

Unit 1: Anatomy and Physiology

Level: **3**

Unit type: **External**

Guided learning hours: **120**

Unit in brief

Learners explore how the skeletal, muscular, cardiovascular and respiratory systems function and the fundamentals of the energy systems.

Unit introduction

Having an understanding of body systems is imperative in the sports industry so that professionals can help support people who are taking part in sport and exercise. The human body is made up of many different systems that interrelate to allow us to take part in a huge variety of sport and exercise activities. For example, an athlete can go from rest to sprinting in a matter of seconds, whereas an endurance athlete can continue exercising for many hours at a time.

In order to appreciate how each of these systems function, you will explore the structure of the skeletal, muscular, cardiovascular, respiratory and energy systems as well as additional factors which affect sport and exercise performance. The anatomy and physiology of each body system and their processes are very different but work together to produce movement. You will gain a full appreciation of how the body is able to take part in sport and exercise through understanding the interrelationships between these body systems.

This unit will give you the detailed core knowledge required to progress to coaching and instruction in the sports industry or further study.

Use the unit specification below to research the required criteria, and make notes to ensure you have a sound understanding of the content. This specification covers all of the content to prepare you for the externally assessed examination.

Use pictures and diagrams to help with your research and understanding.

A The effects of exercise and sports performance on the skeletal system

A1 Structure of skeletal system

Understand how the bones of the skeleton are used in sporting techniques and actions.

- Major bones to include cranium, clavicle, ribs, sternum, scapula, humerus, radius, ulna, carpals, metacarpals, phalanges, pelvis, vertebral column (cervical, thoracic, lumbar, sacrum, coccyx), femur, patella, tibia, fibula, tarsals, metatarsals.
- Type of bone – long, short, flat, sesamoid, irregular.
- Areas of the skeleton to include axial skeleton, appendicular skeleton, spine, curves of the spine, neutral spine alignment, postural deviations (kyphosis, scoliosis).
- Process of bone growth – osteoblasts, osteoclasts, epiphyseal plate.

A2 Function of skeletal system

Understand how the functions of the skeleton and bone types are used in sporting actions and exercise.

- Functions of the skeleton when performing sporting techniques and actions:
 - supporting framework
 - protection
 - attachment for skeletal muscle
 - source of blood cell production
 - store of minerals
 - leverage
 - weight bearing
 - reduce friction across a joint.
- Main functions of different bone types when performing sporting techniques and actions:
 - long bones – provides leverage, red blood cell production
 - short bones – weight bearing
 - flat bones – protection
 - sesamoid bones – reduce friction across a joint.

A3 Joints

Understand how joints of the upper and lower skeleton are used in sporting techniques and actions.

- Joints of the upper skeleton (shoulder, elbow, wrist, cervical and thoracic vertebrae).
- Joints of the lower skeleton (hip, knee, ankle, lumbar, sacrum, coccygeal vertebrae).
- Classification of joints – fibrous (fixed), cartilaginous (slightly moveable), synovial (freely moveable).
- Types of synovial joints (ball and socket, condyloid, gliding, saddle, hinge, pivot).

- The bones forming the following joints (shoulder, elbow, wrist, hip, knee, ankle, and their use in sporting techniques and actions).
- Structure and function of components of synovial joints and their use in sporting techniques and actions (joint capsule, bursa, articular cartilage, synovial membrane, synovial fluid, ligaments).
- Range of movement at synovial joints due to shape of articulating bones and use in sporting actions (flexion, extension, dorsiflexion, plantarflexion, lateral flexion, horizontal flexion and horizontal extension, hyperextension, abduction, adduction, horizontal abduction and adduction, rotation, circumduction).

A4 Adaptations of the skeletal system to exercise

- Simulated increase of mineral uptake in bones due to weight-bearing exercise.

A5 Adaptations of the skeletal system to exercise

The impact of long-term effects of exercise on sports performance.

