Unit 3: Understand Animal Anatomy and Physiology

Unit code: K/600/9367

QCF Level 3: BTEC National

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to provide learners with an understanding of the principles of animal anatomy and physiology. This unit is primarily aimed at learners within a centre-based setting looking to progress into the sector or further education and training.

Unit introduction

Animal managers, technicians and veterinary nurses need to understand anatomical and physiological systems to deal with the situations they are likely to face daily in their jobs. This allows for more effective animal management and health monitoring, including any malfunction or imbalance of the systems which has a negative effect on animals' wellbeing. These systems have evolved in accordance with each animal's natural environment.

This unit gives an overview of some of the main anatomical and physiological systems, their regulation and control, and how these systems have adapted to the animal's environment.

The first part of the unit covers the main body systems, organ structure and function, and hormonal control of reproduction.

The second part of the unit covers biological control mechanisms. Learners will examine the internal regulation of the body and the interaction between the animal body and its external environment.

The final part of the unit learners will examine the adaptation of the body structure and systems to the animal's environment.

Learners will be able to draw on all learning outcomes to understand how and why an animal's body functions in the way that it does.

Learning outcomes

On completion of this unit a learner should:

1 Know the structure and functions of biological systems in animals

2 Know animal reproductive processes

3 Understand the biological control mechanisms in animals

4 Understand how an animal's body structure and systems are adapted to its environment.

Unit content

1 Know the structure and functions of biological systems in animals

Major body systems: respiratory, circulatory, digestive, lymphatic, excretory, nervous, endocrine

Structure and functions of major organs: brain, heart, lungs, pancreas, liver, kidneys, interactions between the systems

2 Know animal reproductive processes

Male reproductive system: structure and function of penis including os penis in dog, urethra, epididymis, vas deferens, testis

Female reproductive system: structure and function of vagina, cervix, uterus, oviduct, ovary

Reproductive processes: spermatogenesis, oogenesis, oestrous cycles; copulation, fertilisation, implantation, gestation, parturition

Role of reproductive hormones: testosterone, oestrogen, progesterone, luteinising hormone, follicle stimulating hormone, oxytocin

3 Understand the biological control mechanisms in animals

Control mechanisms: positive and negative feedback loops, homeostasis

Hormonal control mechanisms: glucoregulation, osmoregulation, fight-or-flight response; endocrine gland location and hormone action

Neural control mechanisms: thermoregulation (ectotherms and endoderms), reflex actions, sensory organs and stimuli, afferent (sensory) and efferent (motor) pathways; autonomic (sympathetic and parasympathetic)

4 Understand how an animal's body structure and systems are adapted to its environment

Adaptation: evolution, natural selection, extremes of environmental conditions and habitats, adaptation to the environment

Body structures: coat/skin, sensory organs, skeletal structure, water conservation

Body systems: reproductive adaptations, thermoregulation, circulatory systems

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 identify the major body systems in animals [IE, RL, SM]	**M1** explain the role of the pancreas and liver in digestion	**D1** explain the interaction of the circulatory and respiratory system during exercise and at rest
P2 describe the structure of the major organs in the animal body [IE, RL, SM]		
P3 describe the functions of the major organs in the animal body [IE, RL, SM]		
P4 describe the structure of the male and female reproductive systems [IE, RL, SM]	**M2** describe the stages of sexual reproduction in selected animals	**D2** describe the hormonal control of the oestrous cycle in selected animals
P5 describe the functions of the male and female reproductive systems [IE, RL, SM]		
P6 state the role of hormones in the mammalian reproductive process [IE, RL, SM]		
P7 examine the hormonal control mechanisms in animals [IE, CT, SM]	**M3** describe thermoregulation in both ectotherms and endotherms	**D3** compare the role of the autonomic nervous system in stressful situations and at rest
P8 examine neural control mechanisms in animals [IE, CT, SM]		

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:**
P9 explain how the body structures of selected animals are adapted to their environments [IE, CT, RL, SM]	**M4** describe the evolution of the pentadactyl limb.	**D4** compare the permanent and temporary respiratory adaptations of animals at different altitudes.
P10 explain how the body systems of selected animals are adapted to their environments. [IE, CT, RL, SM]		

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

Tutors delivering this unit have opportunities to use a wide range of techniques. Suitable techniques include lectures, discussions, seminar presentations, site visits, supervised anatomy practical sessions such as dissections, research using the internet and/or library resources and the use of personal and/or industrial experience.

