Higher National Unit Specification

General information

Unit title: Human Anatomy, Physiology and Biomechanics in Sport (SCQF level 7)

Unit code: J2AP 34

Superclass: RH

Publication date: August 2019

Source: Scottish Qualifications Authority

Version: 02

Unit purpose

This unit is designed to provide learners with the knowledge and understanding of body systems and the role they play within the context of sporting performance, in addition to the biomechanical principles which underpin human movement. Upon successful completion of this unit, learners will be equipped to present and analyse data within the context of enhancing sports performance.

Outcomes

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

1. Understand the structure and function of the musculoskeletal system which underpins human movement.
2. Research and present analysis of a sporting skill using basic biomechanical principles.
3. Understand the structure and function of the cardiorespiratory system in relation to physical activity.
4. Collect, interpret and present physical activity data in relation to the human energy systems.

Credit points and level

2 Higher National Unit credits at SCQF level 7 (16 SCQF credit points at SCQF level 7)
Higher National Unit Specification: General information (cont)

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Recommended entry to the unit

While entry to this unit is at the discretion of the centre, it would be useful for learners to have prior knowledge of basic Human Anatomy and Physiology through Human Physiology in the Development of Performance, Higher Physical Education, Higher Biology or Higher Human Biology.

Core Skills

Achievement of this Unit gives automatic certification of the following Core Skills component:

Core Skill component Critical Thinking at SCQF level 6

There are also opportunities to develop aspects of Core Skills which are highlighted in the Support Notes of this Unit specification.

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 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.
Higher National Unit Specification: Statement of standards

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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

Understand the structure and function of the musculoskeletal system which underpins human movement.

Knowledge and/or skills

♦ Skeletal system:
  — Axial and appendicular skeleton:
    – joint types
    – classification
    – structure

♦ Muscular system:
  — Skeletal muscle structure
  — Skeletal muscle origins and insertions
  — Types of muscular contraction:
    – concentric
    – eccentric
    – isometric
  — Process of muscle contraction:
    – sliding filament theory

♦ Biomechanical principles:
  — Movement terminology:
    – flexion
    – extension
    – adduction
    – abduction
    – rotation
    – circumduction
  — Planes of the body:
    – frontal
    – sagittal
    – horizontal
Higher National Unit Specification: Statement of standards (cont)

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— Lever systems:
  — class 1
  — class 2
  — class 3
— Axis of rotation:
  — frontal
  — sagittal
  — vertical

Outcome 2

Research and present analysis of a sporting skill using basic biomechanical principles.

Knowledge and/or skills

♦ Movement analysis:
  — Movement terminology
  — Axis of rotation
  — Force
  — Impulse
  — Momentum
  — Centre of gravity
  — Spin (Magnus effect)
  — Planes of the body
  — Lever systems

♦ Types of motion:
  — Linear
  — Curvilinear
  — Projectile
  — Angular

♦ Observational skills:
  — Preparation
  — Action
  — Recovery
  — 2D observational analysis
  — Identification of strengths and weaknesses within a sporting performance

♦ Research skills:
  — Rational for filming from specific angle
  — Comparison to model performance
  — Application of mechanical principles
  — Movement patterns required for skill
  — Analytical and evaluative skills
Higher National Unit Specification: Statement of standards (cont)

Unit title: Human Anatomy, Physiology and Biomechanics in Sport (SCQF level 7)

♦ Presentation skills:
  — Selection of relevant and accurate information
  — Effective organisation of information and ideas
  — Oral communication skills
  — Effective use of non-verbal communication
  — Use of technical equipment
  — Techniques for adapting and responding to the needs of an audience

Outcome 3

Understand the structure and function of the cardiorespiratory system in relation to physical activity.

Knowledge and/or skills

♦ Respiratory system:
  — Mechanics of breathing
  — Air volumes (tidal volume, residual volume, vital capacity, total lung capacity, inspiratory and expiratory reserve volume)
  — Internal and external gaseous exchange and VO₂ max
  — Short/long term effects of exercise on the respiratory system

♦ Cardiovascular system:
  — Composition and function of blood
  — Blood pressure
  — Heart rate variability
  — Cardiac output, stroke volume and heart rate
  — Re-distribution of blood flow — circulation
  — Short and long term effects of exercise on cardiovascular system

Outcome 4

Collect, interpret and present physical activity data in relation to the human energy systems.

