Unit 1: Anatomy for Sport and Exercise

Unit code: M/600/0038

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit explores the structure and function of the skeletal, muscular, cardiovascular and respiratory systems.

Unit introduction

The human body is made up of different systems that work together and which allow us to take part in a huge variety of sport and exercise activities. The skeletal and muscular systems work together to allow our bodies to perform a vast range of different movements.

Our cardiovascular and respiratory systems act as a delivery service, working together to supply oxygen to the body which in turn is used to produce energy for muscular contraction.

In order to appreciate how each system operates, learners will study the structure and function of the skeletal, muscular, cardiovascular and respiratory systems. The anatomy of these systems is very different but is implicitly linked.

Most careers in the sports industry require a good level of understanding of how the human body functions. This unit allows the structure and function of each system to be examined and applied to sport and exercise activities. Nervous control of the muscular, cardiovascular and respiratory systems is also investigated.

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 skeletal system: axial skeleton; appendicular skeleton; types of bone (long bones, short bones, flat bones, irregular bones, sesamoid bones); location of major bones (cranium, clavicle, ribs, sternum, humerus, radius, ulna, scapula, ilium, pubis, ischium, carpals, metacarpals, phalanges, femur, patella, tibia, fibula, tarsals, metatarsals, vertebral column, vertebrae – cervical, thoracic, lumbar; sacrum, coccyx)

Function of skeletal system: support; protection; attachment for skeletal muscle; leverage; source of blood cell production; store of minerals; bone growth (osteoblasts, osteoclasts, epiphyseal plate)

Joints: fixed; slightly moveable; synovial/freely moveable (gliding, hinge, pivot, condyloid, saddle, ball and socket joints); movement available (flexion, extension, abduction, adduction, rotation, circumduction, pronation, supination, plantarflexion, dorsiflexion, hyper-extension, inversion, eversion)

2 Know the structure and function of the muscular system

Muscular system: major muscles (biceps, triceps, deltoids, pectoralis major, rectus abdominis, rectus femoris, vastus lateralis, vastus medialis, vastus intermedius, semimembranosus, semitendinosus, biceps femoris, gastrocnemius, soleus, tibialis anterior, erector spinae, teres major, trapezius, latissimus dorsi, obliques, gluteus maximus); location; function; origins; insertions

Types of muscle: cardiac; skeletal; smooth

Fibre types: Type 1; Type 2a; Type 2b; characteristics; types of sports each are associated with; force production

Muscular contraction: sliding filament theory (actin, myosin, sarcomere, troponin, tropomyosin, calcium ions, ATPase); antagonistic pairs (agonist, antagonist); fixator; synergist

Types of contraction: isometric; concentric; eccentric; isokinetic

3 Know the structure and function of the cardiovascular system

Structure: heart (endocardium, myocardium, epicardium, atria, ventricles, bicuspid valve, tricuspid valve, chordae tendineae, aortic valve, pulmonary valve, aorta, superior and inferior vena cava, pulmonary vein, pulmonary artery); blood vessels (arteries, arterioles, capillaries, veins, venuoles), vasodilation, vasoconstriction; blood (composition – plasma, erythrocytes, leucocytes, thrombocytes)

Function of the cardiovascular system: delivery of oxygen and nutrients; removal of waste products; thermoregulation; function of blood (oxygen transport, clotting, fighting infection); cardiac cycle (sino atrial node (SAN), atrio ventricular node (AVN), atrio ventricular bundle – Bundle of His, Purkinje fibres); effect of the nervous system (sympathetic and parasympathetic)

4 Know the structure and function of the respiratory system

Structure: nasal cavity; epiglottis; pharynx; larynx; trachea; bronchus; bronchioles; lungs (lobes, pleural membrane, pleural cavity, parietal pleura, thoracic cavity, visceral pleura, pleural fluid, alveoli); diaphragm; intercostal muscles (external and internal)

