Unit 4: Anatomy and Physiology for Sport

Unit code: D/502/5474

QCF Level 2: BTEC First

Credit value: 5

Guided learning hours: 30

Aim and purpose

The aim of this unit is to give learners a good understanding of the structure and function of the skeletal, muscular, cardiovascular and respiratory systems of the human body.

Unit introduction

A healthy body is an amazing piece of machinery which allows us to go from total rest to all-out sprinting in a matter of seconds. Trained sportspeople are able to run, cycle and swim marathon distances. This ability is due to the efficiency of the physiological systems that work together to enable such activity. An understanding of these systems is imperative in the sport and exercise industries in order to appreciate how the body copes with the stress of exercise.

This unit explores the foundation of anatomy and physiology of the four main body systems.

The unit starts by exploring the skeletal system and includes the main bones, joints and movement. The muscular system is then examined, the main muscles, antagonistic pairs and types of contraction are covered. The structure and function of the cardiovascular system is then covered which includes the structure of the heart and the blood vessels that carry blood all around the body. To complete the unit, the respiratory system is explored and includes the mechanics of breathing and gaseous exchange.

Learning outcomes

On completion of this unit a learner should:

1 Know the structure and function of the skeletal system

2 Know the structure and function of the muscular system

3 Know the structure and function of the cardiovascular system

4 Know the structure and function of the respiratory system.

Unit content

1 Know the structure and function of the skeletal system

Structure of the skeletal system: bones (skull, sternum, ribs, vertebral column, clavicle, scapula, humerus, radius, ulna, pelvis, femur, tibia, fibula, patella)

Function of the skeletal system: protection; movement; shape; support; blood production

Joints: classifications (fixed, slightly moveable, freely moveable/synovial joints); joint structure; synovial joints range of movement

Movement: flexion; extension; adduction; abduction; rotation; circumduction; examples from relevant sporting movements eg the shoulder and elbow joints during an overarm tennis service

2 Know the structure and function of the muscular system

Major muscles: triceps; biceps; quadriceps; hamstrings; deltoids; gluteus maximus; gastrocnemius; abdominals; obliques; pectorals; trapezius; erector spinae; location

Types of muscles: voluntary (skeletal); involuntary (smooth); heart (cardiac); structure; function

Muscle movements: antagonistic pairs; types of contraction (concentric, eccentric, isometric)

3 Know the structure and function of the cardiovascular system

Structure of the cardiovascular system: atria; ventricles; septum; tricuspid valve; bicuspid valve; semi-lunar valves; main blood vessels leading into and out of the heart (aorta, pulmonary vein, pulmonary artery and vena cavae); blood vessels (structure and function); arteries; arterioles; capillaries; veins and venuoles

Function of the cardiovascular system: blood flow through the heart and to the body and lungs; taking up oxygen and 'unloading' carbon dioxide; thermoregulation (vasodilation and vasoconstriction of vessels)

4 Know the structure and function of the respiratory system

Structure of the respiratory system: epiglottis; trachea; bronchus; bronchioles; alveoli; diaphragm; intercostal muscles

Function of the respiratory system: mechanics of breathing (inspiration and expiration); gaseous exchange (alveoli, diffusion of oxygen into the blood, carbon dioxide out of the blood and into the lungs)

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 structure and function of the skeletal system		
P2 describe the different types of joint and the movements allowed at each [CT1, CT2]	**M1** explain the movements occurring at two synovial joints during four different types of physical activity	
P3 identify the major muscles of the body		
P4 describe the different types of muscle and muscle movements [CT1, CT2]	**M2** give examples of three different types of muscular contraction relating to three different types of physical activity	**D1** analyse the musculoskeletal actions occurring at four synovial joints during four different types of physical activity
P5 describe the structure and function of the cardiovascular system		
P6 describe the structure and function of the respiratory system.	**M3** explain how the cardiovascular and respiratory systems work together to supply the body with oxygen.	**D2** evaluate how the cardiovascular system and respiratory system work together to supply the body with oxygen and remove carbon dioxide.

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

The aim of this unit is to give learners a sound understanding of the skeletal, muscular, cardiovascular and respiratory systems.

A wide range of delivery methods should be used including lectures, tutorials, presentations, videos, worksheets, anatomy models, laboratory work and internet sources. There will be a great deal of scientific anatomical language that may be daunting for some learners, so practical application should be used wherever possible.

Study of the skeletal system requires the use of diagrams, and preferably a life-sized, hinged model skeleton. Disarticulated bones and models of human joints should also be accessible. X-rays can be used to illustrate the different bones of the skeleton. Dissection of an animal joint may help to demonstrate the components of a synovial joint.