- Skeletal adaptations – increased bone strength, increased ligament strength.

A6 Additional factors affecting the skeletal system

Understand the impact of the skeletal system on exercise and sports performance and the impact of exercise and sports performance on the skeletal system.

- Skeletal disease – arthritis, osteoporosis, and the effect of exercise in offsetting these conditions.
- Age – young children and resistance training issues stunting bone growth.

B The effects of exercise and sports performance on the muscular system

B1 Characteristics and functions of different types of muscles

Understand different types of muscles and their use in sport.

- Cardiac – non-fatiguing, involuntary.
- Skeletal – fatiguing, voluntary.
- Smooth – involuntary, slow contraction.

B2 Major skeletal muscles of the muscular system

Major skeletal muscles and their combined use in a range of sporting actions.

- Deltoids, biceps, triceps, wrist flexors, wrist extensors, supinators and pronators, pectorals, abdominals, obliques, quadriceps, hip flexors, tibialis anterior, erector spinae, trapezius, latissimus dorsi, gluteals, hamstrings, gastrocnemius, soleus.

B3 Antagonistic muscle pairs

Movement of muscles in antagonistic pairs and their use in a variety of sporting actions.

- Agonist.
- Antagonist.

- Synergist.
- Fixator.

B4 Types of skeletal muscle contraction

Understand skeletal muscle contraction in different sporting actions.

- Isometric.
- Concentric.
- Eccentric.

B5 Fibre types

- Understand fibre type recruitment during exercise and sports performance.
- Characteristics of each muscle fibre type:
 - o type I
 - o type IIa
 - o type IIx
- Nervous control of muscle contraction (all or none law).

B6 Responses of the muscular system to a single sport or exercise session

- Increased blood supply.
- Increased muscle temperature.
- Increased muscle pliability. • Lactate (high-intensity exercise).
- Microtears (resistance exercise).

B7 Adaptations of the muscular system to exercise

The impact of adaptation of the system on exercise and sports performance.

- Hypertrophy.
- Increased tendon strength.
- Increase in myoglobin stores.
- Increase in number and size of mitochondria.
- Increase in storage of glycogen.
- Increase in storage of fat.
- Increased tolerance to lactate.

B8 Additional factors affecting the muscular system

Understand additional factors affecting the muscular system and their impact on exercise and sports performance.

- Age – effect of the aging process on loss of muscle mass.

- Cramp – involuntary sustained skeletal muscle contraction.

C The effects of exercise and sports performance on the respiratory system

C1 Structure of the respiratory system

- Structure of the respiratory system (nasal cavity, epiglottis, pharynx, larynx, trachea, bronchus, bronchioles, lungs, alveoli, diaphragm, thoracic cavity).
- Intercostal muscles (external and internal).

C2 Function

Understand the function of the respiratory system in response to exercise and sports performance.

- Mechanisms of breathing (inspiration and expiration) at rest and during exercise.
- Gaseous exchange.

C3 Lung volumes

Understand the lung volumes and the changes that occur in response to exercise and sports performance.

- Tidal volume.
- Vital capacity.
- Residual volume.
- Total lung volume.
- Minute ventilation (VE).

C4 Control of breathing

Understand how breathing rate is controlled in response to exercise and sports performance.

- Neural (medulla oblongata as the respiratory centre in the brain).
- Chemical (chemoreceptors detect change in blood carbon dioxide concentrations and changes in pH).

C5 Responses of the respiratory system to a single sport or exercise session

- Increase in breathing rate.
- Increased tidal volume.

C6 Adaptations of the respiratory system to exercise

The impact of adaptation of the system on exercise and sports performance.

- Increased vital capacity.
- Increased strength of the respiratory muscles.
- Increase in oxygen and carbon dioxide diffusion rate.

C7 Additional factors affecting the respiratory system

Understand additional factors affecting the respiratory system and their impact on exercise and sports performance.

