Unit 1 Principles and Applications of Biology I

Delivery guidance

This unit covers cellular biology and the anatomy and physiology of body systems in health and disease.

Approaching the unit

Learning aim A covers the microscopic structure and functions of eukaryotic cells and tissues. It requires learners to develop knowledge of the ultrastructure of cells and how cellular components work to perform vital processes. Learners will develop an understanding of how cells obtain energy, synthesise new molecules, communicate, proliferate and survive. Different tissue types will be compared. Learners will need to understand the process of differentiation and how it produces specialised cells and tissues in plants and animals.

Learning aim B focuses on the structure and function of the musculoskeletal system and the impact of disorders and associated corrective treatments on this system. Learners will need to research the musculoskeletal system and be able to identify the major bones, muscles, joints, ligaments and tendons. They must learn how the musculoskeletal system functions normally and understand what can go wrong and the impact this may have on health. Learners will need to develop an understanding of the treatments that may be available to alleviate, if not cure, some of the conditions that have been identified and researched.

Learning aim C concentrates on the structure and function of the lymphatic system, and the impact of disorders and associated corrective treatments on this system. Learners will need to be able to identify the position and function of the spleen, thymus gland, tonsils, lymph glands, lymph vessels and major lymph nodes. They will need to develop an understanding of the symptoms and treatments of the main disorders of the lymphatic system including lymphadenitis, lymphedema and Hodgkin lymphoma. Some learners may have personal experience of disease and dysfunction of one or more of the systems and sensitivity will be required when approaching the unit.

Learners will need access to a wide range of textbooks, journals and scientific magazines and the internet.

Along with opportunities for learners to engage in practical work, it is possible to use a wide range of delivery methods in this unit, for example:

- use models, practical work and simulations to assist with understanding of the complex mechanisms involved in the three systems and to help engage learners
- encourage learners to research and/or create case studies, based on real or fictional characters, to demonstrate the possible impacts of disease or dysfunction
- share TV documentaries and newspaper articles about disorders and dysfunction of the musculoskeletal and lymphatic systems and advances in treatments, as stimulus material for further research
- encourage discussion in small groups to explore the issues of dysfunction and its impact
- arrange visits to a physiotherapy department or visits from a physiotherapist or osteopath

- provide opportunities for learners to discuss conditions and treatments with practitioners diagnosing, treating or supporting people suffering from health conditions
- provide opportunities for learners to discuss conditions and treatments with affected individuals.

Learners can undertake group work, particularly in the teaching and learning stage, but all learners must produce their own individual evidence for the Pearson Set Assignment.

There are opportunities for dissection within this unit. However, for ethical, religious or other reasons, some learners or tutors may feel unable to undertake dissection work. In this case, suitable alternatives to practical dissection should be sought to enable learners to gain a full understanding of the anatomy and physiology of the body systems studied in the unit. This could involve the use of documentaries on dissections/operations, computer-generated simulations and model making.

Delivering the learning aims

Learners should undertake practical work to underpin knowledge and understanding. Centres must ensure they comply with all health and safety guidance and regulations. Encourage learners to risk assess practical work to ensure they are aware of the safety issues and follow the relevant procedures and guidelines.

For **learning aim A**, use simulations, animations and modelling of cells and cell organelles as stimulus material to aid recall of previous knowledge. Use of optical microscopes and electron micrographs will enable learners to extend their understanding of the structure and functions of cells and tissues. In this learning aim, learners must:

- compare similarities and differences between different plant and animal tissues
- analyse the process of differentiation to produce specialised cells and tissues within plants and animals
- be able to produce biological diagrams to aid understanding of structures of cells and organelles
- be able to complete magnification calculations.

For **learning aim B**, use a skeleton, models of joints, dissection of joints and simulations as stimulus material to determine learner knowledge and understanding of the musculoskeletal system. Use secondary source material and tutor input to extend learner knowledge and understanding of the structure and function of the musculoskeletal system, to meet the unit content requirements. A visit to, or from, a physiotherapist, osteopath, sports scientist or similar professional will give a vocational context and engage learners. Encourage the guest speaker to provide detailed information about disease and dysfunction and the corrective treatments available. Such a visit will also give learners the opportunity to develop their questioning skills to gain information; this will assist them in evaluating the impact of the conditions and treatments on human health.

