



## Higher National Unit specification

### General information

**Unit title:** Exercise Physiology and Anatomy

**Unit code:** H4TB 34

**Superclass:** RH

**Publication date:** August 2013

**Source:** Scottish Qualifications Authority

**Version:** 01

### Unit purpose

This Unit is designed to provide learners with underpinning knowledge of human anatomy and physiology, and the effects of designated body systems on exercise performance. It provides an understanding of the importance of the structure and function of the body, and provides underpinning knowledge for many other related Units.

### Outcomes

On successful completion of the Unit the learner will be able to:

- 1 Describe the structure, organisation and function of the human body.
- 2 Describe the structure and function of the skeletal system.
- 3 Describe the structure and function of the muscular system.
- 4 Describe the structure and function of the respiratory system.
- 5 Describe the structure and function of the cardio vascular system.
- 6 Describe the use and replenishment of energy substrates during exercise and recognise the by-products of energy use.

### Credit points and level

2 Higher National Unit credits at SCQF level 7: (16 SCQF credit points at SCQF level 7)

### Recommended entry to the Unit

Ultimately access is at the discretion of the centre. However, learners may find of assistance a prior knowledge of basic Human Anatomy and Physiology, as evidenced by the following Units and certificates: Human Physiology in the Development of Performance, Higher Physical Education, Higher Human Biology. Other courses which may offer appropriate prior knowledge are S/NVQ qualifications in fitness at levels 2 and 3.

## Higher National Unit specification: General information (cont)

**Unit title:** Exercise Physiology and Anatomy

### Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

There is no automatic certification of Core Skills or Core Skill components in this Unit.

### Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

The content of this Unit underpins much of the material within HNC/HND Fitness, Health and Exercise. Consideration should be given to this when timetabling and delivering the Unit.

The Assessment Support Pack (ASP) for this unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website (<http://www.sqa.org.uk/sqa/46233.2769.html>).

### Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website [www.sqa.org.uk/assessmentarrangements](http://www.sqa.org.uk/assessmentarrangements)

## **Higher National Unit specification: Statement of standards**

### **Unit title:**     Exercise Physiology and Anatomy

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

#### **Outcome 1**

Describe the structure, organisation and function of the human body.

##### **Knowledge and/or Skills**

- ◆ Structure of the human body
- ◆ Organisation of the human body
- ◆ Function of the human body

#### **Outcome 2**

Describe the structure and function of the skeletal system.

##### **Knowledge and/or Skills**

- ◆ Anatomy of the axial and appendicular skeleton
- ◆ Classification of bones
- ◆ Structure and development of long bones
- ◆ Structure and classification of major synovial joints
- ◆ Joint movement
- ◆ Factors limiting range of joint movement
- ◆ Effects of exercise on skeletal system

#### **Outcome 3**

Describe the structure and function of the muscular system.

##### **Knowledge and/or Skills**

- ◆ Functions of the muscular system
- ◆ Anatomy and physiology of skeletal muscle
- ◆ Position, attachment and action of selected muscles
- ◆ Characteristics of muscle fibre types
- ◆ Physiology and classification of muscle contraction
- ◆ Neuromuscular control of movement and posture
- ◆ Effects of exercise on skeletal muscle

## Higher National Unit specification: Statement of standards (cont)

**Unit title:** Exercise Physiology and Anatomy

### Outcome 4

Describe the structure and function of the respiratory system.

#### Knowledge and/or Skills

- ◆ Anatomy and physiology of the respiratory system
- ◆ Mechanism of breathing at rest and during exercise
- ◆ Exchange of air volumes at rest and during exercise
- ◆ Neural control of respiratory system

### Outcome 5

Describe the structure and function of the cardio vascular system.

#### Knowledge and/or Skills

- ◆ Anatomy and physiology of the heart and circulatory system
- ◆ Physiology of blood
- ◆ Nervous control and redistribution of blood to meet the demands of exercise

### Outcome 6

Describe the use and replenishment of energy substrates during exercise and recognise the by-products of energy use.

