



Unit 8: Anatomy and Physiology for Exercise and Physical Activity

Delivery guidance

Approaching the unit

This unit gives learners the opportunity to develop an understanding of the main body systems and their responses to sport and exercise. They will also develop a basic understanding of the biomechanics involved in human movement. The knowledge gained in this unit will allow learners to support people in exercise environments.

The unit includes a number of topics that will be new to some learners. With this in mind, it is important that theoretical content is delivered using a variety of methods, including presentations, debates, discussions and posters, as well as in practical activities to demonstrate anatomy and physiology in action.

As this unit is assessed via internal assessment, class notes will be a huge benefit, supporting your learners in achieving success. Reinforcing learning will be extremely important and this should be embedded at all points throughout the delivery of the unit content. Literacy and numeracy skills must be developed, with links made wherever possible to the unit topics and content.

Delivering the learning aims

Learning aim A focuses on the effects of exercise and sports performance on the musculoskeletal system. This content is essential for all gym instructors and personal trainers as this knowledge could be used on a daily basis.

Content on joints and the range of movement at joints can be delivered particularly well in a practical setting, reinforced with formal teaching. Tutor-led delivery can be used to further support theoretical understanding. Case studies can also work well, prompting a discussion on how joints are used to create specific movements in different sports.

Learners should be engaged in practical activities during the delivery of content on major muscles, muscular contraction, antagonistic muscle pairs and fibre types. Tutor-led delivery will be important to support theoretical understanding in this area. Guest lecturers from the sports industry, such as personal trainers and sports coaches, can be invited to explore real-life examples of using anatomy and physiology on a daily basis. These speakers can also give first-hand knowledge of the importance of understanding anatomy and physiology, and answer questions from learners.

For **learning aim B**, learners would benefit from experiencing the changes made by the cardiorespiratory system during exercise. If you have the benefit of respiratory equipment such as a spirometer, it would be helpful to give learners hands-on practical experience of the functions of the respiratory system and allow them to design an experiment on the mechanics of breathing and the process of gaseous exchange. This could also be replicated with heart rate, blood pressure and sweating. Many of these tests can be done within a fitness environment.

The effects of exercise and sport on the cardiorespiratory system could be explored via a learner-centred approach. Group, pair and individual tasks could be set, with information gathered to encourage peer learning/teaching and the consolidation of knowledge. An example of a group task is using 'jigsaw learning', where learners are given a workbook on one key adaptation and must work as a group to piece together all the adaptations to the respiratory system.



Learner-led learning can also work well to engage learners, including peer teaching using methods such as 'speed teaching' (an adaptation of speed dating) for topics including adaptations and additional factors affecting the cardiovascular system. To help learners develop their knowledge of the cardiorespiratory system, a useful strategy might be to organise a trip to a university, science laboratory or museum. A subsequent group presentation with worksheets and tasks to follow is also another successful means of engaging learners.

For **learning aim C**, introduce the body's energy systems, then engage learners in a combination of teaching methods focused largely on learner-centred learning, using practical application wherever possible. Learners should be able to understand how the energy systems relate to different types of training within the fitness suite. Methods including snowball learning can develop peer understanding and learner engagement – this works well with anaerobic energy systems in particular. Practical teaching works particularly well with ATP and the energy systems.

A useful strategy might be to ask a guest coach to run a session exemplifying each energy system in action, coupled with worksheets for learners to complete and a follow-up lesson. Another strategy to consider could be organising a visit to a local university laboratory to investigate the effects of ATP and sports performance further. It is recommended that learners carry out both the Wingate test and VO₂ max test.

Tutor-led delivery may be used to further support theoretical understanding, with worksheets that confirm learning before the adaptations of the system are explored.

For **learning aim D**, learners will focus on the response of the nervous and endocrine systems to exercise. These topics will be new to many learners so teaching methods may include a combination of formal lectures, pair and group research and presentations, as well as independent study and peer teaching to allow learners to gain a full understanding of the topics. Practical application is encouraged wherever possible and learning can be reinforced by watching video recordings, taking part in class discussions and completing worksheets and practice assessments.

The nervous system will be specifically applied to adolescents and older adults, which should enable learners to distinguish between the responses for different types of client. Tutor-led delivery may be used to further support theoretical understanding, with worksheets that confirm learning before the adaptations of the system are explored.

In **learning aim E**, the principles of biomechanics in exercise and physical activity could be introduced through tutor presentations to give learners an understanding of common terms used. Further delivery can be achieved via a combination of methods focusing largely on learner-centred learning. Once learners have established the planes of movement, they can take an active part in identifying the effect of exercise variables on biomechanics and kinesiology. Learners could take pictures of common exercises completed in the fitness suite and then apply the theory to their specific choices of movements. This will also recap on sections of the musculoskeletal system as they will need to identify muscle attachments and levers.



