Unit 44: Applied Sport and Exercise Physiology

Unit code: L/600/0046

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

The aim of this unit is for learners to explore a range of factors including temperature, altitude, age, gender, race and ergogenic aids and their effects on sports performance.

Unit introduction

Few athletes have the luxury of training or competing in ideal exercising conditions – most have to cope with both the demands of their sport and the environment.

Climate can vary dramatically between different locations and seasons. As a result, many athletes may themselves perform in excessively hot conditions or, in some cases, excessively cold conditions. A knowledge of how to cope with and adapt to different climates is essential if a person is going to perform well or train safely.

As competitions take place all over the world, some athletes may find that they have to compete at different altitudes, as was the case in the 1968 Olympics held in Mexico City, where athletes competed at higher altitude than many of them had previously experienced. As with extremes of climate, altitude also places extra stress on the body and can dramatically affect performance.

A person's gender, race and age will impact significantly on their ability in terms of sport and exercise. Training programmes and expectations should take these factors into account. Any person wishing to work as a coach or instructor in sport and exercise will more than likely find themselves dealing with males and females of differing ages and differing races. Therefore, it is vital that they have a good knowledge of the difference in their training needs, abilities and requirements.

Many athletes will try to enhance their performance by using ergogenic aids. Some of these aids are acceptable methods of maximising performances. However, others are banned, and any person found to be using them can be disqualified from competing.

This unit explores all of these issues, starting with the environmental factors of climate and altitude, then moving onto the individual factors of age, race and gender. Ergogenic aids are then covered, including both legal and illegal substances. The effects and implications of taking these aids are explored together with the sports to which they are linked.

Learning outcomes

On completion of this unit a learner should:

1 Know how temperature and altitude affect exercise and sports performance

2 Know about the physical differences between people of different gender and race and their affect on exercise and sports performance

3 Know the impact that the physiological effects of ageing have on exercise and sports performance

4 Know the effects and implications of using ergogenic aids for exercise and sports performance.

Unit content

1 Know how temperature and altitude affect exercise and sports performance

Temperature: responses of body to high temperature, eg sweating, function of the hypothalamus, methods of heat loss; effects of high temperature, eg hyperthermia, dehydration; effects of high temperature on sports performance; responses of body to low temperature, eg shivering, vascular adjustments; effects of low temperature, eg hypothermia; effects of low temperature on sports performance

Altitude: responses of body to high altitude, eg hyperventilation, tachycardia; effects of high altitude, eg reduction in partial pressure of oxygen, reduced maximum oxygen consumption (VO_2 max); adaptation to altitude; effects of high altitude on sports performance

2 Know about the physical differences between people of different gender and race and their affect on exercise and sports performance

Gender: physical differences, eg body size, body composition, muscle mass, testosterone levels, haemoglobin levels, VO_2 max, thermoregulation, heart size, flexibility, training differences; effects, eg recovery periods, anaerobic capacity, aerobic capacity

Race: eg West African origin, East African origin, Caucasian, Asian; physical differences, eg muscle fibre types, body composition, lung capacity, haemoglobin levels, body type; effects, eg heat tolerance, cold tolerance, sprinting ability, high-altitude tolerance

3 Know the impact that the physiological effects of ageing have on exercise and sports performance

Physiological effects of ageing: eg maximum heart rate, lung volumes, flexibility, thermoregulation

Impact: eg training, recovery periods, aerobic and anaerobic capacity, overheating

4 Know the effects and implications of using ergogenic aids for exercise and sports performance

Ergogenic aids: eg anabolic steroids, growth hormone, creatine, insulin, caffeine, blood doping, erythropoietin (EPO), altitude training, glycogen loading, beta blockers, marijuana, amphetamines, cocaine

Effects: positive, eg decreased heart rate, decreased recovery time, increased mobilisation of fatty acids; negative, eg heart palpitations, reduced fertility, cancer, skin disorders, increased blood pressure, breathing difficulties, muscle cramps, kidney failure

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 responses of the body to temperature, and their effects on exercise and sports performance		
P2 describe the responses of the body to high altitude, and their effects on exercise and sports performance		
P3 describe the physiological differences between athletes of different gender, and their effects on exercise and sports performance [CT1, CT4]	**M1** explain the effects of the physiological differences between athletes of different gender on exercise and sports performance	**D1** analyse the effects of the physiological differences between athletes of different gender and race on exercise and sports performance
P4 describe the physiological differences between athletes of different races, and their effects on exercise and sports performance	**M2** explain the effects of the physiological differences between athletes of different races on exercise and sports performance	
P5 describe the impact of the physiological effects of ageing on exercise and sports performance [IE6]	**M3** explain the impact of the physiological effects of ageing on exercise and sports performance	**D2** analyse the impact of the physiological effects of ageing on exercise and sports performance
P6 describe the effects and implications of six different ergogenic aids used for exercise and sports performance.	**M4** explain the effects and implications of six different ergogenic aids used for exercise and sports performance.	**D3** analyse the effects and implications of six different ergogenic aids used for exercise and sports performance.