Knowledge and/or skills

♦ Human energy systems:
  — Three energy systems (Phosphocreatine, Anaerobic Glycolysis, and Aerobic Metabolism)
  — Recovery of adenosine triphosphate (ATP) during repeated physical activity and the subsequent effects on performance
  — Fuelling and re-fuelling strategies
Higher National Unit Specification: Statement of standards (cont)

Unit title: Human Anatomy, Physiology and Biomechanics in Sport (SCQF level 7)

♦ Data collection and interpretation:
  — Selecting and conducting an appropriate physical activity test which will cause a dominance of ATP resynthesis from the three energy systems
  — Collection of physical activity data which is reliable, valid and objective
  — Interpretation of a physical activity data set
  — Production and interpretation of graphical data

♦ Reporting and presentation:
  — Interpret and present physical activity data with reference to current literature

Evidence requirements for this unit

Evidence is required to demonstrate that all outcomes and knowledge and/or skills have been achieved.

Outcomes 1 and 3 will be assessed separately through answers to objective questions. Assessment will be carried out under supervised closed-book conditions.

The assessment for Outcome 1 will comprise objective questions which will contain a minimum of ten questions for each of the three knowledge and/or skills items:

♦ Skeletal system
♦ Muscular system
♦ Biomechanical principles

Learners must achieve a minimum of 70% in each knowledge and/or skills items to pass this assessment. If a learner does not achieve the minimum 70% pass in each of the three knowledge and/or skills items, re-assessment is only required for the knowledge and/or skills items not achieved.

The assessment for Outcome 3 will comprise objective questions which will contain a minimum of ten questions for each of the two knowledge and/or skills items:

♦ Respiratory system
♦ Cardiovascular system

Learners must achieve a minimum of 70% in each knowledge and/or skills items to pass this assessment. If a learner does not achieve the minimum 70% pass in each of the two knowledge and/or skills items, re-assessment is only required for the knowledge and/or skills items not achieved.
Higher National Unit Specification: Statement of standards (cont)

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Outcome 2

Learners will select a skill from their chosen sport to analyse and:

- Record and present findings from a biomechanical video analysis
- Conduct 2D observational analysis of the recorded skill. This analysis must include a minimum of four biomechanical principles which will include impulse, momentum and any two additional principles from:
  - Axis of rotation
  - Force
  - Centre of gravity
  - Spin
  - Movement terminology
  - Planes of the body

Learners will:

- identify and justify strengths and weaknesses of the performance whilst relating to impulse, momentum and two additional biomechanical principles (listed above).
- provide an explanation as to how the weaknesses affected the overall movement/outcome of the skill.
- provide a recommendation of how to improve the performance.
- acknowledge at least one secondary source (ie research article or text book).

Outcome 4

Learners will produce evidence to show they have:

- selected and conducted an appropriate physical activity test which will cause a change in dominance of ATP resynthesis from the three energy systems listed in the Human Energy Systems knowledge and/or skills item.
- produced a graph displaying the data collected.
- analysed the collected data in relation to the impact upon performance following the repetition of the chosen physical activity.
- provided an overview of the energy systems and the role that they play in the performance of the chosen physical activity.
- acknowledged at least one secondary source, ie a research article or text book.
Higher National Unit Support Notes

Unit title: Human Anatomy, Physiology and Biomechanics in Sport (SCQF level 7)

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

In this unit, learners will learn basic components of anatomy, physiology and biomechanics, and understand their application to sports performance.

The unit, where possible, should be delivered practically to allow for contextualisation in a sporting environment.

To develop as a coach, knowledge of anatomy, physiology and biomechanics alongside an understanding of how to apply this to the training process is vital.

This unit bridges the gaps between sports coaching and sports science by introducing techniques and skills required to analyse a performer using evidence base practice.

Learners are suitably prepared to obtain industry qualifications from a range of providers to begin employment.

Learners will benefit from prior completion of units before studying this unit, such as SCQF level 6 Sport and Fitness courses, Higher PE, Higher Biology and Higher Human Biology. After the completion of the four learning outcomes learners will achieve two mandatory credits. Assuming learners achieve the desired credits in other units, they may progress onto an HND in Sports Coaching and Development or directly enter second year study within Sport and Exercise Sciences (or similar degree course titles) at university (subject to university requirements).

Guidance on approaches to delivery of this unit

It would be advantageous to complete the outcomes in numerical order. Outcome 1 will need to be delivered first.

Possible delivery methods include classroom activities, field trips, visits and group work, the aim being to encourage the use of learning and teaching approaches that are varied and appropriate to the aims of the unit.
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Outcome 1: Aspects of this outcome could be taught in a gym environment to demonstrate exercises that involve the different types of contraction (ie eccentric, concentric, isometric and isotonic).

