Unit 29: Physiological Investigations

Unit code: K/502/5574

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 knowledge, understanding and skills related to physiological measurement techniques. Learners will also learn how the results obtained from clinical laboratory investigation can be related to specific conditions.

Unit introduction

The human body is highly complex and, like most complicated systems, it has the ability to malfunction. Physiology is the study of mechanical, physical and biochemical functions and it is the job of clinical physiological measurement technicians to carry out tests to diagnose what may have gone wrong when the body is not functioning properly.

As clinicians, it is essential that physiological measurement technicians understand how various symptoms present themselves and how they may indicate underlying problems.

Learners will become familiar with the eight clinical areas of physiological testing: Audiology, cardiac physiology, gastrointestinal physiology, neurophysiology, ophthalmic and vision care, respiratory physiology, urodynamics and vascular technology, as well as the allied fields of haematology, biochemistry, endocrinology and cellular physiology, that are often essential for a clinical diagnosis. They will understand the range of normal measurements in a healthy body and therefore be able to recognise abnormal results and their effects on patients' health. Learners will carry out clinical investigations from a range of disciplines and be able to relate the results of clinical investigations to specific conditions and understand the impact on the patient's life. This unit complements the in-depth study of human physiology in the unit *Physiology of Human Body Systems*.

In addition to developing specialist skills, learners could extend their interpersonal skills by carrying out investigations and role playing or taking part in real conversations with patients. They will need to explain their findings and the changes that patients may need to make in order to manage their condition.

Learning outcomes

On completion of this unit a learner should:

1 Know the different physiological measurement tests available and the conditions they can detect

2 Understand the profile of normal and abnormal test results

3 Be able to carry out clinical investigations using appropriate physiological measurement tests

4 Be able to interpret the results of a clinical investigation.

Unit content

1 Know the different physiological measurement tests available and the conditions they can detect

Audiology: otoscopic examination; pure tone audiometry; tympanometry tuning fork tests; speech audiometry; hearing aid issue; detection of conditions eg congenital or acquired hearing loss, conductive hearing loss, sensory hearing loss, acoustic trauma

Cytology: histological study of a range of tissues; detection of conditions eg skin, breast or cervical cancer, malignant and benign skin conditions, malignant and benign breast tumours

Haematology: red cell count; platelets; white cell count, plasma proteins; detection of conditions eg leukaemia and other cancers (using CEA and tNOX tests), sickle cell anaemia, pernicious anaemia, haemophilia

Biochemistry: blood urea nitrogen (BUN); creatinine; phosphorous; glucose; bilirubin; ALT; amylase; lipase; alkaline phosphatase; thyroid hormone; cortisol; cholesterol; creatinine kinase; bile acids; calcium; total protein

Cardiology: electrocardiogram (ECG); ambulatory ECG and blood pressure; stress ECG; echocardiography; detection of conditions eg coronary heart disease, congenital heart disease, arrhythmias

Neurophysiology: electroencephalogram (EEG); evoked potentials (EP); nerve conduction velocity (NCV); electromyogram (EMG); detection of conditions eg epilepsy, sleep disorders, neuropathy, myopathy, demyelination

Respiratory physiology (including sleep physiology): dynamic lung volumes; flow-volume curve; static lung volumes; single-breath transfer factor; sleep studies to measure airflow obstruction; restrictive defects; asthma; obstructive sleep apnoea

Gastrointestinal physiology: endoscopy, measurement of muscle and sphincter function; analysis of bacterial byproducts; investigation of eg food intolerance, malabsorption and gastric and duodenal ulcers

Opthalmic and vision care: sweep visual evoked potential test (SVEP); low vision testing; sensitivity tests; electroretinogram (ERG); visual evoked potential (VEP)

Urodynamics: dip-stick haematuria/microscopic haematuria; flow rate tests; cystometry; pressure-flow studies

Vascular technology: ultrasound to image blood vessels; blood flow assessment; colour duplex ultrasonography; continuous wave Doppler ultrasound, used as a screening tool or to make pre- and post- exercise measurements, and plethysmography

2 Understand the profile of normal and abnormal test results

Data: interpret data from each discipline; against accepted health ranges; categorising normal and abnormal results