#### Knowledge and/or Skills

- ◆ Aerobic production systems
- ◆ Anaerobic production systems

### Evidence Requirements for this Unit

Learners will need to provide evidence to demonstrate their Knowledge and/or Skills across all Outcomes by showing that they can:

**Outcome 1** should be assessed by closed-book restricted response paper:

- ◆ Describe the organisation and relationship between: cells and tissues; tissues and organs; and organs and systems.

**Outcome 2** should be assessed by closed-book restricted response paper:

- ◆ Identify functions and main components of the axial and appendicular skeleton.
- ◆ Identify bone types by classification, function, and location.
- ◆ Identify components of a typical synovial joint and describe their functions.
- ◆ Describe major synovial joints by classification and movement patterns.
- ◆ Identify factors limiting ranges of movement at the major synovial joints.
- ◆ Describe the structure and development of a long bone.
- ◆ Describe the long term effects of exercise on the skeletal system.

## Higher National Unit specification: Statement of standards (cont)

### Unit title: Exercise Physiology and Anatomy

**Outcome 3** should be assessed by closed-book restricted response paper:

- ◆ Describe major muscles by position, attachment, and action (assessment should cover a minimum of 15 selected muscles).
- ◆ Explain the functions, structure and the process of contraction of Skeletal muscles.
- ◆ Recognise types of muscle work and contraction.
- ◆ Describe the characteristics of muscle fibre types.
- ◆ Describe the neuromuscular control of movement.
- ◆ Describe the effects of long term exercise on skeletal muscle.

**Outcome 4** should be assessed by closed-book restricted response paper:

- ◆ Identify the structures of the Respiratory System and outline their function.
- ◆ Explain the mechanism of breathing, and the process of gas exchange.
- ◆ Describe the respiratory volumes.
- ◆ Describe neural control of respiration.

**Outcome 5** should be assessed by closed-book restricted response paper:

- ◆ Describe the anatomy of the heart and circulatory system.
- ◆ Describe the physiology of the heart, blood vessels and blood.
- ◆ Describe the nervous control of blood through the heart and the redistribution of blood flow during exercise.

**Outcome 6** should be assessed by closed-book restricted response paper:

- ◆ Describe aerobic and anaerobic energy production including Glycolysis; Krebs Cycle; Electron Transport System; Phosphagen system, Anaerobic Glycolysis.
- ◆ Describe the use and replenishment of energy substrates.
- ◆ Identify the effects of metabolic waste products developed during exercise.



## Higher National Unit Support Notes

**Unit title:** Exercise Physiology and Anatomy

Unit Support Notes are offered as guidance and are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 80 hours.

### Guidance on the content and context for this Unit

The Unit is intended to introduce the learner to the fundamental concepts of anatomy and physiology in an exercise context, helping to prepare the learner for roles as a fitness, health and exercise professional and for progression to higher level study. The Knowledge and Skills in this Unit underpin other mandatory Units.

The Unit will help prepare the learner to develop an understanding of the structure and function of the human body systems particularly relevant to exercise and activity.

#### Outcome 1

This examines the basic anatomy of the body beginning with the cellular components. Basic physiology of these is also covered. This is a vital foundation for the complete understanding of the anatomy and physiology of the human body's response to exercise in both the short and the long term.

#### Outcome 2

This Outcome continues to develop the learners' knowledge of the skeletal system in terms of anatomy, physiology, and development. The following areas should be covered:

