O Level Biology (5090)
Unit 5: Coordination, Response, Movement and Homeostasis

Recommended Prior Knowledge
Some knowledge of cells, blood and the circulatory system, osmosis and enzymes (particularly the effect of temperature on enzyme activity) would be helpful. A basic understanding of the behaviour of light rays as they pass through lenses would be useful, though not essential.

Context
This unit builds on the idea that all Units so far studied do not describe activities which operate in isolation within the body. All processes are interlinked to maximise the survival and success of the organism.

Outline
Waste products from metabolism must not be allowed to accumulate within a body. Their removal is linked to the maintenance of a constant internal environment. In the unit, the removal of carbon dioxide is considered as well as a simple treatment of the structure of the excretory system. The function of the kidney and of the artificial kidney are given basic coverage and the homeostasis theme is continued with skin structure, temperature regulation and control by negative feedback. Nervous and hormonal control are studied in relation to co-ordination, with reflex actions being amplified by a wider consideration of eye structure and the antagonistic arrangement of muscles in the arm.

AO	Learning outcomes	Suggested activities and further guidance	Online resources	Other resources
9(a)	Define excretion as the removal of toxic materials and the waste products of metabolism from organisms.	Teachers should be aware that many pupils hold an inaccurate belief that excretion is the correct term for defecation.		**Textbooks** M. & G. Jones – 10 Homeostasis and Excretion Mary Jones – Unit 10 Excretion Ian J. Burton - Topic 12 Excretion
9(b)	Describe the removal of carbon dioxide from the lungs.	This outcome links excretion with respiration considered in Unit 4 and will already have been described when considering gaseous exchange and exhalation.		

9(c)	Identify on diagrams and name the kidneys, ureters, bladder, urethra, and state the function of each (the function of the kidney should be described simply as removing urea and excess salts and water from the blood. Details of kidney structure and the nephron are **not** required).	Note that 'ureter' and 'urethra' **must** be spelt correctly. Stress that it is **excess** water which is removed and refer to this helping to maintain the blood at a constant concentration. An OHT diagram identifying the structures may be shown to students who may then label their own copy. Students may add annotations to their diagram to describe the function of each labelled component.	Labelled urinary tract diagram: http://www.enchantedlearning.com/subjects/anatomy/urinary/label/answers.GIF Unlabelled urinary tract diagram: http://www.enchantedlearning.com/subjects/anatomy/urinary/label/label.GIF	
9(d)	Describe dialysis in kidney machines as the diffusion of waste products and salts (small molecules) through a membrane; large molecules (e.g. protein) remain in the blood.	A simple labelled diagram of a kidney dialysis machine should be provided. Use the suggested online animation to demonstrate the movement of substances across the dialysis membrane and to show that the content and concentration of the dialysis fluid controls which substances leave the blood. Submerge lengths of Visking tubing, tightly tied at both ends, in distilled water. One tube should contain a solution of egg albumen (use dried albumen to make the solution) and the other a solution of glucose. After 30 minutes test the distilled water for the presence of protein and reducing sugar. As students will have met Visking tubing as a partially permeable membrane associated with osmosis in Unit 1 it will be necessary to explain that water molecules are not the only ones able to pass through (N.B. Visking tubing is available with different-sized 'pores'.)	Dialysis machine diagram: http://www.goldiesroom.org/Multimedia/Bio_Images/13%20Human%20Other/13%20Kidney%20Dialysis.jpg Dialysis membrane animation: http://healthsciences.merlot.org/images/18loop.gif	