3 Be able to carry out clinical investigations using appropriate physiological measurement tests

Tests: cardiovascular and respiratory physiology measurements; histology slide analysis; tests from other disciplines as appropriate

Presenting symptoms: eg underlying problems, related symptoms, severity of case

Patient history: age; gender; height; weight; disability; health history

Communications: verbal questioning of patient; verbal answering of patient questions; written patient details

Interpersonal skills: put patient at ease; timekeeping; politeness; empathy

Environment: appropriate; private; confidential

Equipment: safety; maintenance; calibration

4 Be able interpret the results of a clinical investigation

Interpretation of results: against accepted health ranges; normal and abnormal range; graphical presentation and interpretation; reports

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 identify the tests available to measure physiological function	**M1** explain tests to measure physiological function and their relevance to clinical diagnosis	**D1** evaluate physiological measurement techniques including factors that produce variations in test results
P2 describe the conditions which can be identified by using them		
P3 compare the results of normal and abnormal test results from different disciplines, indicating which clinical conditions are causing the abnormal results	**M2** discuss the significance of abnormal test results to a patient's condition	
P4 plan the implementation of appropriate physiological measurement tests [CT1,2; SM2,3]		
P5 carry out a clinical investigation, indicating the appropriateness of methods chosen [IE1,2,4; TW3,4,6; EP3]	**M3** explain the underlying reasons for contrasting/ dissimilar results in at least two different disciplines	
P6 report on clinical investigation, evaluating results from planned tests for patient feedback. [RL5]	**M4** explain the significance of the findings of the investigation.	**D2** evaluate the 'health' of the individual and the accuracy and reliability of results.

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

This unit should be delivered with learners gaining access to patient groups where this is practicable. Where access is not possible the unit should be delivered through a mix of case studies, mock data and role play scenarios.

The material in this unit should be introduced through a programme of tuition, demonstration and guided learning, concentrating on the clinical relevance at each juncture.

Learners will carry out and be assessed on clinical investigations, starting with the initial history of the subject so that the correct investigation can be planned. Learners will plan the investigation, carry it out (although for tests that are inaccessible to learners tutors can provide a set of data, for example a study of blood or fluids) and prepare a full written report.

A visit to a clinic or clinical laboratory is strongly recommended. Ideally, learners should have access to patients and hospital testing equipment. It would be helpful if learners have previously studied physiology units to understand the structure and function of the body systems. Other units covering practical techniques in science and scientific methods would also be an advantage.

It is important that learners understand the confidential nature of the clinical investigations being carried out, and the importance of the interpersonal skills needed to put their patients' minds at rest. In the event that learners gain access to patients, clinics or records, the correct level of supervision is essential for the successful completion of the unit.

The practical techniques involved in the unit will vary according to the opportunities available to learners. It may not be possible for learners to use all techniques or have access to all stated equipment. Therefore, the list of possible techniques is neither prescriptive nor exhaustive. Learners should be encouraged to study a range of techniques and investigate new developments and research in the area of physiological measurement.

The techniques used to take physiological measurements are constantly being updated. It is essential that learners are aware of such changes and whenever possible use the most up-to-date physiological testing techniques. The unit delivery would benefit from the practice of as many techniques as possible. For improved reliability and accuracy of results, learners should have the opportunity to use techniques a number of times. Learners could also share their experiences through class discussions or presentations.