Function: transport, eg oxygen, carbon dioxide, haemoglobin, oxyhaemoglobin; mechanisms of breathing (inspiration and expiration, respiratory volumes – tidal volume, inspiratory reserve volume, expiratory reserve volume, vital capacity, residual volume, total lung capacity); control of breathing (neural control, chemical control)

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 classifications of joints and the range of movement available at each [IE1]	**M1**	explain the different classifications of joints and the range of movement available at each	**D1**	compare and contrast the different classifications of joints and the range of movement available at each
P3	identify the location, function, origin and insertion of the major muscles				
P4	describe the different types of muscle and the fibre types [IE1]	**M2**	explain the properties of the different types of muscle and the different muscle fibre types	**D2**	compare and contrast the properties of the different types of muscle and the different muscle fibre types.
P5	describe the process of muscular contraction and the different types of contraction [IE1]	**M3**	explain how muscles produce movement and the different types of contraction		
P6	describe the structure and function of the cardiovascular system	**M4**	explain the function of the cardiovascular system		
P7	describe the structure and function of the respiratory system.	**M5**	explain the function of the respiratory system.		

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 detailed understanding of the structure and function of the skeletal, muscular, cardiovascular, and respiratory systems.

Teaching the structure and function of the skeletal system will require the use of diagrams of the skeleton and a life-sized hinged model skeleton. Disarticulated model bones should be accessible so that the bony landmarks and features can be seen and felt. Models of human joints should also be provided for learners to examine. X-rays can be used to illustrate the different bones of the skeleton. A dissection of an animal joint may help to demonstrate the components of a synovial joint.

The content covering the muscular system requires access to microscopes and pictures of, or access to slides of cardiac, skeletal, and smooth muscle so that learners can see the differences between the structure of the tissues. This will help inform the teaching of the function of each of these types of muscle. Diagrams of the muscular system that show all the named muscles are required.

Software is available for learners to see 3D images of the muscular system and would be useful in the delivery of this unit.

Detailed pictures and tables should be accessible for learners to see the origin and insertion of each muscle. In order for learners to understand the concept of muscles working in antagonistic pairs, it would be useful for them to watch a video of how the muscles relax and contract as a pair. Teaching the sliding filament theory of muscular contraction follows on from this. This is quite a challenging concept for many learners to grasp, and it is recommended that animated diagrams illustrating the process be used. These are available on CD ROM, video or from various internet sites.

Delivery of the cardiovascular and respiratory systems could include laboratory work in which learners watch or take part in performing animal heart and lung dissections. Labelled diagrams on worksheets or OHTs should be used to show the anatomical structure of the heart, circulatory system and respiratory system.

Lung volumes can be taught in a practical manner using a spirometer. The values attained from the spirometer can be recorded and then the theory behind each reading can be taught.

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.
Assignment 1: The Skeletal System (P1, P2, M1, D1). Tutor introduces the assignment brief.
Structure of skeletal system – major bones of the skeletal system are taught – labelled diagrams and disarticulated skeleton.
Function of skeletal system – theory and DVD.
Joint structure and function of three types of joint and all synovial joints are taught.
Different types of movement – theory and practical session.
Major muscles – diagrams and sticky label game. Interactive lecture and practical activity: function of each major muscle (origins and insertions). Internet research: major muscle origins and insertions.
Types of muscle – theory and practical with prepared microscope slides.
Assignment 2: The Muscular System (P3, P4, M2, D2, P5, M3). Tutor introduces the assignment brief.
Fibre types and characteristics of each: learner-centred research.
Sliding filament theory – CD ROM, internet sites and tutor-led discussion.
Antagonistic pairs and different types of muscular contraction – practical session.
Structure of the heart – theory and practical dissection.
Assignment 3: The Cardiorespiratory System (P6, P7, M4, M5). Tutor introduces the assignment brief.
Blood vessels and blood – learners in small groups given one blood vessel or a component of blood to research – present their findings to the rest of the group.
Function of the cardiovascular system and the function of blood.
Cardiac cycle – theory and DVD.
Structure of the respiratory system and mechanics of breathing – theory and practical making a model of the respiratory system.
Function of the respiratory system – DVD.
Respiratory volumes – practical investigation using a spirometer.
Evaluation of the unit and assessment activities.