10(a)	Define homeostasis as the maintenance of a constant internal environment.	'Internal environment' may be explained as 'conditions within the body'. 'Homeostasis' may be split into 'homeo' (meaning 'the same') and 'stasis' (meaning 'staying' or 'standing'). Students may watch the suggested animated video following which a class 'brainstorm' can be used to list the body functions controlled by homeostasis and the organs involved.	Homeostasis animated video: http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/homeo/homeosts.shtml Homeostasis introduction: http://www.s-cool.co.uk/gcse/biology/homeostasis/what-is-homeostasis.html	**Textbooks** Ian J. Burton – Topic 1 Homeostasis Mary Jones – Unit 11 Homeostasis M. & G. Jones – 10 Homeostasis and Excretion
10(b)	Explain the concept of control by negative feedback.	The operation of a thermostat illustrates the concept well, but it should be explained that temperature is not the only variable that can be controlled. An introduction relating to temperature control leads comfortably on to outcome 10(d). Use the negative feedback cycle diagram to explain the steps involved in controlling a constant room temperature and then diversify to explain the control of homeostatic functions in the body listed when studying 10(a) above.	Negative feedback cycle: http://www.bbc.co.uk/scotland/learning/bitesize/higher/biology/images/01stages_negativefdback.gif	
10(c)	Identify, on a diagram of the skin, hairs, sweat glands, temperature receptors, blood vessels and fatty tissue.	Provide students with a labelled diagram of the skin to show the features required. The suggested online resource may be printed for this purpose and students asked to add temperature receptors to the diagram.	Skin (no temp. receptor shown): http://www.ewart.org.uk/biology/pics/skin.gif	

10(d)	Describe the maintenance of a constant body temperature in humans in terms of insulation and the role of temperature receptors in the skin, sweating, shivering, blood vessels near the skin surface and the coordinating role of the brain.	The functions of the labelled structures is important here. Stress that capillaries **do not move** nearer or further away from the skin surface and that they **do not** constrict or dilate (as they are not muscular). Students may use the suggested online interactive activity, following which two bullet-point lists can be made to outline the ways in which the body responds to cause an increase or decrease in its internal temperature. Describe the role of the brain in monitoring the temperature of blood flowing through it and the control, via nerves, of the action effectors in the skin to bring about the changes previously listed.	Temperature regulation by skin: http://www.abpischools.org.uk/page/modules/skin/skin3.cfm	
11(a)	State that the nervous system – brain, spinal cord and nerves, serves to coordinate and regulate bodily functions.	Provide a simple diagram showing the three main parts and explain that all parts of the body are served by the nervous system.	Nervous system basic diagram: http://www.yachigusaryu.com/blog/pics/top_ten_principles/3/image007.jpg	**Textbooks** Ian J. Burton – Topic 14 Coordination and Response M. & G. Jones – 9 Coordination and Response Mary Jones – Unit 12 Coordination
11(b)	Identify, on diagrams of the central nervous system, the cerebrum, cerebellum, pituitary gland and hypothalamus, medulla, spinal cord and nerves.	Provide a labelled diagram of the brain showing the required features - avoid any further labels not required by the syllabus.	Labelled diagram of brain: http://www.epilepsy.org.au/images/Brain2b.gif	

11(c)	Describe the principal functions of the above structures in terms of coordinating and regulating bodily functions.	Students may use the suggested online resource to add annotations to the diagram from 11(b) (or to produce a separate table) outlining the major functions of each named structure.	Brain structure and function: http://kidshealth.org/misc/movie/bodybasics/bodybasics_brain.html	
11(d)	Describe the gross structure of the eye as seen in front view and in horizontal section.	The front view of the eye may be studied by students using hand-mirrors and a list of the structures observed collated. Students may draw and label the front view of one of their eyes using a mirror. A demonstration dissection of an eye is a possible, however students often find it difficult to relate eye structure as seen in this way to structure as represented diagrammatically. Invite students to demonstrate their blind spots by drawing two small circles about 9 cm apart and moving them towards and away from one eye with the other closed. The second spot disappears at a distance of about 30 cm. Students may use the suggested online resources to label a diagram of the eye in horizontal section.	Eye anatomy: http://www.bbc.co.uk/schools/gcsebitesize/science/ocr_gateway/ourselves/3_keeping_in_touch2.shtml Eye and vision, for learning outcomes11(d) to (f): http://www.s-cool.co.uk/gcse/biology/nerves-and-hormones/the-eye.html Eye labelling activities: http://www.kscience.co.uk/animations/eye_drag.htm http://www.kscience.co.uk/animations/eye_function_drag.htm	**Bioscope CD** Rat eye
11(e)	State the principle functions of component parts of the eye in producing a focused image of near and distant objects on the retina.	Explain that refraction of light occurs at both the cornea and the lens (which fine-tunes the focus depending on the distance away of the object). Explain the action of the ciliary muscles in **reducing** tension on the suspensory ligaments as they contract (note that the ligaments themselves do not contract). Details of rod and cone cells are not required. Students may draw simple ray diagrams of light from both near and distant objects being focused on the fovea and showing the different shapes of the lens in each case.	See suggested resources listed above.	