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 and programme of assignments– tutor leads a group discussion.
Outline of different body systems and their respective tests. Individual research on cytology and haematology. Interactive lecture: cardiology measurement tests. Visit to cardiology clinic to view the use of test equipment eg ECG, EEG, lung volumes, ERG, ultrasound imaging of blood vessels. Individual research on biochemistry measurement techniques. Small group work: Each group researches the tests that are used to measure one of the following and describes the conditions that the tests may identify: Audiology, cardiology, neurophysiology; respiratory physiology; gastrointestinal physiology; ophthalmic and vision care; urodynamics; vascular technology. Each group produces a set of notes for the rest of the class and presents their topic to the group, inviting questions from the audience including the tutor. Cytology practical laboratory tasks: histology of normal and abnormal tissues. **Assignment 1: Physiological Measurement Tests (P1,P2,M1,D1)**
Normal and abnormal data. Tutor led discussion: accepted health ranges, normal and abnormal data, using realistic exemplars. Case studies: normal and abnormal data for different patients. **Assignment 2: Normal and Abnormal Measurement Profiles (P3,M2)**
Tutor demonstration: Maintenance and calibration of equipment. Tutor demonstration: communicating with patients; interpersonal skills. Class discussion: the ideal environment. Case study simulation: clinicians (learners) to use communication skills and interpersonal skills to obtain patient (other learners) history and present their symptoms. Tutor demonstration: Carrying out tests. Learners to carry out tests on each other. Learners to demonstrate how to maintain and calibrate equipment. Use of mock case studies or mock data covering a number of conditions. Learners to work in small groups to provide clinical diagnosis. Case Study notes: respiratory disorders – small group work. Learners use case study notes and data to make comparisons. Between abnormal and normal accepted health ranges. Group data can provide for interesting discussions eg respiratory test results for asthma suffers. **Assignment 3: Clinical Measurement (P4,M3)**
Interpretation of clinical symptoms and planning of appropriate investigation. Tutor discussion: Interpretation of results and their presentation. **Assignment 4: Clinical Investigation (P5,P6, M4,D2)**
Review of unit and programme of assignments.

Assessment

Pass grade learners will require significant assistance from a tutor to achieve all the unit learning outcomes

For P1 and P2, learners should know the different areas of measurement and how several disciplines may have to work together to give a comprehensive picture of a presenting patient. They must understand the importance of accurate recording and the presentation and interpretation of results.

Merit grade learners will work with a little more independence. Their skill will lie in interpreting data, whether it be from the equipment itself, the general trends of the population, including, size, gender and racial differences and understanding the data they collect themselves.

For M1, learners must show understanding of how results can differ but still be in a 'normal range' and how this informs the clinical diagnosis. They will need to apply other knowledge of biology in order to achieve this.

For a distinction grades learners are expected to be able to evaluate data whether it be primary or secondary.

For D1, learners should evaluate the reliability and accuracy of the equipment, for apparatus not available to them this will require considerable research probably through the internet and presented in report or presentation form.

For P3, learners must show their understanding of how physiological measurement techniques work and understand that investigations will need to be interpreted in terms of normal and abnormal results. Tutors may present data and 'normal limits' for learners to be able to achieve this. For M2, learners will be able to discuss how the abnormal test results affect the patient. They must understand the link between experimental results and the symptoms these may be linked to.

For P4, it is essential that learners take into account all aspects of such investigations and not just the actual testing. Therefore acting as clinicians they will plan an investigation guided by the presenting symptoms. For P5, learners should experience as many physiological tests as possible, but certainly in at least two disciplines. They should be competent at taking their own measurements and collecting data.

For P6, learners must report on their clinical investigations. There must be some explanation of the results.

For M3, based on their own measurements learners should be able to explain variation seen, be it related to size/gender/fitness etc, bringing to bear previous learning about the physiology of bodily systems.

For M4, learners need to explain the significance of the findings of each investigation.

For D2, learners must clearly demonstrate the link between results and clinical diagnosis of certain conditions. They must also be able to make critical judgments on the accuracy and reliability of such techniques, not just the procedures themselves, but the manipulations that are carried out, for example applying electrodes and even the ease of data interpretation. The D2 criteria brings together all the skills of this unit to interpret multidisciplinary results and inform a clinical judgement.

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, P2, M1, D1	Physiological Measurement Tests	You are a sales person for physiological measurement equipment company advising staff of a new hospital about the range of testing equipment available.	Presentation.
P3, M2	Normal and Abnormal Measurement Profiles	You are the head of the physiology department training new staff in measurement profiles.	Report with supporting data.
P4,M3	Clinical Measurement	You are one of the clinical staff in the physiological measurement department seeking to calibrate your new machines.	Experimental measurement and report.
P5, P6, M4, D2	Clinical Investigation	You are a clinician presented with a patient with certain symptoms.	Investigation and presentation of findings and conclusion.

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 following units in the Applied Science suite:

Level 1	Level 2	Level 3
Defeating Disease (FLT)	Biology and Our Environment	Physiology of Body Systems
	Health Applications of Life Sciences	Physiology of Human Reproduction and Regulation
	The Living Body	
	Science in Medicine	

Essential resources

It is essential that learners have access to physiological measurement equipment and ideally to patients (or patient data) from NHS clinics, private health care practices, armed forces etc.