- ◆ Bones of the axial skeleton: cranium, spine (cervical vertebrae, thoracic vertebrae, lumbar vertebrae, sacrum, coccyx), ribs, sternum
- ◆ Bones of the appendicular skeleton: shoulder girdle (clavicle, scapula); bones of upper limb (humerus, radius, ulna, carpal bones, metacarpals, phalanges); pelvic girdle (ischium, ilium, pubis); bones of lower limb (femur, tibia, fibula, patella, tarsal bones, metatarsals, phalanges)
- ◆ Functions of the Skeletal System in relation to other body systems:
- ◆ Framework, Attachment and role of tendons/muscles, Mineral Storage, Energy storage, Blood Cell Production
- ◆ Gross Structure of long bone: Periosteum; Hyaline cartilage, Diaphysis, Epiphysis; Medullary Cavity; Marrow; Compact and Cancellous bone, Epiphyseal plate
- ◆ Microstructure:
- ◆ Compact bone- Haversian system, Osteocytes, canniculi
- ◆ Development of Bone tissue: Process of Endochondral Ossification
- ◆ Synovial joint structure: Location and functions of Joint Capsule, Ligaments, Hyaline Cartilage, Fibrocartilage Discs, Synovial fluid, Synovial membrane,
- ◆ Synovial joint classification: Ball and socket, gliding, pivot, hinge, condyloid, saddle
- ◆ Synovial joint movement characteristics:
- ◆ Major Joints: Hip; Knee; Ankle; Shoulder; Elbow; Wrist

## Higher National Unit Support Notes (cont)

### Unit title: Exercise Physiology and Anatomy

- ◆ Joint movement by direction and range: Flexion (including horizontal, dorsi, plantar); Extension (including horizontal); Abduction/Adduction; Medial/Lateral Rotation; Protraction/retraction; supination/pronation; circumduction
- ◆ Factors limiting Range of movement at major synovial joints: soft Tissue; Bone shape
- ◆ Long term effects of exercise: Mineralisation, lines of stress, Cartilage, Ligaments, collagen, density

#### Outcome 3

Introduces the learner to the Muscular System (with specific emphasis on skeletal muscle) and develops knowledge of the mechanics of human movement by describing major muscle groups and the interaction of muscular and skeletal systems:

- ◆ Functions of skeletal muscle: thermo regulation, venous return, posture, movement, energy storage, movement and regulation of fluids
- ◆ Gross structure: tendon, epimysium, perimysium, endomysium, fasciculi
- ◆ Micro structure: myofibrils, sarcomere, myofilaments, t-tubules, sarcoplasmic reticulum, actin and myosin, sarcomere arrangement
- ◆ Sliding filament theory
- ◆ Major muscles: gluteals (maximus, medius, minimus); psoas major, iliacus;
- ◆ Adductors(magnus, longus, brevis), pectinius; quadriceps(rectus femoris,vastus lateralis, vastus medialis, vastus intermedialis); hamstrings (semi tendonosis, semi membranosis, biceps femoris); gastrocnemius; soleus; tibialis anterior, fibularis
- ◆ Deltoid; biceps brachii, tricep, flexor and extensor muscles of the forearm; pectoralis major, latissimus dorsi; teres major; rotator cuff (supraspinatus, infraspinatus, teres minor, subscapularis) trapezius, serratus anterior; erector spinae
- ◆ Quadratus lumborum, abdominals (transversus abdominus, rectus abdominus, internal/external oblique), sternocleidomastoid
- ◆ Types of muscle work and contraction: concentric, eccentric, isometric
- ◆ Fibre Types and their properties: Type 1, Type 2a, Type 2b
- ◆ Neuromuscular control: motor Unit structure and recruitment, neuromuscular junction, reflex arcs; sensory receptors(muscle spindle, golgi tendon organ)

#### Outcome 4

Introduces the learner to the Respiratory System, looking at anatomy, physiology, and respiratory responses of to exercise:

- ◆ Anatomy of the Respiratory System: oral and nasal cavities; pharynx; larynx; trachea, epiglottis; bronchus/bronchioles; alveolar structure
- ◆ Physiology of the Respiratory System: gas exchange; diffusion; pressure gradient; Oxygen Delivery; Carbon Dioxide
- ◆ Mechanism of breathing at rest and during exercise: Inspiration and Expiration
- ◆ Volume and pressure changes; use of ancillary muscles; increased respiratory rate
- ◆ Exchange of air volumes during exercise: Total Lung volume; Tidal volume; Vital Capacity; Residual volume; Expiratory reserve; Inspiratory Reserve

## Higher National Unit Support Notes (cont)

**Unit title:** Exercise Physiology and Anatomy

### Outcome 5

This Outcome continues to develop the learners knowledge, introducing the anatomy and physiology of the cardio-vascular System.