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 strategies can be used to teach this unit. Theory can be taught and then applied to practical situations. Learners can also carry out independent research on athletes of their choice in order to meet some of the content.

The knowledge and understanding relating to thermal stress can be taught and applied to practical situations. For example, learners could take part in a multi-stage fitness test in their usual exercise clothing. A week or so later the test could be completed with learners wearing more clothing and in a warmer environment so that it mimics the effects of thermal stress. The results of the test could then be compared and the effects of the thermal stress discussed. As with all exercise and fitness tests, learners should complete informed consent prior to participating in these activities.

For altitude, the field and track athletic performances during the 1968 Olympic Games held in Mexico City could be examined and compared to the previous and next Olympics. From this, the theory behind the difference in these results can be taught.

If the group taught are of mixed gender then the theory behind the physiological differences between gender can be taught in conjunction with undertaking some fitness tests. Depending on the group demographics, the comparison between male and female test results should then illustrate the differences between gender. Comparison to world record performances would also help to illustrate the theory.

In order to explore the effects of race on performance, an examination of sprinting records, distance running records, weight lifting records and swimming records will help to show how race may have an impact on sporting ability.

Learners should be taught how age has an impact on exercise and sports performance, including how children respond to exercise, through to adolescents, adults and older adults aged 50+.

The theory behind age and its affect on performance and training can be taught together with case studies to illustrate these effects.

To cover the theory of ergogenic aids, learners could investigate athletes and sports performers who have been banned from competing because of their illegal use of ergogenic aids.

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
Tutor introduces the unit.
The effects of high temperature on the body – practical and theory.
Methods of heat loss – practical and theory.
The effects of low temperature on the body – practical and theory.
Effects of high temperature on sports performance – learner practical activities.
Assignment 1: The Effect of Temperature and Altitude on Sports Performance (P1, P2). Tutor introduces the assignment brief.
Effects of low temperature on sports performance – theory and research.
Altitude – effect of high altitude on the body – theory and research.
Altitude – effects of high altitude on sports performance -– theory and research.
Physical differences between gender – theory and practical.
Physical and physiological differences between race – learner centred learning – research and feedback to the rest of the group.
Assignment 2: The Effects of Gender, Race and Ageing on Sports Performance (P3, M1, D1, P4, M2, P5, M3, D2). Tutor introduces the assignment brief.
Physiological effects of ageing – theory and research.
Impact of ageing on sports and sports performances – theory and research.
Different types of ergogenic aids – learner centred learning – presentations on selected ergogenic aids.
Assignment 3: The Effects and Implications of Ergogenic Aids (P6, M4, D3). Tutor introduces the assignment brief.
Advantages of ergogenic aids – theory and research.
Disadvantages of ergogenic aids – theory and research.
Unit review and evaluation.

Assessment

For P1, learners must describe how the body responds to high temperatures and low temperatures and how these changes in climate affect both aerobic and anaerobic sports performance. This can be assessed through learners taking part in thermal stress practical activities, and then writing a report that describes the results.

For P2, learners must describe how the body responds to high altitude and how competing at altitude affects both aerobic and anaerobic sports performance. This can be covered through learners researching an athlete of their choice who either is competing at altitude or trains at altitude.

For P3, learners must describe the physiological differences between males and females and how these differences affect both aerobic and anaerobic sports performance.

For P4, learners must describe the physiological differences between athletes from different races. They should describe how physiological differences can affect both aerobic and anaerobic sports performance.

For P5, learners must describe the physiological effects of ageing on exercise and sports performance. Learners should explore a range of ages including pre-adolescence, adolescence, adults and older age, eg 50+.

For P6, learners must describe six different ergogenic aids, and describe their effects and implications when used for exercise and sports performance.

For M1, learners must explain why, and how, the physiological differences between males and females can affect both aerobic and anaerobic sports performance.

For M2, learners must explain why, and how, the physiological differences between athletes from different races can affect both aerobic and anaerobic sports performance.

For M3, learners must describe why and how the physiological effects of ageing can affect exercise and sports performance.

For M4, learners must explain the effects and implications of six different ergogenic aids when used for exercise and sports performance.

For D1, which builds on M1, learners must analyse the effects of the physiological differences between athletes of different gender and race on exercise and sports performance. Criteria P3, P4, M1, M2 and D1 can be assessed via an analysis of group test results and/or world record performances of athletes of different gender and also athletes of the same gender but from different races. Learners can then write a report or prepare a poster to show these results.

For D2, which builds on M3, learners must analyse the impact of the physiological effects of ageing on exercise and sports performance. Criteria P5, M3 and D2 can be assessed through the analysis of case studies of older athletes and younger athletes.