Health and safety issues relating to working with live animals and animal material must be stressed and regularly reinforced. Risk assessments must be undertaken before any practical activities.

Examples can be used from a wide range of animal groups as appropriate to the learner's situation. It is expected that the unit will focus mainly on mammals but it may also cover birds, reptiles, amphibians, fish, insects and other animal groups as appropriate.

Learning outcome 1 covers the structure and functions of the major organs in the animal body and how they work together as coherent systems carrying out particular functions. This links to learning outcome 3, which involves the regulation and control of these systems.

Learning outcome 2 covers the reproductive process and the normal sequence of events during oestrus, copulation, fertilisation, gestation and parturition. Examples can be drawn from relevant species groups, for example mammals and birds.

The delivery of learning outcomes 1 and 2 will be enhanced by learners seeing the organs concerned, for example as photographs or specimens, or during veterinary operations. Health and safety issues must be assessed before any practical activities. Adequate personal protective equipment (PPE) must be provided for learners and used following the production of suitable risk assessments. Visiting expert speakers could add to the relevance of the subject for learners. For example, a veterinarian or veterinary nurse could give an illustrated talk about the structure of animals' organs and body systems. It is suggested that examples of particular animals and the adaptations of their systems are given wherever possible, to help learners relate to and understand the systems.

Learning outcome 3 deals with individual body regulation and control systems, as well as how the neural and hormonal mechanisms allow the animal to interact with its external environment in order to survive.

Learning outcome 4 enables the learner to view animals, their body structures and systems, within their environmental context. Discussion of evolution may lead into topical debates on the acceptance of scientific theories or habitat destruction and conservation.

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 gives **an indication of the volume of learning it would take the average learner** to achieve the learning outcomes. It is **indicative and is one way of achieving the credit value.**

Learning time should address all learning (including assessment) relevant to the learning outcomes, regardless of where, when and how the learning has taken place.

Topic and suggested assignments/activities and/assessment
Introduction and overview of the unit.
Assignment 1: Organs and Organ Systems (P1, P2, P3, M1, D1)
Tutor introduces assignment brief.
Body systems.
Personal study.
Major organs.
Personal study.
Section review.
Individual support.
Assignment 2: Reproductive Physiology (P4, P5, P6, M2, D2)
Tutor introduces assignment brief.
Reproductive systems, to include dissections where possible (real or virtual).
Personal study.
Reproductive processes and hormones.
Personal study.
Section review.
Individual support.
Assignment 3: Biological Control Mechanisms (P7, P8, M3, D3)
Tutor introduces assignment brief.
Control mechanisms, homeostasis.
Personal study.
Hormonal control mechanisms.
Personal study.
Neural control mechanisms.
Personal study.
Section review.
Individual support.
Assignment 4: Environmental Adaptations (P9, P10, M4, D4)
Tutor introduces assignment brief.
Environments and habitats.
Personal study time.
Evolution and natural selection.
Personal study time.
Environmental adaptations – body structures.
Personal study time.
Environmental adaptations – body systems.
Personal study time.
Section review.

Topic and suggested assignments/activities and/assessment
Individual support.
Unit reflection.
Unit review.

Assessment

For P1, learners are expected to identify the major body systems in animals as listed in the unit content. It may be assessed at the same time as P2, P3 and M1. Evidence could be posters or presentations with notes, using one animal as the basis for identification.

For P2, the structure of each major organ given in the unit content should be described. Only one animal is required, which may be identified by the tutor or agreed through discussion with learners. P2 should be assessed at the same time as P3 and may be assessed at the same time as P1 and M1. Evidence could be an annotated poster, pictorial presentation or a project where each organ and system are clearly labelled and linked.

P3 looks at the functions of each major organ and should be assessed at the same time as P2, using the organs of one animal for illustrative purposes. Evidence could be in the same format as for P2. P3 could also be assessed at the same time as M1.

For P4, learners must describe the organs of the reproductive systems, for both male and female animals, of two species that have different reproductive processes. Labelled diagrams would be suitable evidence for this criterion. This could be assessed at the same time as P5, P6 and M2 and D2.

P5 requires learners to describe the functions of each part of the reproductive systems used in P4. If the structure has the same function in both animals, this should be stated (rather than needlessly repeating information). This could be assessed at the same time as P4, P6, M2 and D2. An annotated poster, pictorial presentation or a project would be suitable evidence.