Assessment model

Learning aim	Key content areas	Recommended assessment approach
<p>A Examine the function of the musculoskeletal system and how it responds to exercise and physical activity</p>	<p>A1 Structure of skeletal system A2 Function of skeletal system A3 Structure and function of joints A4 Bone structure and growth A5 Structure of muscular system A6 Function of muscular system A7 Muscle fibre types A8 Musculoskeletal responses to exercise A9 Musculoskeletal system in special populations</p>	<p>A presentation evaluating the structure and function of the musculoskeletal and cardiorespiratory systems, how these produce effective movement, including the effects of acute and long-term exercise on the systems and differences in these systems in special populations.</p>
<p>B Examine the function of the cardiorespiratory system and how it responds to exercise and physical activity</p>	<p>B1 Structure of cardiovascular system B2 Function of cardiovascular system B3 Structure of the respiratory system B4 Function of the respiratory system B5 Lung volumes and control of breathing B6 Cardiorespiratory system responses to exercise</p>	
<p>C Explore the energy and digestive systems and their response to exercise and physical activity</p>	<p>C1 Structure and function of the digestive system C2 Energy systems C3 Energy and digestive systems response to exercise</p>	<p>A presentation evaluating the energy, digestive, nervous and endocrine systems and the effects of exercise on each system.</p>
<p>D Explore the nervous and endocrine systems and their response to exercise and physical activity</p>	<p>D1 Nervous system D2 Endocrine system D3 Nervous and endocrine systems' responses to exercise D4 The nervous system in special populations</p>	
<p>E Explore the principles of biomechanics in exercise and physical activity</p>	<p>E1 Planes of movement E2 Anatomical terms E3 The effect of exercise variables on biomechanics and kinesiology</p>	<p>A written report reviewing the principles of biomechanics and kinesiology and how these principles are applied to participation in exercise.</p>



Assessment guidance

This unit is internally assessed. There is a maximum number of three summative assignments for this unit. Tutors should refer to the assessment guidance in the specification for specific detail, particularly in relation to the requirements for Pass, Merit and Distinction grades.

It is suggested that **learning aims A** and **B** are assessed via a presentation. Within the presentation, learners must label diagrams of the skeletal and muscular system. There should be blank diagrams that they label by hand. Learners should then discuss the function of the skeletal and muscular systems. Learners will then include a section on the three types of joint in the body and further detail on the six types of synovial joint, including the movement available at each joint. They will then consolidate this information by discussing the acute and long-term adaptations of the musculoskeletal system to exercise. This discussion should be enhanced with examples from sport.

Learners should then describe the structure and function of both the cardiovascular and respiratory systems. This should include hand-labelled diagrams and a discussion of the function of each structure. Learners will then consider topics such as; delivery of oxygen and removal of waste products, gaseous exchange, thermoregulation, the function of blood, mechanics of breathing and lung volumes. Learners will then examine how the cardiovascular system and the respiratory system react to acute and long-term exercise. Learners should be encouraged to use examples from their chosen sport to demonstrate their understanding of the benefits of the body systems' adaptations.

To support learners in the creation of their presentation, they should be encouraged to use different slides for different topics and annotations such as pictures and diagrams to support explanations.

Learning aims C and **D** require learners to create a presentation that discusses the three main energy systems. Learners will need to link each energy system to a sport or position and discuss recovery times. They should then explore the energy systems' responses to acute and long-term exercise. Learners should be encouraged to use a range of sports to strengthen their review of each energy system. Comparisons between different sports and/or positions in team sports would also be beneficial.

In the second part of the presentation learners could begin by annotating a diagram of a neuron and nerve cell. This would lead into a discussion about the role and functions of the nervous system. The endocrine system may be best introduced through a discussion surrounding hormones and glands. Once the structure and function of these two systems have been established, learners can then begin to give examples of how they would respond to exercise in a fitness environment. The nervous system should be specifically related to the age of the client and how this body system can impact on different types of client.

Learning aim E is assessed through a written report that reviews the principles of biomechanics and kinesiology and how these principles are applied to participation in exercise. Learners will need to discuss the three planes of movement. It would be beneficial for them to include diagrams to illustrate their points. They could then produce a glossary of anatomical terms to explain the key terms related to biomechanics and kinesiology. Learners should then use a wide range of examples to discuss the effect of exercise variables on a client's biomechanics. This should culminate with a discussion referring to how biomechanics can be used to reduce the risk of injuries in the gym.