For **learning aim C**, keep in mind that learner knowledge of the lymphatic system is likely to be limited. Consider the use of posters and textbooks to enable learners to identify the positions, and then research the functions, of the lymphatic system components. Use paired or small group presentations to share information and encourage discussion. Encourage learners to create a vocabulary sheet or table for the

system. To develop cognitive and problem-solving skills, give learners questions to research, e.g. Why would someone in a wheelchair be at greater risk of malfunction of the lymphatic system? How might a splenectomy impair a person's ability to fight disease? Learners can present their findings to the rest of the group for discussion and questioning. Individual learners or small groups of learners could investigate and produce a case study on a specific disease/dysfunction of the lymphatic system.

Assessment Model

Learning aim	Key content areas	Recommended assessment approach
A Understand the microscopic structure and the functions of eukaryotic cells and tissues	**A1** Ultrastructure of plant and animal cells **A2** Specialised cells **A3** Differentiation and formation of tissues	This unit is assessed through a Pearson Set Assignment.
B Understand the impact of disorders of the musculoskeletal system and their associated corrective treatments	**B1** Structure of the musculoskeletal system **B2** Function of the musculoskeletal system **B3** Health matters and treatments related to the musculoskeletal system	
C Understand the impact of disorders on the physiology of the lymphatic system and the associated corrective treatments	**C1** Structure of the lymphatic system **C2** Function of the lymphatic system **C3** Health matters and treatments related to the lymphatic system	

Assessment guidance

There are 60 guided learning hours assigned to the unit, of which 15 hours will be required for assessment.

The unit is assessed by a Pearson Set Assignment. The assessment is set by Pearson and must be taken under controlled conditions before it is marked by tutors.

Set assignment units are subject to external standards verification processes common to all BTEC units. By setting an assignment for some units, Pearson can ensure all learners take the same assessment for a specific unit.

Learners are permitted to re-sit set assignment units during their programme.

Set assignments are available from September each year and are valid for one year only.

Delivery must cover all the unit content and prepare learners to produce evidence to meet the assessment criteria and assessment guidance in preparation for taking the Pearson Set Assignment.

Getting started

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

Unit 1: Principles and Applications of Biology I

Introduction

Split learners into pairs or small groups and ask them to map their current understanding of each of the three learning aims. This will give you an overview of current learner knowledge and understanding and help you to plan delivery of the unit.

Ask learners to produce mind maps or hand out a simplified list of the unit content and ask them to assess their current knowledge in terms of 'good understanding', 'heard of it' or 'no understanding'. Encourage discussion between learners, in particular about dysfunctions, their impact on quality of life and the impact/availability of treatments.

It may be better to do this for each learning aim in turn, at the start of teaching for that aim, rather than covering all three aims together at the start of the unit.

Learning aim A – Understand the microscopic structure and the functions of eukaryotic cells and tissues

A1/A2

- Learners will use optical microscopes to observe slides of various cells and tissues from plants and animals. Encourage them to prepare their own slides as well as using commercially prepared slides.
- Learners will use electron micrographs of plant and animal subcellular structures and tissues.
- Teach learners how to calculate the size of cells using 'I AM' calculations (Image size (μ)/actual size (μ) × magnification), from direct viewing using an optical microscope or using images from electron micrographs.
- Ask learners to draw and label subcellular structures of eukaryotic cells, from electron micrographs. Reinforce good drawing technique.
- Learners could make jelly cells to illustrate the subcellular structures of plant and animal eukaryotic cells, using sweets as organelles to distinguish specific structures.
- Learners could access and use computer animations, simulations and videos to aid understanding of the ultrastructure of cells and tissues.
- Give a presentation showing three-dimensional views of cells to enable further understanding of these structures.
- Assign to each learner (or allow learners to choose) one or more subcellular structures to research and present to the class. Ensure the unit content is covered.
- Encourage learners to produce a song/rap/poem about cell components, their structure and functions, and to share it with the class.
- Learners will observe and draw plant and animal tissues using a light microscope and electron micrographs.
- Assign to each learner a plant or animal tissue. Ask them to research their tissue and then share with the class information about its structure, function and position in a cell.

