

Unit title: Physiology of Cellular Systems in Animals

Unit code: **J/601/0218**

QCF level: **4**

Credit value: **15**

Aim

The unit provides learners with an understanding of the structure of the main physiological systems and how they function together to utilise nutrients and remove waste products effectively.

Unit abstract

It is essential that learners understand how differing body systems are structured and, in turn, are able to understand the associated physiology. This unit will enable learners to gain an understanding of a number of systems within the body, including the nervous, blood and cardiovascular, respiratory, digestive, renal and endocrine systems.

The unit also gives learners an opportunity to examine the importance of the interrelationship between these diverse systems in maintaining homeostasis within an organism.

This unit provides a general introduction to human physiology and learners will have the opportunity to examine the differences between mammalian, amphibian, bird and fish physiology.

Learners will use underpinning knowledge of cellular structure and its associated physiology by considering two specific processes, the assimilation of nutrients and removal of waste products.

Learning outcomes

On successful completion of this unit a learner will:

- 1 Understand the relationship between the structure of specialised cells and their functioning within tissues
- 2 Understand how different tissues communicate with each other
- 3 Understand how different systems assimilate nutrients and remove waste products.

Unit content

1 Understand the relationship between the structure of specialised cells and their functioning within tissues

Muscle cells: muscle anatomy (myofibrils, myofilaments, myosin, actin); differences in structure and function between smooth, cardiac and skeletal muscle; movement of myosin and actin during contraction

Neuronal cells: neuroglia (Schwann cells, astrocytes, microglia, oligodendrocytes); neuron structure (dendrites, axons); synapses; myelin sheath

Epithelial cells: tight junctions; membrane transport of ions, fluids and macromolecules; membrane transport of Na^+/K^+ pump; ion channels

Secretory cells: increased number of mitochondria for additional energy requirements for synthesis of material for release; packaging of secreted material into secretory granules; comparison of different secretory cells eg anterior pituitary, gastric cells, liver cells

2 Understand how different tissues communicate with each other

Endocrine system: intracellular triggers for release of stored peptides (second messenger systems); receptors and their regulation; different hormone structures and mechanisms of action (peptide, steroid, thyroid and neurotransmitters)

Nervous system: membrane potential and action potential; structure and function of the central, peripheral and autonomic nervous systems; signalling, the reflex arc; fibre tracts in the spinal cord; functional neuroanatomy of the brain

Homeostasis: maintenance of consistent cellular conditions for certain variables (pH, temperature, concentrations of dissolved gases, ions and organic nutrients); components of homeostatic control systems (receptor, sensory pathway, integration centre, motor pathway, effector); negative feedback mechanisms

Control of homeostasis: hypothalamic releasing and inhibitory hormones; the hormones of the anterior pituitary and their effects on their target organs; nervous control of the release of hormones from the posterior pituitary (antidiuretic hormone and oxytocin); nervous control of blood pressure

3 Understand how different systems assimilate nutrients and remove waste products

Systems: mammalian; amphibian; bird; fish

Absorption of nutrients: morphological and functional relationships in the gastrointestinal tract; mechanisms and control of motility; neurohormonal control of gastric and pancreatic exocrine secretions; nature and function of bile; general anatomy and histology of the cardiovascular system; physiology and electro-physiology of the heart; blood pressure and its control; capillary blood flow and exchange of fluid

Waste product removal: structure and function of the renal system; counter current mechanisms; water and salt balance; regulation of pH of body fluids; structure of the respiratory system; mechanisms of ventilation; gaseous exchange; transport of respiratory gases; generation of rhythmic breathing; nervous and chemical control of breathing

Learning outcomes and assessment criteria

| Learning outcomes | Assessment criteria for pass |
|---|--|
| On successful completion of this unit a learner will: | The learner can: |
| LO1 Understand the relationship between the structure of specialised cells and their functioning within tissues | 1.1 explain the cellular structures of specialised muscle, neuronal, epithelial and secretory cells 1.2 assess how the properties of specialised cells enable them to perform their specialised functions |
| LO2 Understand how different tissues communicate with each other | 2.1 explain the operation of the endocrine system with respect to its regulatory roles within an organism 2.2 evaluate the operation of the nervous system as a method of rapid signalling within an organism 2.3 explain the homeostatic control mechanisms necessary for effective functioning within an organism |
| LO3 Understand how different systems assimilate nutrients and remove waste products | 3.1 explain the systems by which an organism absorbs nutrients to meet its need to maintain a constant internal environment 3.2 discuss the mechanisms by which an organism maintains a water and salt balance different to its external environment 3.3 discuss the processes by which gaseous exchange occurs between an organism and its external environment 3.4 evaluate the efficacy of the systems employed by organisms to rid themselves of solid and gaseous waste. |

Guidance

Links

This unit has particular links with the following units within this qualification:

- *Unit reference number T/601/0215: Cell Biology*
- *Unit reference number L/601/0219: Laboratory Techniques for Applied Biology*
- *Unit reference number F/601/0220: Analysis of Scientific Data and Information*
- *Unit reference number F/601/0217: Biochemistry of Macromolecules and Metabolic Pathways*
- *Unit reference number Y/601/0224: Neurophysiology and Homeostatic Control of the Human Body*
- *Unit reference number D/601/0225: Molecular Biology and Genetics*
- *Unit reference number K/601/0227: Pharmacological Principles of Drug Actions*

Essential requirements

Delivery

It is highly recommended that the unit is delivered using an integrated approach of theory, practical investigations and practical demonstrations. The theoretical element could be delivered using a variety of practical activities. Tutors should guide learners carefully towards understanding the link between the identified cell structures and their function.

Homeostatic functioning must be discussed in relation to nutrient assimilation and the process of gaseous exchange relating to the removal of waste products.

Assessment

For learning outcome 1, learners must assess how the properties of two specialised cells enable them to perform their specialised functions. The learning outcomes can be treated on an individual basis, concentrating on specific cells and body systems. Alternatively, a thematic approach covering several or all learning outcomes may be used, in which studies of communication between cells within tissues and different systems are used to illustrate the principles of homeostasis within an organism.

Resources

Learners require access to ICT and library resources and well-equipped laboratory facilities.

Employer engagement and vocational contexts

Learners would benefit from visits to industrial laboratories and research facilities.