Getting started

This gives you a starting place for one way of delivering the unit, based around the recommended assessment approach in the specification.

Introduction

Introduce the unit to learners by using a series of activities relating to anatomy and physiology, identifying any prior knowledge and understanding. Outline that the unit explores the effects of exercise and sports performance on the body systems, as well as the biomechanics of movement. Explain that learners will be equipped with the skills to apply anatomical knowledge to other units and vocational employment opportunities in the fitness industry. This unit will also give learners a good understanding of physiological effects on the systems.

Learning aim A: Examine the function of the musculoskeletal system and how it responds to exercise and physical activity

- Learners take part in an activity to locate different skeletal bones on a peer. Use formal delivery of the location of major bones, types of bone, the axial and appendicular skeleton, curvature of the spine and the process of bone growth. Incorporate various tasks to maintain learner-led learning. Delivery should be visual, using video clips and photographs where possible. Use learners to peer teach where possible to aid ownership of learning.
- With A2, for each function of the skeletal system and type of bone, learners should research and provide detail. They can then work together to share knowledge and develop understanding, feeding back to the rest of the group.
- For joints, a group discussion is a good starting point to provide an overview of the classification of joints, and their structure and function. Use visual prompts, including video clips and photographs wherever possible. Ask learners to label joints and then create information booklets and other sources to use as notes for the assessment.
- Introduce the muscular system by discussing different muscular injuries or occurrences related to the muscular system. Lead a discussion on the muscular system and functions of the different types of muscle within the human body. Learners can use this knowledge to design an information leaflet to use as reference notes.
- If possible, learners should have access to 'real' or imitation bones. They can then create a living poster that identifies the different structures in the bone. The stages of bone growth can be created on a poster, like a cartoon, showing how bone either grows or remodels.
- Small-group activities are a useful way of delivering A5 and A6. 'Pin the muscle on the body' is a good starter activity (you may wish to use an alternative to pins). Follow this by allocating each group a different sporting action. The task is to identify the muscle(s) of the agonist, antagonist, synergist and fixator. Get the groups to feed back to the class.
- Practical workshops can allow learners to understand the relationship between the theory and exercise. This can be done in a classroom or sports hall. Learners take part in a range of movements/activities that include aspects of A1–A7; this is particularly fitting for A7.
- Introduce the topic of responses of the musculoskeletal system to a single sport or exercise session. Groups of learners can then produce a presentation with supplemented demonstrations to show the responses.
- Adaptations of the musculoskeletal to exercise can be introduced and taught using a 'knowledge cafe' or 'carousel'. Learners should be given an information pack to represent one



key adaptation. They are then given time to read, annotate and gain a sound understanding in the field. On completion, learners become tutors to create a knowledge cafe where learners teach among themselves.

- Pairs could work together to create a poster on musculoskeletal adaptations to exercise.
- Case studies would be useful to introduce considerations an instructor would need to think about when working with special populations.
- Guest speakers (e.g. a personal trainer) could discuss all aspects of their role, incorporating the importance of understanding anatomy.

Learning aim B: Examine the function of the cardiorespiratory system and how it responds to exercise and physical activity

- Introduce learning aim B with a walkthrough of the pathway of blood through the heart. Learners should follow the route of oxygenated blood through the heart, which is made out of cones laid out on the floor. Learners can perform functions in the heart, such as valves, and represent structures so that when they return to class, they can recall between them the whole pathway.
- You can then facilitate an activity labelling the structures of the heart. Follow this with a class discussion and tutor-directed questions. Learners can then work independently to develop their subject knowledge in an area within this topic. Give them ideas, facilitate their learning and support as necessary.
- You could use formal delivery for the functions of the cardiovascular system, supported by tutor-directed Q&A. You can also use 'marketplace learning': individually or in groups, learners research to become knowledgeable in a function. In the structure of a marketplace, learners then walk among the different 'stalls' to share learning and content.
- Lead a discussion on thermoregulation. On completion of this, explore its practical application using additional clothing, sweat vests etc. Oversee the activities and demonstrate what the body does to maintain homeostasis.
- Case studies can be used to demonstrate responses of the cardiovascular system to a single sport or exercise session. Direct learners to depict responses and explain/justify why they are occurring, and feed back to the rest of the class.
- The peer teaching method 'speed teaching' can be used to cover the adaptations of the cardiovascular system to exercise. Small groups/pairs are given a content area to research to increase their knowledge in the field. Groups rotate round to teach each other the content in the format of speed dating. Ask individuals to collate a workbook of content and score each other's teaching.
- ABC learning can be a useful way of introducing the additional factors affecting the cardiovascular system. Each key additional factor is labelled A, B or C. Learners are given a letter and must research independently to form an information booklet. On completion, they should merge their work with others working on the same aspect, and then teach the rest of the class.
- Consolidate learner understanding by producing online quizzes or using dominoes for the learners.
- Introduce the structures of the respiratory system. Learners label the structures of the respiratory system using a diagram with labels and a choice of structures to aid their understanding.