- Give learners opportunities to observe specialised cells (listed in the unit content) in terms of structure and function.
- Individually or in small groups, ask learners to produce posters/leaflets to describe and explain the structure and function of one type of plant or animal tissue. Then ask learners/groups to share their information with the rest of the class.
- Ask learners to produce 'fact cards', with diagrams of specialised cells and tissues on one side and key facts on the other side. These cards could then be used as a quiz with other learners.
- Create a 'circus' of display materials and investigations into plant tissues for learners to move around, drawing the tissues and making notes or completing tutor-devised worksheets about the structure and function of each tissue.

A3

- Learners must research and understand the process of differentiation in plant meristems and animal stem cells. Videos could be used to assist understanding.
- Microscopes and prepared slides can be used to observe and draw stages in differentiation in plants and animals.
- Ask pairs of learners to produce presentation material showing differentiation in plants, then present their work to the class.
- Ask pairs of learners to produce presentation material showing differentiation in a zygote, then present their work to the class.

For assessment, learners must be able to analyse the process of differentiation to produce specialised cells and tissues within plants and animals. They must be able to describe and compare/contrast the structures and function of eukaryotic cells and the different tissues present in plants and animals.

Learning aim B – Understand the impact of disorders of the musculoskeletal system and their associated corrective treatments

B1/B2

- Access to a range of 'hands-on' bones and skeletons will give learners an interesting and exciting practical introduction to this learning aim.
- If possible, give learners access to a human skeleton and ask them to name as many bones as they can from the unit content. You could also source/borrow other animal skeletons for comparison. These models will be particularly helpful to support research into types of joints and the range of movement they support.
- It may be possible to source bones and joints from a local butcher, so learners can see and feel the weight of them and investigate their structure.
- Dissections of chicken wings, legs and thighs will help kinaesthetic and visual learners to understand the structure and range of movement at joints. Dissection will also allow learners to see the relationship between bones, muscles, tendons and ligaments.
- If possible, source models of the spine, cranium and different joints. Encourage learners to handle these models and observe how the bones articulate.
- If learners are not comfortable handling biological specimens, encourage them to make their own models of joints using cardboard and split pins, hardboard cut-outs and elastic bands.
- Encourage learners to watch and/or take photographs or videos of models and dissections.
- Use simulations (available on the internet) to help learners familiarise themselves with the bones and joints listed in the unit content and how they function.

- Demineralisation of bones by placing them in acid is an interesting activity and emphasises the importance of minerals in strengthening bones.
- You could use honeycomb chocolate bars to model the internal structure of bones.
- Give learners the opportunity to observe for themselves the microscopic structure of bones and muscles; they could compare these with electron micrographs from the internet. Encourage learners to draw the structure and relate their observations to textbook diagrams and accounts of structure and function.
- Encourage groups of learners to investigate types of joint (one type per group) and give a presentation to the rest of the class about the structure and function.
- Using images from the internet or a t-shirt showing muscles, ask learners to name muscles and research those they do not know.
- Use meat (e.g. chicken legs from a butcher) and microscopic slides to observe muscle structure, tendons and ligaments.
- Encourage learners to carry out exercises to improve their understanding of the antagonistic nature of muscles at joints. They could do this in collaboration with a visiting physiotherapist or a member of the Sports Department or a local gym. Consider all relevant health and safety requirements and complete a risk assessment before the activity begins.

B3

- Ask learners to work in pairs or small groups and give each pair/group one or more of the disorders listed in the unit content. They should research the condition, the corrective treatments available and the effectiveness of these treatments. Each pair/group should then feed back to the class.
- Use scientific texts, journals and information sheets from support groups for different conditions (ensuring all sources are referenced) to extend learners' knowledge and understanding. Your input will be required to ensure learners are using appropriate (accurate and appropriately detailed) sources and gaining sufficient depth of coverage. This is especially important if learners are encouraged to access virtual surgery websites. Each learner must create a bibliography to identify the sources they have accessed.
- Invite 'specialists' – e.g. physiotherapists, osteopaths, research workers – from a local university to encourage learners to develop their questioning skills and give a vocational context to the learning aim. Some hospitals have patient meetings before hip/knee surgery where the procedure, post-operative care, rehabilitation and long-term prognosis are explained, and the patient is able to handle the prosthetics available. If possible, arrange a visit to such a facility, or from personnel working there.
- Ask learners to produce case studies to compare disorders that impair the normal functioning of the musculoskeletal system and evaluate corrective treatments. These case studies may be based on individuals known to learners, TV characters, or fictional individuals created by the learners.