Outcome 2: Data collected could be measured quantitatively with the use of jump mats, force platforms and freely available software systems such as Kinovea.

Outcome 3: VO$_2$ max/peak tests can be measured with the use of Cortex gas analyser software and equipment. Additionally, these tests can be measured predictively with the use of a Watt Bike and beep test VO$_2$ max table. Heart rate monitors could be used to measure maximal heart rate, predicted cardiac output and heart rate variability. Furthermore, blood pressure monitors can be used to measure blood pressure, differences between systolic and diastolic pressure, and resting pulse rate.

Outcome 4: It is recommended that learners identify changes in athletic performance and changes in dominance of energy system by performing repeat sprint ability tests. Given the volume of research present for this type of exercise, which will complement the understanding of high intensity training for future potential learning (ie university). Repeat sprint ability protocol testing could be mimicked or adapted from the appropriate research methodology. Equipment used to measure this could be Watt Bikes, Monark Ergometers (along with Monark software) and speed gates. Additionally, learners could measure distance covered when performing 6–30 second long sprints.

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.

Outcomes 1 and 3 will be assessed separately through answers to objective questions. Assessment will be carried out under supervised closed-book conditions.

The assessment for Outcome 1 will comprise objective questions which will contain a minimum of ten questions for each of the three knowledge and/or skills items:

- Skeletal system
- Muscular system
- Biomechanical principles

Learners must achieve a minimum of 70% in each knowledge and/or skills items to pass this assessment. If a learner does not achieve the minimum 70% pass in each of the three knowledge and/or skills items, re-assessment is only required for the knowledge and/or skills items not achieved.
Higher National Unit Support Notes (cont)

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The assessment for Outcome 3 will comprise objective questions which will contain a minimum of ten questions for each of the two knowledge and/or skills items:

- Respiratory system
- Cardiovascular system

Learners must achieve a minimum of 70% in each knowledge and/or skills items to pass this assessment. If a learner does not achieve the minimum 70% pass in each of the two knowledge and/or skills items, re-assessment is only required for the knowledge and/or skills items not achieved.

Outcome 2 evidence could be generated by a written or oral presentation with the use of technology and nonverbal aids, covering all of the evidence requirements.

Outcome 4 evidence could take the form of a single sheet lab report which presents the graphical data collected alongside an explanation of what is happening to athletic performance due to the dominant shifts between the three energy systems.

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.

Opportunities for developing Core and other essential skills

Learners may acquire skills in Information and Communication Technology (ICT), Communication (Oral, Written and Reading) and Problem Solving. Learners using book based material will develop skills in these aspects while learners making full use of electronic resources will acquire skills in ICT. Learners may develop skills in Communication and Problem Solving depending on how the candidate develops their knowledge. Learners are required to observe and analyse and this may well provide opportunities to develop skills in Problem Solving and in some cases, Numeracy. This may depend on the type of data and the use made of it. Learners may also have additional opportunities to develop skills in problem solving where they are required to consider different views on some aspect of the science behind current views.

The Critical Thinking component of Problem Solving at SCQF level 6 is embedded in this unit. When a learner achieves the unit, their Core Skills profile will also be updated to include this component.
History of changes to unit

<table>
<thead>
<tr>
<th>Version</th>
<th>Description of change</th>
<th>Date</th>
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<tbody>
<tr>
<td>02</td>
<td>Core Skills Component Critical Thinking at SCQF level 6 embedded.</td>
<td>16/08/19</td>
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General information for learners

Unit title: Human Anatomy, Physiology and Biomechanics in Sport (SCQF level 7)

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.

The aim of this unit is to provide you with the knowledge and understanding of the body systems and basic biomechanical principles that underpin human movement. Upon successful completion of this unit, you will be equipped to present and analyse biomechanical data within the context of enhancing sports performance.

While working through this unit you will learn about the structure and function of the musculoskeletal and cardiorespiratory systems, which underpin human movement. You will learn how to use biomechanical principles to analyse a sporting skill and how to collect and interpret physical activity data in relation to the human energy systems. You will go on to develop your observation and analytical skills, to enable you to give appropriate feedback to enhance sporting performance. The unit will conclude with you being able to collect, interpret and present physical activity data in relation to the energy systems.

Assessments will be in the format of a question paper, under supervised closed-book conditions, possibly using e-learning online multiple-choice tests, a presentation on the knowledge and understanding of basic biomechanical principles relating to the chosen sports performance and a lab report.

The Critical Thinking component of Problem Solving at SCQF level 6 is embedded in this unit. When a learner achieves the unit, their Core Skills profile will also be updated to include this component.