records of their practical activities, including recording and analysis of raw data, and evaluating and drawing conclusions. These reports should be monitored throughout by tutors, with the use of formative feedback.

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
Unit introduction.
Learning outcome 1 Visit to a laboratory alongside tutor-led or -facilitated secondary research and, where possible a presentation from a current practitioner working in a relevant setting. Tutor input: coverage of necessary health, safety and security. Learners will need to acquire knowledge of relevant legislation such as the Health and Safety at Work Act and the need for confidentiality. **Assignment 1: A day in a health-related laboratory (P1, M1, D1)**
Learning outcome 2 Learners take notes on a laboratory visit related to the various analytical techniques that were seen, and write up as a report. Learner research/group work followed by presentations: tutors need to ensure that the groups cover sufficient content for this learning outcome. Practical investigations: using one of the analytical techniques from *Unit content*. Learners will need to be supported in recording their practical work in order to produce evidence for M2. **Assignment 2: Analytical techniques – what are they and how do they work? (P2, P3, M2, D2)**
Learning outcome 3 Tutor input: the use of a microscope to view various cell preparations. This can be carried out through a demonstration and by learners carrying out their own microscopy examinations. Where possible visits to laboratories/practical work where learners can see the workings of a range of microscopes would be helpful. **Assignment 3: Why are microscopes useful? (P4)**
Learning outcome 4 Practical demonstration/work: techniques to culture micro-organisms. **Assignment 4: How do I culture micro-organisms? (P5, M3)**
Unit review and assessment.

Assessment

Practical laboratory work, and accurate reports of this work, will form the basis of most of the assessment for this unit. In addition, learners could produce pamphlets and information booklets to cover some of the pass criteria (see the *Programme of suggested assignments* for more information).

An initial assignment could be used for P1, M1, D1, preferably following a period of work experience in, or a visit to, a health-related laboratory. It could include written work, plans, diagrams or other visual images, and potentially extracts from work experience diaries if these are relevant to the criteria. Learners need to provide a description of the laboratory including an explanation of health, safety and security requirements, organisation and management, role and functions, daily activities, and career pathways for staff. Depending on the type of laboratory this could also include, for example, how specimens for analysis are received and processed. Learners need to evaluate the importance of health, safety and security in order to achieve D1.

A second assignment based on analytical techniques could be used to assess P2, P3, M2 and D2. P2 requires learners to describe the underlying principles in relation to the application of three different analytical techniques. Learners should ideally choose techniques they are familiar with, either through practical use or observation. Evidence could include written descriptions, along with diagrams, other visual images, printouts of results and a description and interpretation of any data obtained, either through primary or secondary methods.

P3 then requires learners to choose an analytical technique they have become familiar with and design and carry out their own investigation, reporting on it appropriately. This investigation does not have to be complex, and could involve, for example, investigating changes in a dependent variable against independent variables or vice versa. The results should be interpreted and assessed for M2, and for D2 learners need to evaluate the strategies and precautions that may be taken when using laboratory techniques and equipment, in order to improve the accuracy and reliability of data. This can relate to their own investigation and/or others.

For P4, learners need to provide a piece of writing describing the safe and effective use of a microscope to view stained slides of cell preparations. An annotated diagram of a microscope could be used to supplement this. This criterion links to *Unit 5: Fundamentals of Anatomy and Physiology for Health and Social Care,* and learners could also provide drawings of different tissues as supplementary evidence.

P5 requires learners to design and implement their own investigation to demonstrate their ability to use practical microbiological techniques. They need to produce a scientific report on their investigation, and for M3 interpret and assess the findings of their investigation accurately.

Witness statements or testimonies could be used during practical assessments, to confirm that learners have worked in accordance with the health and safety requirements of the practical tasks. A standard cover sheet for individual practical activities could include this, and also space for feedback as appropriate.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the 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	A day in a health-related laboratory	You work for a careers advice service at your local university and have been asked to produce a pamphlet to advertise work within health-related laboratories.	Storyboard covering a typical day in a laboratory, or career information pamphlet, or written report.
P2, P3, M2, D2	Analytical techniques – what are they and how do they work?	You have started work as a junior practitioner in a health laboratory. As part of your training programme you must carry out analytical investigations and produce a scientific report.	Information leaflet or a written report. Learners should be encouraged to include relevant diagrams and images. A scientific report on their own practical work, using headings such as method, results and conclusions.
P4	Why are microscopes useful?	You have been asked to produce a guide to using microscopes for the company induction manual.	A step-by-step guide to using a range of microscopes in healthcare.
P5, M3.	How do I culture micro-organisms?	You are working on a project for the health-related laboratory and have to explain how to culture micro-organisms to a new member of staff.	Scientific report.