For assessment, learners must be able to explain the functional role of the musculoskeletal system. They need to be able to describe and compare the effects of disorders in bringing about movement. They must then compare and evaluate possible corrective treatments.

Learning aim C – Understand the impact of disorders on the physiology of the lymphatic system and the associated corrective treatments

C1/C2

- Learners should be familiar with the circulatory system, but their knowledge of the lymphatic system is likely to be rudimentary. You could use a song about the lymphatic

system, downloaded from the internet, as stimulus material. This would particularly suit aural learners.

- Give learners an outline of the human body and ask them to draw and label the main components of the lymphatic system. They should then research the function of each component and present their findings to the rest of the group.
- You could use a 'onesie' (jumpsuit) with string/wool attached to it to represent the lymphatic system. This will appeal to kinaesthetic learners in particular.
- Learners should be aware of tissue fluid and its role in delivering dissolved substances to cells and removing dissolved waste. Ask questions about how this fluid is removed, what would happen if it was not removed, and why blood volume does not decrease as tissue fluid 'leaks' from capillaries.
- Use videos or animations sourced from the internet to improve learners' understanding of the functions of the lymphatic system.
- Learners may have heard the term 'spleen' from TV programmes about rescues and A&E departments. Encourage them to research where the spleen is, its function and how removal (a splenectomy) might affect a patient.

C3

- Help learners to develop their critical thinking and problem-solving skills. For example:
    - show photographs of someone suffering from oedema and ask learners to discuss/speculate what has caused the swelling
    - show photographs of a patient with mumps and ask learners why this has happened.
- Ask pairs or small groups of learners to choose a lymphatic system disorder to research (including lymphadenitis, lymphedema and Hodgkin lymphoma). They should produce an information leaflet, including symptoms and treatments, and present this to the rest of the class. This will also help to develop learners' interpersonal and communication skills.
- Your input will be required to ensure the breadth and depth of the research is appropriate to the level of the programme and that information is accurate and understood by all learners.

For assessment, learners will need to be able to describe the anatomy and function of the lymphatic system. They will need to describe the effects of disorders on the system. They will also need to explain and evaluate the physiological reasoning for corrective treatments of disorders.

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

This unit links to:

- *Unit 5: Principles and Applications of Biology II*
- *Unit 9: Biomedical Science*
- *Unit 11: Functional Physiology of Human Body Systems*
- *Unit 14: Genetics and Genetic Engineering*
- *Unit 15: Diseases and Infections.*

Resources

In addition to the resources listed below, publishers are likely to produce Pearson-endorsed textbooks that support this unit of the BTEC International Level 3 in Applied Science. Check the Pearson website at: http://qualifications.pearson.com/endorsed-resources for more information as titles achieve endorsement.

Textbooks

Hartley, J., Annets, F., Meunier, C., Llewellyn, R., Hocking, S., Peers, A. and Parmar, C., *Pearson BTEC National Applied Science: Student Book 1*, Pearson, 2016, ISBN 978-1-292-13409-3 – A useful general reference and contains sections on the musculoskeletal system and lymphatic system.

Videos

You may wish to search YouTube for the following titles:

- The Musculoskeletal System | Biology – A good overview of the musculoskeletal system.
- Knee Anatomy Animated Tutorial – A useful video about how the knee works.
- Knee Replacement Surgery | What to Expect – An interesting video about knee replacement surgery.
- The lymphatic system | Health | Biology – A good introduction to the lymphatic system.
- The Lymphatic System, Part 1 – One of three videos about the lymphatic system.

Websites

- Arthritis and Musculoskeletal Alliance (ARMA) – This association gives a collective voice to the arthritis and musculoskeletal community in the UK. It works with member organisations to improve standards of care for people suffering from musculoskeletal disorders.
- Surgery Squad – This website will give learners opportunities to research virtual knee/hip replacement and other surgeries. **Note:** There are some graphic photographs and video images of surgery, which may be unsuitable for some learners. Centres are recommended to view content before suggesting this site to learners.
- Anatomy and Physiology Study Guide – This website has a number of tracks and lyrics to help learners understand physiology. For example, there is one about muscles, the skeletal system, the lymphatic system and the digestive system.

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.