- Have a group discussion on the functions of the respiratory system, making sure it covers what learners consider to be the key functions. There is an opportunity for independent study where learners research the mechanics of breathing.
- For a practical application, ask learners to measure vital capacity using the balloon method (method available online). If available, use a peak flow and spirometer to measure lung volumes and capacity.
- You can use learner-led research to cover the control of breathing. Give learners articles (from credible sources) with the task of answering questions on neural and chemical control of breathing. On completion, use the 'snowball method', with learners feeding back in pairs, then in small groups and then as a class to discuss.
- Allow learners to participate in short experiments to see if there are different reactions from the body in terms of different forms of exercise.
- 'Think, pair, share' activity to list, discuss and explain long-term adaptations of the respiratory system. Learners initially have time to think on their own, then they share ideas with a partner and eventually bring their lists together with another pair to consolidate learning.
- To demonstrate the responses of the respiratory system to exercise, you could allocate one key response to groups and ask them to create a presentation to deliver to the class.
- Consolidate individual learner understanding by getting learners to produce plenary quizzes for each other.

Learning aim C: Explore the energy and digestive systems and their response to exercise and physical activity

- Introduce the digestive system with a knowledge quiz (a quick-fire quiz). Each learner is given an outline of the human body. Quiz master calls out an organ, learner puts its position and name on the blank diagram. Go through the answers and tutor keeps the diagrams for a future lesson.
- Use a video of the digestive system to formally introduce learners to key processes and structures in the digestive system. Use a follow-up discussion to make sure that all learners agree on the definitions for the key words and understand the processes in the digestive system.
- Introduce C2 with a group discussion about energy, ATP and its role in sport and exercise. Introducing the practical effects this early can be very effective. A simple experiment using five balloons can demonstrate how energy is created and recreated (one balloon represents the adenosine molecule, with a further four balloons available to represent the role of phosphate molecules). This can be followed by learners practising extended writing, looking specifically at ATP and energy production.
- You could use learner-led research for the ATP-PC system, using articles (from credible sources) and getting them to answer questions on the ATP-PC system. On completion, use the 'snowball method', with learners feeding back first in pairs, then in small groups and finally as a class to discuss. Video clips can be a useful support to help learners.
- Use formal delivery for the lactate system in exercise and sports performance, followed by pair work to create an information leaflet to be presented to the rest of the group and used as a revision aid.
- Practical sessions will allow learners to apply the theory to sporting activities. A local sports coach could be invited to run a session exemplifying each anaerobic system in action. The aerobic system could be taught via formal delivery with videos to supplement understanding.



- Learners can work in groups to prepare a presentation on the adaptations of the energy systems. This can then be followed with a whole-class debate, encompassing all aspects of ATP and the energy systems during sport and exercise performance.
- You could arrange a laboratory trip to a local university to investigate effects of ATP and energy systems further (to include the Wingate tests and VO₂ max). This will also help to motivate those learners thinking of moving in to higher education.

Learning aim D: Explore the nervous system and endocrine systems and their response to exercise and physical activity

- Introduce learning aim D with a presentation that introduces how we rely on our nervous system and investigates reaction times, reflex actions and exercises in the gym. Learners can take part in simple reaction time tests like the ruler drop test. They can then discuss what these simple tests say about the human nervous system.
- Learners should be made familiar with the CNS including major areas of the brain and their function. They can then investigate voluntary and involuntary activities and relate these to movement in the gym.
- If possible, learners could use microscopes to look at nerve cells and nerves. This activity can then be linked to the structure of nerve cells and conduction of impulses.
- Topic D2 could be introduced with a group discussion on hormones and learners' understanding of their role in the human body. This can be followed by independent research to identify the role and function of each hormone.
- To familiarise learners with the endocrine system and glands, learners could be given the outline of a blank human body. Ask learners to tell you where to put each of the glands: pituitary, thyroid, ovaries, pancreas, adrenals, testes. Give definitions of the endocrine system and use visual aids to show the structure of the glands.
- Learners could work in pairs to identify the responses of the nervous and endocrine systems to exercise. They should then be given specific exercises used in the gym and asked to apply the responses of the nervous and endocrine systems to chronic exercise. They should discuss how the adaptations would enhance the performance of their clients.
- Learners can independently research the effect of growth spurts on nervous coordination and how the nervous system affects older adults. This should be linked to considerations an instructor would have to make in a gym environment.