Links to National Occupational Standards (NOS), other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Health and Social Care sector suite (see *Appendix A*) and has links with units from other qualifications in that suite. See *Appendix E* for NOS links and *Appendix G* for a mapping of the NHS Knowledge and Skills Framework against particular units in this qualification.

Essential resources

The following resources are essential for delivery and successful assessment of this unit:

- an appropriately qualified tutor
- a laboratory equipped with relevant resources to support the practical components of the assessment
- library resources with key texts and relevant reference materials
- access to relevant work experience placements, guest speakers and/or visits to appropriate settings
- access to laboratory facilities
- correct scientific equipment to carry out all practical tasks
- relevant videos and DVDs.

Employer engagement and vocational contexts

Much of the unit content is related to current practical work carried out across a range of health related laboratories. Employers in these sectors should be sought to underpin the delivery of up- to-date information particularly in relation to methods of analysis of specimens and current health and safety procedures. This inclusion of employers would support learners in to understanding the current advances in laboratory sciences, in areas such as advances in histological techniques and biochemical analysis and their place in the diagnosis of conditions that can affect a range of health and social care service users. Engaging relevant employers would also inform learners about the vast range of careers available in the allied health field.

Indicative reading for learners

Textbooks

Adds J – *Microorganisms and Biochemistry* (Nelson Thornes, 2000) ISBN 9780174482697

Clugston M – *Advanced Chemistry* (Oxford University Press, 2000) ISBN 9780199146338

Kent M – *Advanced Biology* (Advanced Science) (Oxford University Press, 2000) ISBN 978019914195 1

Myers B – *The Natural Sciences* (Nelson Thornes, 2004) ISBN 9780748785834

Stretch B and Whitehouse M – *BTEC National Health and Social Care Book 2* (Heinemann, 2007) ISBN 9780435499167

Stretch B and Whitehouse M – *BTEC Level 3 Nationals in Health and Social Care Student Book 1* (Pearson, 2010) ISBN 9781846907663

Stretch B and Whitehouse M – *BTEC Level 3 Nationals in Health and Social Care Student Book 2* (Pearson, 2010) ISBN 9781846907470

Journals and magazines

Biological Science

New Scientist

Nursing Times

Websites

www.ase.org.uk	Association for Science Education
www.bbc.co.uk/health	BBC health website
www.bbc.co.uk/science	BBC science and nature website
www.bhf.org.uk	British Heart Foundation
www.bupa.co.uk	BUPA – healthcare company
www.cancerresearchuk.org	Cancer Research UK
www.dh.gov.uk	Department of Health
www.gsk.com	Glaxo SmithKline
www.iddinternational.org	Insulin Dependent Diabetes Trust
www.nhs.uk	National Health Service
www.nhscareers.nhs.uk	National Health Service – Careers
www.nice.org.uk	National Institute for Health and Clinical Excellence
www.patient.co.uk	Patient UK – health advice
www.sgm.ac.uk	Society for General Microbiology
www.teachernet.org.uk	Teaching resources

Delivery of personal, learning and thinking skills

The following table 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] describing principles of analytical techniques [IE2] carrying out research into the functions of a health-related laboratory [IE3] exploring events or problems from a different perspective when describing the functioning of a health-related laboratory [IE4,6] judging the relevance of information and supporting conclusions when preparing a scientific report
Self-managers	[SM2,3,4] working towards goals; organising time, resources and prioritising actions; anticipating risks when carrying out practical work.

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	accessing appropriate websites for their research into the functions of a health-related laboratory
Manage information storage to enable efficient retrieval	appropriately storing information on the functions of a health-related laboratory, analytical principles or the uses of microscopes
Follow and understand the need for safety and security practices	accessing appropriate websites for their research into evidence needed to meet the assessment criteria
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching different analytical techniques
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	accessing appropriate websites
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	presenting written reports, information leaflets or pamphlets using images that are scanned or from clip art for assignment evidence designing a leaflet using ICT
Bring together information to suit content and purpose	presenting information using ICT using images designing a leaflet/pamphlet
Present information in ways that are fit for purpose and audience	presenting information for their assignments using ICT using images designing a leaflet/pamphlet
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	researching and presenting relevant information for their assignment work

Skill	When learners are ...
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	using measurements relevant to their investigations
Identify the situation or problem and the mathematical methods needed to tackle it	interpreting and explaining results from investigations
Select and apply a range of skills to find solutions	carrying out practical work
Use appropriate checking procedures and evaluate their effectiveness at each stage	reporting results from practical investigations
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	resolving any problems during their practical investigations
Draw conclusions and provide mathematical justifications	interpreting any mathematical results from their practical investigations
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	carrying out a presentation on analytical techniques
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching the functions of health-related laboratories researching analytical techniques researching the uses of microscope.