Employer engagement and vocational contexts

Any links with the NHS or private healthcare practices would be useful in delivering the unit.

Indicative reading for learners

Textbooks

Department of Health – *What is Physiological Measurement? A Guide to the Tests and Procedures Conducted by Physiological Measurement Diagnostic Services* (Crown Copyright, 2007)

Mulroney S and Myers A – *Essential Physiology* (Saunders, 2008) ISBN 9781416041962

Rhoades R and Bell D – *Medical Physiology: Principles for Clinical Medicine* (Lippincott Williams and Wilkins, US, 2008) ISBN 9780781768528

Tucker, L – *An Introductory Guide to Anatomy and Physiology* (EMS Publishing, 2008) ISBN 9781903348284

Journals

American Journal of Physiology

Journal of Applied Physiology

Journal of Physiology

Physics in Medicine and Biology

Physiological Measurement

The Journal of Exercise Physiology

The Open Physiology Journal

Websites

cks.library.nhs.uk	NHS information for patients
www.18weeks.nhs.uk/Content.aspx?path=/achieve-and-sustain/Diagnostics/Physiological-measurement/	NHS physiological measurement
www.18weeks.nhs.uk/Content.aspx?path=/achieve-and-sustain/Diagnostics/Vascular-technology/	Vascular technology
www.artp.org.uk/	Association of Respiratory Physiology and Technology
www.bbc.co.uk/health/conditions/index.shtml?heart_and_blood_vessel_disorders	BBC health
www.bcis.org.uk/	British Cardiovascular Intervention Society
www.brit-thoracic.org.uk/	British Thoracic Society
www.bsecho.org/	British Society for Echocardiology
www.innervody.com	Human anatomy online
www.iscev.org/	International Society for Clinical Electrophysiology of Vision
www.kvh.com.au/biochemistry.htm	Biochemistry
www.physoc.org/site/cms/contentChapterView.asp?chapter=1	The Physiology Society
www.scst.org.uk/	Society for Cardiological Science and Technology
www.scst.org.uk/clin_guidance/Consensus%20guidelines%20for%20recording%20a%2012%20lead%20ECG%201106.pdf	Consensus guidelines on performing a 12 lead resting ECG

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	[IE1,2,4] carrying out physiological measurements
Creative thinkers	[CT1,2] planning an experiment
Reflective learners	[RL5] evaluating results from clinical investigations
Team workers	[TW3,4,6] taking and enabling others to take physiological measurement.
Self-managers	[SM2,3] planning physiological measurement investigation independently.
Effective participators	[EP3] taking and enabling others to take physiological measurement.

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	[IE1,3,6] investigating background to physiological measurement
Reflective learners	[RL5,6] using underlying principles of physiology to explain results of tests undertaken
Team workers	[TW5,6] using team presentation opportunity during teaching and learning
Self-managers	[SM3,4,5] demonstrating ability to plan and investigate
Effective participators	[EP4,5,6] showing willingness to participate during team presentations

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	Collecting, manipulating and presenting data
Manage information storage to enable efficient retrieval	spreadsheet data from measurements taken
Follow and understand the need for safety and security practices	collecting data from clinical practice/patients
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching into physiology and using this to interpret 'clinical' data
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	researching epidemiology data, assessing its relevance and applying it to interpret 'clinical' trends
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 notes and reports
Bring together information to suit content and purpose	collating research data to give and interpretation of underlying principles
Present information in ways that are fit for purpose and audience	producing reports and presentations
Evaluate the selection and use of ICT tools and facilities used to present information	using spreadsheets, interactive whiteboards, presentation tools
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	collecting patient/clinical data.

Skill	When learners are ...
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	manipulating data to determine and explain trends
Select and apply a range of skills to find solutions	manipulating data to determine and explain trends
Use appropriate checking procedures and evaluate their effectiveness at each stage	manipulating data to determine and explain trends.
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	manipulating data to determine and explain trends
Draw conclusions and provide mathematical justifications	manipulating data to determine and explain trends eg epidemiological data
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	presenting own findings and contributing to group presentations and discussions
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	searching all information sources available to glean relevant physiological and epidemiological data
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	preparing findings and conclusion in reports and presentations