Learning aim E: Explore the principles of biomechanics in exercise and physical activity

- The planes of movement could be initially taught through formal delivery. Learners could then be separated into different groups and given a range of pictures. They must identify the plane of movement in the picture.
- Each learner is given an anatomical term to research. They must find out:
 - a definition
 - application of the term in a fitness suite
 - a picture that demonstrates the term.
- Learners work in small groups and are given specific exercises to focus on. They must evaluate the effect of exercise variables on the biomechanics and kinesiology of the movement. Peer assessment could take place by groups swapping their findings.



Details of links to other BTEC units and qualifications, and to other relevant units/qualifications

This unit links to

- Unit 6 Exercise and Fitness Skills Development
- Unit 7: Personal Training and Programming
- Unit 9: Nutrition for Physical Activity and Exercise.

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC International L3 Qualifications in Sport. Check the Pearson website at: (<http://qualifications.pearson.com/endorsed-resources>) for more information as titles achieve endorsement.

Textbooks

The following textbooks offer comprehensive coverage of the unit, enabling learners to develop their understanding of anatomy and physiology while developing their personal learning skills. The range of resources also enables learners to see where this unit makes links with many other aspects within the field of sport.

Howley ET and Franks BD, *Health Fitness Instructor's Handbook (Fourth Edition)*, Human Kinetics Publishers, 2003 ISBN 9780736042109

Marieb EN and Hoehn K, *Human Anatomy & Physiology (10th Edition)*, Pearson, 2015 ISBN 9781292097060

Palastanga N, Soames RW and Field D, *Anatomy and Human Movement: Structure and Function (Fifth Edition)*, Butterworth-Heinemann, 2006 ISBN 9780750688147

Sharkey BJ and Gaskill SE, *Fitness and Health (Sixth Edition)*, Human Kinetics Publishers, 2006 ISBN 9780736056144

Tortora GJ and Derrickson BH, *Principles of Anatomy and Physiology (12th Edition)*, John Wiley & Sons, 2008 ISBN 9780470233474

Journals

The following journals give comprehensive and up-to-date research into the fields of anatomy and physiology, demonstrating the impact on health and wellbeing as well as how the human body functions and sustains life.

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 Journal of Anatomy

Medicine and Science in Sports and Exercise Research Quarterly for Exercise and Sport



Videos

<https://www.youtube.com/watch?v=Og5xAdC8EUI&t=195s>

Digestive system – this video discusses the whole process of digesting food and can be played in its entirety'

www.youtube.com/watch?v=0cYal_hitz4

Joints – this video discusses the six types of synovial joint.

www.youtube.com/watch?v=l80Xx7pA9hQ

Antagonistic muscle pairs – this video discusses antagonistic muscle pairs and gives examples of each. The video only needs to be played until about four minutes.

<https://www.youtube.com/watch?v=KSbbDnbSEyM>

Circulatory system Rap – a fun video where a rap is used to discuss the functions of the heart.

<https://www.youtube.com/watch?v=CWFyxn0qDEU>

The Heart and Circulatory system – How they work – this video discusses how the heart works to pump blood around the body.

<https://www.youtube.com/watch?v=dWe8vtztW-4&t=98s>

Energy Systems – ATP Energy in the Body - this video discusses the three energy systems in the body, ATP energy, aerobic energy, anaerobic energy, adenosine triphosphate, creatine phosphate and ways to train the energy systems in the body.

<https://www.youtube.com/watch?v=6O-0CVAgEM>

Nervous System - Get to know our nervous system a bit closer, how does it work? – this video gives learners an introduction to the nervous system and how it controls voluntary and involuntary movements.

<https://www.youtube.com/watch?v=r3-UuoQ6fbY>

Australian Coaches - Basic Biomechanics - five important components of biomechanics are featured in this video, including motion, force, momentum, levers and balance.

Websites

The following websites give further information on a range of topics and work well in association with the recommended textbooks and journals. They provide good sources for information, ranging from anatomy and physiology in exercise .

www.acsm.org – American College of Sports Medicine

www.heart.org – American Heart Association

www.bases.org.uk – The British Association of Sport and Exercise Sciences

www.sportscoachuk.org – Sports Coach UK www.sportsci.org – Sport Science

www.topendsports.com – Topend Sports

Pearson is not responsible for the content of any external internet sites. It is essential for tutors to preview each website before using it in class so as to ensure that the URL is still accurate, relevant and appropriate. We suggest that tutors bookmark useful websites and consider enabling learners to access them through the school/college intranet.