Assessment

It is possible to assess this unit through a number of structured assignments. For P1, learners must describe the axial and appendicular skeleton, the different types of bone in the skeleton and be able to locate all of the bones named in the *Unit content*. They must also be able to describe all functions of the skeleton, including bone growth.

For P2, learners must be able to describe all three classifications of joints and be able describe the amount of movement allowed at each; this also includes the movement allowed at each of the synovial joints.

For P3, learners must be able to identify the location of all of the muscles named in the *Unit content* and be able to name the origin and insertion of each of these muscles. They must also be able to describe the function of the muscular system.

For P4, learners must be able to describe each of the three classifications of muscle (cardiac, skeletal and smooth) and also describe the different muscle fibre types.

For P5, learners must be able to describe the sliding filament theory in order to demonstrate an understanding of muscle movement. They must also describe the different types of muscular contraction.

For P6, learners must be able to describe the structure and function of the cardiovascular system including all parts named in the *Unit content*. It would be a good idea to ask learners to hand-draw the structure of the heart and blood vessels and then give a description of each labelled part.

For P7, learners must be able to describe the structure of the respiratory system including all parts named in the *Unit content*. The function must also be described and will include the neural and chemical control of breathing.

For M1, learners must examine each of the classifications of joints, including all six synovial joints, and explain the range of movement available at each.

For M2, learners must examine the three different types of muscle and explain the different properties related to their function. They must also examine all three different fibre types and again explain how they differ.

For M3, learners must explain the sliding filament theory of muscular contraction and how muscles produce movement. The different types of contraction should also be explained, using relevant examples as appropriate.

For M4, learners must examine the cardiovascular system and explain how the system works together and how each part of the system is designed to meet its function.

For M5, learners must examine the respiratory system and explain how the system works together and how each part of the system is designed to meet its function.

In order to meet D1, which builds on M1, learners need to compare and contrast the different classifications of joints and the range of movement available at each. Learners should support their work with practical examples where appropriate.

For D2, which builds on M2, learners need to compare and contrast the properties of the different types of muscle and the different muscle fibre types.

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 Pearson assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, M1, D1	The Skeletal System	You aspire to work in sports coaching or health fitness instruction and need to gain an understanding of the structure of the human body and how it works.	Written report.
P3, P4, P5, M2, M3, D2	The Muscular System		Practical observation and written report.
P6, P7, M4, M5	The Cardiorespiratory System		Laboratory report.

Links to other BTEC units

This unit forms part of the BTEC Sport and Exercise Sciences 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
		Sport and Exercise Physiology
		Exercise, Health and Lifestyle
		Fitness Training and Programming
		Instructing Physical Activity and Exercise
		Applied Sport and Exercise Physiology
		Research Project in Sport and Exercise Sciences
		Sports Coaching
		Research Investigation in Sport and Exercise Sciences
		Laboratory and Experimental Methods in Sport and Exercise Sciences

Essential resources

Learners will need access to laboratory equipment, models and/or images relating to the skeletal and other body systems.

Employer engagement and vocational contexts

Centres are encouraged to develop links with health fitness instructors and local health education professionals so that learners can understand the importance of human anatomy and physiology, to pursue a career in the sport and leisure industry.

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	describing the different classifications of joints and the range of movement available at each describing the different types of muscle and the fibre types describing the process of muscular contraction and the different types of contraction.

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 ...
Team workers	working in groups to identify the location, function, origin and insertion of the major muscles.

Functional Skills – Level 2

Skill	When learners are …
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 cardiovascular and respiratory 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 muscular and skeletal systems.