For D3, which builds on M4, learners need to analyse the effects and implications of the six different ergogenic aids that have been described (P6) and explained (M4). Criteria P6, M4 and D3 can be assessed through a presentation of the chosen athletes and ergogenic aids research that learners have carried out.

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 Effect of Temperature and Altitude on Sports Performance	You are assisting a team of scientists in a sports science laboratory. Prepare a leaflet for an athlete competing at altitude and in extremes of temperature.	Leaflet covering the effects of temperature and altitude.
P3, P4, P5, M1, M2, M3, D1, D2	The Effects of Gender, Race and Ageing on Sports Performance	Explore the effects of gender, race and ageing on performance.	Written report.
P6, M4, D3	The Effects and Implications of Ergogenic Aids	You've been asked to give a presentation to a local football team on ergogenic aids.	Presentation. Witness statement.

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 and 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
Fitness Testing and Training	Principles of Anatomy and Physiology in Sport	Anatomy for Sport and Exercise
Development of Personal Fitness	Fitness Training and Programming	Sport and Exercise Physiology
	Sports Coaching	Exercise, Health and Lifestyle
	Exercise, Health and Lifestyle	Fitness Training and Programming
	Instructing Physical Activity and Exercise	Instructing Physical Activity and Exercise
	Research Investigation in Sport and Exercise Sciences	Sports Coaching
	Laboratory and Experimental Methods in Sport and Exercise Sciences	Research Project in Sport and Exercise Sciences
	The Physiology of Fitness	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:

- Achieving Excellence in Sports Performance at Level 3
- Coaching, Teaching and Instructing at Level 3
- Instructing Physical Activity and Exercise at Level 3.

Essential resources

Learners will need access to a range of information sources including journals, texts and the internet.

Employer engagement and vocational contexts

Learners will benefit from discussion with elite sportspeople and sports professionals covering factors such as temperature and altitude, and the steps they take to prevent such factors from detrimentally affecting sports performance.

Indicative reading for learners

Textbooks

Adams G M – *Exercise Physiology Laboratory Manual: Health and Human Performance* (McGraw Hill Higher Education, 2001) ISBN 97800724891 25

Allen M B – *Sports, Exercise and Fitness: A Guide to Reference and Information Sources* (Libraries Unlimited Inc, 2005) ISBN 9781563088193

American College of Sports Medicine – *ACSM's Guidelines for Exercise Testing and Prescription, 7th edition* (Lippincott Williams and Wilkins, 2005) ISBN 9780781745901

American College of Sports Medicine – *ACSM's Health-Related Physical Fitness Assessment Manual* (Lippincott Williams and Wilkins, 2007) ISBN 9780781775496

Coulson M – *The Fitness Instructor's Handbook: A Complete Guide to Health and Fitness – Fitness Professionals* (A&C Black, 2007) ISBN 9780713682250

National Coaching Foundation – *Physiology and Performance – NCF Coaching Handbook No 3* (Coachwise Ltd, 1987) ISBN 9780947850241

Powers S K and Howley E T – *Exercise Physiology: Theory and Application to Fitness and Performance* (McGraw Hill Higher Education, 2006) ISBN 9780071107266

Sharkey B J – *Physiology of Fitness, 3rd edition* (Human Kinetics, 1990) ISBN 9780873222679

Sharkey B J and Gaskill S E – *Fitness and Health* (Human Kinetics, 2006) ISBN 97807360561 44

Skinner J – *Exercise Testing and Exercise Prescriptions for Special Cases: Theoretical and Clinical Applications* (Lippincott Williams and Wilkins, 2005) ISBN 9780781741132

Watson A W S – *Physical Fitness and Athletic Performance: A Guide for Students, Athletes and Coaches* (Longman, 1996) ISBN 9780582091108

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
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 impact of the physiological effects of ageing on exercise and sports performance
Creative thinkers	describing the physiological differences between athletes of different gender, and their effects on exercise and sports performance.

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...
Independent enquirers	describing the physiological differences between athletes of different races, and their effects on exercise and sports performance describing the impact of the physiological effects of ageing on exercise and sports performance describing the effects and implications of six different ergogenic aids used for exercise and sports performance
Creative thinkers	describing the physiological differences between athletes of different gender, and their effects on exercise and sports performance.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	researching the effects of high altitude and temperature on sporting performance and exercise researching physiological differences of athletes
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	researching the effects of high altitude and temperature on sporting performance and exercise researching physiological differences of athletes
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching the effects of high altitude and temperature on sporting performance and exercise researching physiological differences of athletes
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	researching the effects of high altitude and temperature on sporting performance and exercise researching physiological differences of athletes
ICT – Develop, present and communicate information	
Present information in ways that are fit for purpose and audience	presenting the effects of high altitude and temperature on sporting performance and exercise presenting physiological differences of athletes.