For P6, learners must state the role of each of the hormones listed in the unit content. This does not have to be species-specific and a simple table will suffice as evidence. This could be assessed at the same time as P4, P5, M2 and D2. An annotated poster, pictorial presentation or a project would be suitable evidence.

P7 could be assessed at the same time as P8, M3 and D3. Learners must examine one hormonal control mechanism in detail, ensuring that they demonstrate their knowledge of why the animal requires control mechanisms to be in place. A short report, leaflet or poster would be suitable evidence.

P8 could be assessed at the same time as P7, M3 and D3. Learners must examine one neural control mechanism in detail, such as a reflex arc or voluntary reaction, ensuring that they demonstrate their knowledge of why the animal requires control mechanisms to be in place. A short report, leaflet or poster would be suitable evidence.

P9 and P10 are closely linked and should be assessed together. Two animals from contrasting environments should be selected by the tutor or through discussion with learners. Learners should clearly state the adaptation and how it is of benefit to the animal. This may link with assessment for M4 and D4. An illustrated essay, poster, leaflet, presentation or short film could be used as evidence.

M1 reflects the role of organs within their systems. It is expected that learners will link enzymatic and hormonal secretions from the pancreas and bile from the liver with the location of these organs and the importance of these in digestion. It may be possible to link this with P1, P2, P3 and D1, and evidence could be in the form of an illustrated essay, detailed poster or presentation.

For M2, learners must describe the stages of sexual reproduction in two different animals, for example the horse and the dog. The stages covered must include copulation, fertilisation, implantation, gestation and parturition. Links to P4, P5, P6 and D2 are logical and these could be assessed at the same time. An illustrated essay or presentation would be suitable evidence.

M3 requires learners to describe thermoregulation in one ectotherm and one endotherm. Learners should explain these terms along with the relevant habitats of the selected animals in order to set the scene. It is expected that all relevant thermoregulatory mechanisms will be described for each animal. It may be possible to assess M3 at the same time as P7, P8 and D3.

M4 links closely with P9, P10 and D4, and the same animals may be used if appropriate. Reference to other forms of pentadactyl limb evolution should be made but detail is only required for two.

D1 may build on P1, P2, P3 and M1 and should be based on one mammalian species selected by the tutor or through discussion with learners. It is expected that the requirements of the animal to respire both aerobically and anaerobically will be discussed, and that the structure and function of both systems will be described fully.

D2 requires a discussion of animals with quite different oestrous cycles, for example the horse and the dog. The use of a graph showing hormone levels throughout the cycle is expected, along with a description of their role in the reproductive process and the effect they may have on the behaviour of the animal. This may follow on from P4, P5, P6 and/or M2, in the form of an illustrated essay or presentation.

For D3, learners must describe the sympathetic and parasympathetic parts of the autonomic nervous system and how they work together during stressful situations and at rest. The typical fight-or-flight situation should be described to set the scene, for one mammalian species selected by the tutor or through discussion with learners. It may be possible to assess this at the same time as P7, P8 and M3.

To achieve D4, learners must compare permanent and temporary respiratory adaptations that occur at different altitudes, including differing red blood cell counts, blood pressure and lung capacity. Two animals should be used, for example horses and mountain goats. These may be selected by the tutor or agreed through discussion with learners. There are potential links with P9, P10 and M4 and suitable evidence would be in the same format.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the 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, P3, M1, D1	Organs and Organ Systems	You are producing an illustrated project about the major organs and organ systems in a given animal. You should identify the major organs in the animal, the system they belong to and the role they play in that system, in particular the role of the pancreas and liver in digestion. You should also explain the interaction of the circulatory and respiratory system while the animal is exercising and at rest.	Written.
P4, P5, P6, M2, D2	Reproductive Physiology	You are working for a company that provides informative leaflets for animal owners and you have been asked to produce a descriptive leaflet on reproductive physiology for two different species. You should include labelled diagrams of the male and female reproductive systems, outline the stages of sexual reproduction in animals and describe the hormonal control of the oestrous cycle.	Written.

