

Unit 1: Principles of Anatomy and Physiology in Sport

Unit code:	D/502/4888
QCF Level 3:	BTEC National
Credit value:	5
Guided learning hours:	30

● Aim and purpose

The aim of this unit is to explore the structure and function of the skeletal, muscular, cardiovascular and respiratory systems and also to learn the fundamentals of the energy systems.

● Unit introduction

The human body is made up of many different systems that work together and allow us to take part in a huge variety of sport and exercise activities. An athlete can go from rest to all-out sprinting in a matter of seconds, whereas an endurance athlete can continue exercising for many hours at a time.

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 and nutrients to the body which in turn is used to produce energy for muscular contraction.

In order to appreciate how each of these systems function, learners will study the structure of the skeletal, muscular, cardiovascular and respiratory systems. The human anatomy of these systems is very different but in terms of operation, each system is implicitly linked. Having an understanding of these body systems is imperative in the sport and active leisure industries in order to begin to appreciate how the body functions and how it copes with the many different stresses of exercise.

The unit starts by exploring the structure and function of the skeletal system which includes the different bones of the skeleton and the different types of joints. The muscular system is then studied, including the major muscles of the body, muscle movement, the different types of muscle and muscle fibre types.

The structure of the heart and blood vessels is covered, together with the function of the cardiovascular system. The unit goes on to explore the structure of the respiratory system and the function, including the mechanics of breathing. The final part of the unit explores the three different energy systems and the sports in which they are predominantly used.

● 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
- 5 Know the different types of energy systems.

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 – cervical, thoracic, and lumbar vertebrae, sacrum, coccyx)

Function of skeletal system: support; protection; attachment for skeletal muscle; source of blood cell production; store of minerals

Joints: fixed; slightly moveable; synovial/freely moveable (types, structures, movement at each joint)

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); function; location; types of muscle (cardiac, skeletal, smooth)

Function of the muscular system: movement – antagonistic pairs (agonist, antagonist); fixator; synergist; types of contraction (isometric, concentric, eccentric, isokinetic)

Fibre types: Type I; Type 2a; Type 2b; characteristics; types of sports each are associated with

3 Know the structure and function of the cardiovascular system

Structure of the cardiovascular system: heart (atria, ventricles, bicuspid valve, tricuspid valve, aortic valve, pulmonary valve, aorta, vena cava – superior and inferior, pulmonary vein, pulmonary artery); blood vessels (arteries, arterioles, capillaries, veins, venuoles)

Function of the cardiovascular system: delivery of oxygen and nutrients; removal of waste products; thermoregulation (vasodilation and vasoconstriction of vessels); function of blood (oxygen transport, clotting, fighting infection)

4 Know the structure and function of the respiratory system

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

Function: gaseous exchange; mechanisms of breathing (inspiration and expiration); lung volumes, eg tidal volume, vital capacity, residual volume; control of breathing (neural and chemical)

5 Know the different types of energy systems

Energy systems: phosphocreatine; lactic acid system; aerobic energy system; amount of ATP produced by each system; sports that use these systems to provide energy; recovery time

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		
P3 identify the location of the major muscles in the human body		
P4 describe the function of the muscular system and the different fibre types	M1 explain the function of the muscular system and the different fibre types	D1 analyse the function of the muscular system and the different fibre types
P5 describe the structure and function of the cardiovascular system	M2 explain the function of the cardiovascular system	
P6 describe the structure and function of the respiratory system	M3 explain the function of the respiratory system	
P7 describe the three different energy systems and their use in sport and exercise activities. [IE3]	M4 explain the three different energy systems and their use in sport and exercise activities.	D2 analyse the three different energy systems and their use in sport and exercise activities.

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

A wide range of delivery methods should be used to teach this unit including lectures, tutorials, presentations, videos, work sheets, anatomy models, laboratory work and use of internet sources. Theoretical knowledge should be coupled with as many practical activities as possible.

To develop knowledge and understanding of the human skeletal system, diagrams of the skeleton and a life-sized hinged model skeleton will be required. Disarticulated bones should also be accessible so that learners can see and feel the bony landmarks. 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 also help to demonstrate the components of a synovial joint.

To develop knowledge and understanding of the muscular system pictures of, or access to, microscopes and slides of cardiac, skeletal and smooth muscle will be required, for learners to see the differences between the structure of the tissues. This information will then 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.

To enable learners to understand the concept of muscles working in antagonistic pairs, it would be useful for them to watch a video/DVD or visit a relevant internet site that shows how the muscles relax and contract as a pair. Diagrams or OHTs of the different muscle types and shapes could be examined together with pictures of aerobically and anaerobically trained muscle tissue.

Work relating to the cardiovascular and respiratory systems could include laboratory practicals in which learners watch or take part in animal heart and lung dissections. Again, labelled diagrams either printed on work sheets or shown on OHTs should be used to show the anatomical structures of the heart, circulatory systems and respiratory systems. Learners could take part in a practical experiment to see what happens to heart rate during exercise and these results could then be analysed and related back to anatomical structure and function.

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

Energy systems can be explored using practical activities, for example, working the creatine phosphate system through plyometric exercises.