- Asthma.
 - Effects of altitude/partial pressure on the respiratory system.
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D The effects of sport and exercise performance on the cardiovascular system

D1 Structure of the cardiovascular system

- Structure of the cardiovascular system – atria, ventricles, bicuspid valve, tricuspid valve, semi-lunar valves, septum, major blood vessels (aorta, vena cava, pulmonary artery, pulmonary vein), coronary arteries.
- Structure of blood vessels – arteries, arterioles, veins, venuoles, capillaries.
- Composition of blood – red blood cells, plasma, white blood cells, platelets.

D2 Function of the cardiovascular system

Understand the function of the cardiovascular system in response to exercise and sports performance.

- Delivery of oxygen and nutrients.
- Removal of waste products – carbon dioxide and lactate.
- Thermoregulation – vasoconstriction, vasodilation of blood vessels.
- Fight infection.
- Clot blood.

D3 Nervous control of the cardiac cycle

Understand the control of the cardiac cycle and how it changes during exercise and sports performance.

- Conduction process
 - o Sinoatrial node (SAN).
 - o Atrioventricular node (AVN).
 - o Bundle of His.
 - o Purkinje fibres.
- Effect of the sympathetic and parasympathetic nervous system.

D4 Responses of the cardiovascular system to a single sport or exercise session

- Anticipatory increase in heart rate prior to exercise.

- Increased heart rate.
- Increased cardiac output.
- Increased blood pressure.
- Redirection of blood flow.

D5 Adaptations of the cardiovascular system to exercise

The impact of adaptation of the system on exercise and sports performance.

- Cardiac hypertrophy.
- Increase in resting and exercising stroke volume.
- Decrease in resting heart rate.
- Capillarisation of skeletal muscle and alveoli.
- Reduction in resting blood pressure.
- Decreased heart rate recovery time.
- Increase in blood volume.

D6 Additional factors affecting the cardiovascular system

Understand additional factors affecting the cardiovascular system and their impact on exercise and sports performance.

- Sudden arrhythmic death syndrome (SADS).
 - High blood pressure/low blood pressure.
 - Hyperthermia/hypothermia.
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E The effects of exercise and sports performance on the energy systems

E1 The role of ATP in exercise

Understand the role of adenosine triphosphate (ATP) for muscle contraction for exercise and sports performance.

- Immediately accessible form of energy for exercise.
- Breakdown and resynthesis of ATP for muscle contraction.

E2 The ATP-PC (alactic) system in exercise and sports performance

Understand the role of the ATP-PC system in energy production for exercise and sports performance.

- Anaerobic.
- Chemical source (phosphate and creatine).
- Resynthesis of ATP.

- Recovery time.
- Contribution to energy for exercise and sports performance (duration and intensity of exercise).

E3 The lactate system in exercise and sports performance

Understand the role of the lactate system in energy production for exercise and sports performance.

- Anaerobic.
- Process of anaerobic glycolysis (glucose converted to lactic acid).
- Recovery time.
- Contribution to energy for exercise and sports performance (duration and intensity of exercise).

E4 The aerobic system in exercise and sports performance

Understand the role of the aerobic energy system in energy production for exercise and sports performance.

- Aerobic site of reaction (mitochondria).
- Food fuel source.
- Process of aerobic glycolysis, Krebs cycle, electron transport chain.
- Recovery time.
- Contribution to energy for exercise and sports performance (duration and intensity of exercise).

E5 Adaptations of the energy system to exercise

The impact of adaptation of the systems on exercise and sports performance.

- ATP-PC.
- Increased creatine stores.
- Lactate system.
- Increase tolerance to lactate.
- Aerobic energy system.
- Increased use of fats as an energy source.
- Increased storage of glycogen.
- Increased numbers of mitochondria.

E6 Additional factors affecting the energy systems

Understand additional factors affecting the energy systems and their impact on exercise and sports performance.

- Diabetes (hypoglycaemic attack).
- Children's lack of lactate system.