#### Anatomy

- ◆ Heart structure (Atria, Ventricles, Aorta, Pulmonary vessels, Superior and Inferior Vena cavae, Valves); Blood vessels — structure and function of arteries, arterioles, veins, venules, capillary network
- ◆ Physiology of blood (Red blood cells; white blood cells, platelets, plasma)
- ◆ Blood flow through the heart
- ◆ Cardiac Conduction system
- ◆ Redistribution of blood to meet demands of exercise: Vasodilation/Vasoconstriction,
- ◆ Cardiac Function in response to exercise: Cardiac output, Blood pressure, Heart rate

### Outcome 6

This Outcome concentrates on the use and replenishment of energy substrates in exercise, in particular the processes of aerobic and anaerobic energy production and associated metabolic by-products (lactate, pyruvate).

## Guidance on approaches to delivery of this Unit

Due to the nature of the subject matter, it is suited to delivery over a longer period (perhaps the whole of the HNC year or HND first year) in order that learners can assimilate and understand the material.

## Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

The assessment of this Unit is best suited to closed-book, restricted response/short answer papers. The use of diagrams and pictures is recommended where appropriate. It is important that learners develop a sound understanding of the anatomy and physiology of the specified systems in order that they may understand and apply the principles of training which underpin many Units within this award.



## **Higher National Unit Support Notes (cont)**

**Unit title:** Exercise Physiology and Anatomy

### **Opportunities for e-assessment**

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at [www.sqa.org.uk/e-assessment](http://www.sqa.org.uk/e-assessment)

### **Opportunities for developing Core and other essential skills**

Learners should be encouraged in the use of information technology as they develop their Knowledge and Understanding of the anatomy and physiology of the human body as affected by exercise. Instruction in the effective use of learning resource centre systems (including online learning, VLE, and similar electronic media) will support learners to access and analyse factual information and current theories on the impact of exercise.

Editing and collating of notes from a range of sources could be particularly useful in the development of an academic approach to underpinning knowledge. Teaching should support analytical and critical evaluation of information accessed, encouraging and allowing learners to become autonomous learners.

The need to develop efficient systems of recording, coding and storing personal notes for ease of reference should be emphasised. Where practical, learners should have opportunities for e-learning and be aware of the importance of information backup.

## History of changes to Unit

Version	Description of change	Date

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## General information for learners

### Unit title:     Exercise Physiology and Anatomy

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

On completion of this Unit you should have gained an understanding of the skeletal, muscular, respiratory, and cardiovascular systems of the human body. You will also be able to describe the ways which the body uses energy substrates in exercise.

This knowledge is fundamental to your understanding of exercise and human performance and will be built upon in other mandatory Units within the HNC/HND award.

In addition to tuition you will receive additional support and guidance in the form of teaching packs and use of Virtual Learning Environments. A significant amount of self study and review is essential for successful completion of this Unit.

In **Outcome 1** you will study the structure and function of the cells and tissues of the human body. This will help you to understand the basic structure and organisation of the body which will give a clear foundation and put the remaining Outcomes into context.

In **Outcome 2** you will study the anatomy, physiology, and effects of exercise on the skeletal system. This will include the bones, their structure and development, and the tissues which connect them together.

In **Outcome 3** you will study the anatomy, physiology, and effects of exercise on the muscular system. You will look in detail at how muscles contract, where they are located, and their specific roles in each location.

In **Outcome 4** you will study the anatomy, physiology, and effects of exercise on the respiratory system. You will look at how this system responds to the demands placed on it by exercise, and how the body adapts in order to maintain the supply of oxygen to the tissues.

In **Outcome 5** you will study the anatomy, physiology, and effects of exercise on the cardiovascular system. You will see how the heart and vascular system delivers blood, hormones and nutrients to the working muscles, and how waste products are removed. You will examine the electrical system of the heart.

In **Outcome 6** energy systems are studied, and the body's different responses to the requirement for energy are examined closely.