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
The tutor introduces the unit
Assignment 1: The Skeletal System (P1, P2). Tutor introduces the assignment brief. Interactive lecture
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 the different types of joints: interactive lecture and learner activities in small groups
Major muscles: diagrams and sticky label game
Assignment 2: The Muscular System (P3, P4, M1, D1). Tutor introduces the assignment brief
Fibre types and characteristics of each: learner-centred research
Antagonistic pairs and different types of muscle contraction – practical session
Structure of the heart – theory and practical dissection
Blood vessels and blood: learners work in small groups and are given one type of blood vessel to research – present their findings to the rest of the group
Structure of the respiratory system: theory and practical making a model of the respiratory system
Function of the respiratory system DVD: gaseous exchange and the mechanism of breathing
Respiratory volumes – practical investigation using a spirometer
Assignment 3: The Cardiorespiratory and Energy Systems (P5, M2, P6, M3, P7, M4, D2). Tutor introduces the assignment brief
Neural and chemical control of breathing – tutor-led lesson and practical investigation
Phosphocreatine energy system and lactic acid system: theory and practical lesson Includes practical tasks
Aerobic energy system – theory and practical tasks
Review of unit and assessment

Assessment

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 named bones stated in the *Unit content*. They must also describe the function of the skeletal system. For P2, learners need to be able to describe all three classifications of joint and the amount of movement available 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 the named muscles in the *Unit content*, including the three types of muscle. For P4, learners must describe the function of the muscular system and the different fibre types (Type 1, Type 2a, Type 2b). Criteria P1, P2, P3 and P4 could be assessed via a written laboratory report or alternatively a presentation, supported by a tutor witness statement.

Criteria P5, P6, P7, M1, M2, M3, M4, D1 and D2 could be assessed via production of a laboratory report. For P5, learners must be able to describe the structure and function of the cardiovascular system, which includes 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 describe each labelled part in their laboratory report.

For P6, learners must describe the structure and function of the respiratory system, which includes all parts named in the *Unit content*, including gaseous exchange and the mechanism of breathing.

For P7, learners must be able to describe each of the energy systems named in the *Unit content* and relate the energy systems to their use in different sport and exercise activities.

For M1, which links to P4, learners need to explain the function of the muscular system and the three different muscle fibre types. For M2, learners must examine the cardiovascular system and explain how it works and how each part of the system is designed to meet its function. For M3, learners must examine the respiratory system and explain how it works and how each part of the system is designed to meet its function. For M4, learners must examine each energy system and explain its use in a variety of sport and exercise activities.

Grading criterion D1 builds on M1, and requires learners to analyse the function of the muscular system and the different muscle fibre types. Practical examples should be provided where appropriate to support the analysis, which can be evidenced in the laboratory report. Grading criterion D2 builds on M4, and requires learners to analyse three different energy systems and their use in a wide variety of sport and exercise activities.

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	The Skeletal System	As a sports therapist you regularly apply anatomical knowledge to sports and exercise activities. Conduct practical and laboratory-based activities to explore the anatomy and physiology of the body systems.	Presentation Witness statement
P3, P4, M1, D1	The Muscular System		Practical observation and written report
P5, P6, P7, M2, M3, M4, D2	The Cardiorespiratory and Energy Systems		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
Anatomy and Physiology for Sport	Fitness Training and Programming	Anatomy for Sport and Exercise
Fitness Testing and Training	Sports Coaching	Sport and Exercise Physiology
Development of Personal Fitness	Exercise, Health and Lifestyle	Exercise, Health and Lifestyle
	Instructing Physical Activity and Exercise	Fitness Training and Programming
	Research Investigation in Sport and Exercise Sciences	Instructing Physical Activity and Exercise
	Laboratory and Experimental Methods in Sport and Exercise Sciences	Applied Sport and Exercise Physiology
	The Physiology of Fitness	Sports Coaching
		Research Investigation in Sport and Exercise Sciences
		Laboratory and Experimental Methods in Sport and Exercise Sciences

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

- Coaching, Teaching and Instructing at Level 3
- Instructing Physical Activity and Exercise at Level 3.

Essential resources

Learners will need access to laboratory equipment and models and/or images relating to the body systems, for example a skeleton.

Employer engagement and vocational contexts

This unit will provide learners with the knowledge and understanding of human anatomy and physiology 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 et al – *BTEC Level 3 National Sport (Performance and Excellence) Student Book* (Pearson, 2010)
ISBN 9781846906510

Adams M et al – *BTEC Level 3 National Sport (Development, Coaching and Fitness) Student Book*
(Pearson, 2010) ISBN 9781846906503

Adams M et al – *BTEC Level 3 National Sport Teaching Resource Pack* (Pearson, 2010) ISBN 9781846906541

Howley E T and Franks B D – *Health Fitness Instructor's Handbook* (Human Kinetics Europe, 2003)
ISBN 9780736042109

Palastanga N – *Anatomy and Human Movement* (Butterworth-Heinemann, 2006) ISBN 9780750688147

Sharkey B J and Gaskell S E – *Fitness and Health* (Human Kinetics, 2006) ISBN 9780736056144

Stafford-Brown J et al – *BTEC National Sport and Exercise Science* (Hodder Arnold, 2007) ISBN 9780340939512

Tortora G J and Derrickson B H – *Principles of Anatomy and Physiology* (John Wiley and Sons, 2008)
ISBN 9780470233474

Journals

American College of Sport Medicine's Health and Fitness Journal

British Journal of Sports Medicine

Exercise and Sport Sciences Reviews

International Journal of Sports Science and Coaching

Medicine and Science in Sports and Exercise

Research Quarterly for Exercise and Sport

Websites

American College of Sports Medicine

www.acsm.org

British Association of Sport and Exercise Sciences

www.bases.org.uk

Coachwise

www.1st4sport.com

Human Kinetics

www.humankinetics.com

Sport Science

www.sportsci.org

Sports Coach UK

www.sportscoachuk.org

Top End Sports

www.topendsports.com

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 three different energy systems and their use in sport and exercise activities.

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 ...
Self-managers	carrying out practical activities to explore muscular contraction.

● 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 delivering a presentation
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.