Study of the muscular system requires pictures of, or access to, microscopes and slides of cardiac, voluntary and involuntary muscles in order for learners to see the differences between the tissues. Diagrams of the muscular system showing all the named muscles will also be required. In order for learners to understand the concept of muscles working in antagonistic pairs, it would be useful for them to watch a DVD/video, or relevant internet sites, that shows how the muscles relax and contract as a pair.

To explore the cardiorespiratory system learners could use laboratory work where they watch or take part in a dissection of animal hearts and lungs. Again, labelled diagrams and hand-drawn diagrams should be used to show the anatomical structure of the heart, circulatory and respiratory systems.

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 and overview of the unit
Structure of the skeleton. Main bones named and labelled on a diagram. Use of an articulated skeleton to show learners the different bones
Assignment 1: The Musculoskeletal System (P1, P2, P3, P4, M1, M2, D1). Tutor introduces the assignment brief
Structure and classification of joints – diagrams from textbooks and worksheets to illustrate each classification of joint. Models of joints for learners to examine and see how much movement each type of joint allows. Structure of a synovial joint – diagram for learners to label. Learners draw the diagram themselves
Function of the skeleton – learners work in small groups to work out the functions of the skeleton. Learners feedback to the rest of the group and the tutor ensures all five functions are covered
DVD to show learners and recap on the structure and function of the skeleton
Different types of movement – terminology of each type of joint movement is taught. Learners then take part in practical activities to fully understand the terminology and apply it to sporting movements
Assessment of the skeletal system – learner practical task

Topic and suggested assignments/activities and/assessment
Structure of the muscular system. Main muscles named and labelled on a diagram. Learners take part in practical activities (eg sticky label game) to help reinforce learning
Different type of muscles. Learners are taught about the different types of muscle and the properties of each. Learners then view microscope slides of each type of muscle and draw diagrams to help illustrate the differences between them
Muscle movements. The principle of antagonistic pairs is taught. Learners then take part in a range of practical activities to work out which muscles are working as an antagonistic pair
The different types of contraction are taught – concentric, eccentric, isometric. Learners then take part in a range of practical activities and need to work out what type of contraction specified muscles are performing
DVD showing structure and function of the muscular system is shown
Assessment of the muscular system – learner practical activity
Assignment 2: The Cardiorespiratory System (P5, P6, M3, D2). Tutor introduces the assignment brief
Structure of the cardiovascular system is taught: diagrams are drawn on the whiteboard. Diagram of the heart with all four chambers labelled, a second diagram of the heart with each of the valves labelled, a third diagram is then drawn of the heart with labelled blood vessels leading into and out of it
If possible a heart dissection is shown to the learners or a DVD of the process to help learners fully understand the structure of the heart
Structure and function of blood vessels is taught – diagrams of the structure used to illustrate their function
Function of the cardiovascular system is taught with the help of CD ROMs or internet sites to show animation of blood flow through the heart and to the body and lungs. The process of the blood taking-up oxygen at the lungs and unloading carbon dioxide is taught
Thermoregulation is taught through practical activities to show how increased blood flow to the skin can help the body to lose heat
Structure of the respiratory system: diagrams are drawn and labelled to show the different parts of the respiratory system
Mechanics of breathing: learners build a set of 'lungs' to help them understand how the decrease in thoracic pressure, through the contraction of the diaphragm and upwards and outwards movement by the intercostal muscles, brings air into the lungs
The process of gaseous exchange is researched by learners and feedback provided to the rest of the group via a group discussion
Assessment of the cardiovascular and respiratory systems – learner practical activity
Evaluation of the unit

Assessment

For P1, learners need to label the main bones of the skeleton, describing the structure and all the different functions.

For P2, learners need to describe the three different classifications of joint, each of the synovial joints and the movements allowed at each. The structure of each synovial joint can be discussed to help describe the movements that each allow.

For P3, learners need to label a diagram of the major muscles of the human body or, alternatively, undertake a viva where they point to the appropriate muscles on a diagram or person and name each correctly. This activity would need to be supported by a witness statement provided by the tutor.

For P4, learners could hand draw diagrams of each of the different types of muscle and describe the characteristics of each. Learners can then investigate muscles that work in antagonistic pairs and describe how as one contracts the other relaxes.

For P5, learners could hand draw a labelled diagram of the heart and describe each part, and then describe the function of the cardiovascular system. Learners will also need to outline the role of thermoregulation, covering the vasodilation and vasoconstriction of vessels.