Criteria covered	Assignment title	Scenario	Assessment method
P7, P8, M3, D3	Biological Control Mechanisms	A local college has asked you to design a series of posters about biological control mechanisms. The first needs to explain the need for control mechanisms, using examples of both hormonal and neural control; the second must describe thermoregulation in ectotherms and endotherms, while the third must compare the role of the autonomic system in stressful situations and at rest.	Written.
P9, P10, M4, D4	Environmental Adaptations	You have been asked to give a presentation about the environmental adaptations of animals. You should prepare notes, handouts and slides to cover each of the following: descriptions of the adaptations of two animals to their environment, the evolution of the pentadactyl limb and a comparison of permanent and temporary respiratory adaptations at different altitudes.	Written /recorded.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC land-based sector suite. This unit has particular links with:

Level 2	Level 3
Introduction to Animal and Plant Biology	Understand and Promote Animal Health

Essential resources

Learners will need access to a selection of models and pictures of the main organs and systems. Access to laboratories, animal organs and observation (directly or by video/live camera) of veterinary post-mortems and operations may enhance delivery.

The use of live animals to monitor respiratory rates and other anatomical and physiological signs should be encouraged, but only if animal welfare is adhered to and animals do not become stressed.

Internet access is essential but should be guided to avoid confusion when higher level or incorrect anatomy and physiology resources are encountered. When researching, learners will also need access to a range of information, which may require use of interlibrary loans or visits to collections.

Employer engagement and vocational contexts

Learners working at veterinary laboratories should observe operations and post-mortems if possible.

Indicative reading for learners

Textbooks

Aspinall V and O'Reilly M – *Introduction to Veterinary Anatomy and Physiology* (Butterworth-Heinemann, 2004) ISBN 9780750687829

Boden E – *Black's Veterinary Dictionary, 21st Edition* (A & C Black Publishers, 2005) ISBN 9780713663624

Boyle M – *Biology* (Collins Educational, 2008) ISBN 9780007267453

Hayes M – *Veterinary Notes for Horse Owners, 18th Edition* (Ebury Press, 2002) ISBN 9780091879389

Jones A, Reed B and Weyers J – *Practical Skills in Biology* (Prentice Hall, 2002) ISBN 9780130451415

Kent M – *Advanced Biology* (Oxford University Press, 2000) ISBN 9780199141951

Lane D and Cooper B – *Veterinary Nursing, Third Edition* (Butterworth-Heinemann, 2003) ISBN 9780750655255

Pond K and Pond W – *Introduction to Animal Science* (J Wiley & Sons Inc, 2000) ISBN 9780471170945

Toole G and Toole S – *New Understanding Biology for Advanced Level* (Nelson Thornes, 1999) ISBN 9780748739578

Williams G – *Advanced Biology for You* (Nelson Thornes, 2000) ISBN 9780748752980

Journals

Animal Science

Biologist

Biological Sciences Review

New Scientist

Websites

www.darwin-online.org.uk	Complete Works of Darwin online
www.defra.gov.uk	Department for Environment, Food and Rural Affairs
www.hse.org.uk	Health and Safety Executive
www.keyskill.com	Key Skill Company
www.purchon.com/biology/animal.htm	Gondar Design Science
www.wellcometreeoflife.org	Wellcome Trust Tree of Life

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Independent enquirers	selecting information to use when identifying major organs and biological systems choosing examples to illustrate the need for biological control mechanisms researching the environmental adaptations of animals
Creative thinkers	considering the purpose of biological control mechanisms discussing natural selection and the theory of evolution
Reflective learners	communicating scientific ideas in relevant ways for different audiences
Self-managers	planning resources during personal study time in preparation for assignments.

Although PLTS opportunities 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	researching animal adaptations drawing conclusions from different types of evidence
Creative thinkers	discussing biological control mechanisms discussing natural selection and evolution of the pentadactyl limb
Reflective learners	reviewing their progress throughout the unit linking learning outcomes
Team workers	giving constructive feedback to others following presentations
Self-managers	carrying out practical work examining the structure of organs.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching the internet for appropriate anatomical diagrams and photographs
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	producing written assignments using ICT programs
Bring together information to suit content and purpose	selecting resources to illustrate the function of organs
Present information in ways that are fit for purpose and audience	producing written assignments, presentations and videos using ICT programs and digital media
Mathematics	
Draw conclusions and provide mathematical justifications	interpreting graphs of hormone levels in oestrous cycles
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	discussing environmental adaptations
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	researching books and journals for information on reproductive processes
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing written assignments relating the circulatory and respiratory systems to each other.