For P6, learners could hand draw a labelled diagram of the respiratory system and describe each part, and then describe the mechanics of breathing and the process of gaseous exchange.

M1 can be achieved by learners examining different types of physical activity for example, kicking a football, and then explaining the different types of movement that occur at two synovial joints for example, knee and hip. Four different types of physical activity need to be covered.

M2 can be achieved by learners correctly identifying each of the different muscular contractions that occur during different types of physical activity for example, upwards phase of a bicep curl, biceps concentrically contract. Three different types of physical activity need to be covered.

M3 can be achieved by learners explaining how the cardiovascular and respiratory systems work together to take in oxygen and supply it to the body.

For D1, which builds on P2, P4, M1 and M2, learners need to analyse the muscles at four joints involved in four different types of physical activity. Assessment evidence could be presented in a table with supporting written text for analysis.

For example:

Physical activity	Type of joint	Movement at joint	Agonist muscle	Type of muscle contraction	Antagonist muscle

For D2, learners need to explore and evaluate the efficiency and functions of the cardiovascular and respiratory systems in supplying the body with oxygen and removing waste products.

Assessment evidence for the higher grading criteria of this unit could be achieved by learners producing a written laboratory report or, alternatively, learners could produce PowerPoint presentations and present to the tutor and the group. Presentations would need to be supported by observation records/witness statements provided by the tutor.

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, P3, P4, M1, M2, D1	The Musculoskeletal System	You are training to be a health fitness instructor and know that it is important to have knowledge and understanding of the structure and function of the body systems. Examine the musculoskeletal system and movement.	Practical and written investigation
P5, P6, M3, D2	The Cardiorespiratory System	Your training continues and having studied the musculoskeletal system, you now move onto look at the cardiorespiratory system. Explore the structure and function of the cardiovascular and respiratory systems.	Practical investigations and laboratory report

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

This unit forms part of the BTEC Sport sector suite. This unit has particular links with the following unit titles in the BTEC Sport suite and the BTEC Sport and Exercise Sciences suite:

Level 2 Sport	Level 3 Sport	Level 3 Sport and Exercise Sciences
Effects of Exercise on the Body Systems	The Physiology of Fitness	Anatomy for Sport and Exercise
Fitness Testing and Training	Principles of Anatomy and Physiology in Sport	Sport and Exercise Physiology
Development of Personal Fitness	Fitness Training and Programming	Exercise, Health and Lifestyle
	Sports Coaching	Fitness Training and Programming
	Exercise, Health and Lifestyle	Instructing Physical Activity and Exercise
	Instructing Physical Activity and Exercise	Applied Sport and Exercise Physiology
		Sports Coaching

This unit links with the National Occupational Standards (NOS) for:

- Coaching, Teaching and Instructing at Level 2
- Instructing Exercise and Fitness at Level 2.

Essential resources

Learners will need access to diagrams of the skeletal, muscular, cardiovascular and respiratory systems. Models of each body system would be of benefit but are not essential for unit delivery.

Employer engagement and vocational contexts

This unit focuses on the anatomy and physiology of the body and will give learners the background knowledge and skills needed to work in a fitness suite, leisure club or gym. Centres are encouraged to develop links with local health education professionals and health fitness instructors so that learners can understand the importance of learning about the structure and function of the human body in order to pursue a career in the sport and fitness industry.

Indicative reading for learners

Textbooks

Adams M, Beashel P, Hancock J, Harris B, Phillippo P, Sergison A and Taylor I – *BTEC Level 2 First Sport Student Book* (Pearson, January 2010) ISBN 9781846906220

Adams M, Beashel P, Harris B, Johnson S, Phillippo P and Sergison A – *BTEC Level 2 First Sport Teaching Resource Pack* (Pearson, April 2010) ISBN 9781846907173

Hartigan S – *Essential GCSE PE for Edexcel* (Hodder Arnold, 2005) ISBN 9780340905586

Scott T – *GCSE PE for Edexcel* (Heinemann, 2001) ISBN 9780435506360

Sharkey B and Gaskill E – *Fitness and Health* (Human Kinetics, 2006) ISBN 97807360561 44

Websites

BBC Health	www.bbc.co.uk/health
British Heart Foundation	www.bhf.org.uk

Delivery of personal, learning and thinking skills (PLTS)

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 ...
Creative thinkers	describing the different types of joint and the movements allowed at each describing the different types of muscle and muscle movements

Functional Skills – Level 2

Skill	When learners are ...
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching the structure and function of the different body systems
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	discussing the structure and function of the different body systems
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching the structure and function of the different body systems
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	writing assignments/laboratory reports.