11(f)	Describe the pupil reflex in response to bright and dim light.	Working in pairs, students may observe on one another the effect of turning on a bench lamp or torch (with a bulb of low rating) held about a metre from the eye. Students may draw labelled diagrams of the pupil and iris in each instance and add annotations to explain their observations. Stress the distinction between ciliary and iris muscles. The antagonistic action of the iris muscles (circular and longitudinal) should be mentioned together with the reasons for this reflex.	Iris muscle action in pupil reflex: http://www.apsu.edu/thompsonj/anatomy%20&%20physiology/2010/2010%20exam%20reviews/exam%204%20review/15-09_Pupil.JPG Also see suggested resources listed above.	
11(g)	Outline the functions of sensory neurones, relay neurones and motor neurones**.**	Students may draw diagrams of the three types of neurone and specify the function of each – possibly following study of 11(h) below. Stress that neurones carry 'electrical impulses' (**not** 'messages' or 'signals').		
11(h)	Discuss the function of the brain and spinal cord in producing a coordinated response as a result of a specific stimulus (reflex action).	All students will be familiar with the rapid withdrawal of their hand when it accidentally comes in contact with a hot object. This reflex may be used to introduce the steps and structures involved in a reflex arc. Cross reference this example of a 'spinal reflex' with the pupil reflex studied in 11(f) as an example of a 'cranial reflex' centred on the brain. A labelled diagram may also include structural details of the arm bones, joints and antagonistic muscle arrangement required in 12 (a), (b) and (c) below. Students may demonstrate the 'knee jerk' response by striking below their kneecap with their hand whilst their legs are loosely crossed. Students may then write an account, in the form of numbered steps, to explain each step involved in the reflex arc. Students may be invited to identify the stimuli, receptors and effectors in the two other reflex actions.	Reflex arc diagram (knee jerk): http://img.tfd.com/h/i/0013n039.gif	

11(i)	Define hormone as a chemical substance, produced by a gland, carried by the blood, which alters the activity of one or more specific target organs and is then destroyed by the liver.	Unit 3 considered substances passing between tissue fluid and blood capillaries, here we identify a useful substance passing from cells into the circulatory system, performing a particular function, then being destroyed. Cross reference 9(a) in this unit as hormones are removed from the body as waste products of metabolism.		
11(j)	State the role of the hormone adrenaline in boosting the blood glucose concentration and give examples of situations in which this may occur.	Ask students to 'brainstorm' specific 'fight or flight' situations. Invite students to offer suggestions for the value of increased blood glucose in these situations. This unit links with 5(s) in Unit 3 and 8(d) in Unit4.		
11(k)	Describe the signs (increased blood glucose concentration and glucose in urine) and treatment (administration of insulin) of diabetes mellitus.	It may be possible to invite a diabetic into the classroom to offer further information. Students may use the suggested online resource to research the signs and treatment of diabetes and to summarise their findings in the form of a brief talk or presentation.	Diabetes information site: http://www.diabetes-explained.co.uk/ Blood sugar control animation: http://www.abpischools.org.uk/res/coResourceImport/modules/hormones/en-flash/bloodsugar_b.cfm	

12(a)	Identify and describe, from diagrams, photographs and real specimens, the main bones of the forelimb (humerus, radius, ulna and scapula) of a mammal	Examine the bones (or photographs or drawings of the bones) of a small mammal. Students should learn to identify each bone, how they fit together and the type of joint formed in each case. Students may prepare labelled diagrams of their observations. Where actual specimens and photographs are difficult to obtain, X-ray photographs may be used to illustrate both the bones and the joints.	Skeleton: http://www.bbc.co.uk/schools/gcsebitesize/pe/appliedanatomy/2_anatomy_skeleton_rev1.shtml Elbow joint anatomy: http://images.conquestchronicles.com/images/admin/elbow_anatomy06.jpg X-ray photographs of bones and joints: http://www.accessexcellence.org/RC/VL/xrays/	**Textbooks** M. & G. Jones – 11 Support and Movement Ian J. Burton – Topic 11 Support, Movement and Locomotion Mary Jones – Unit 13 Support, Movement and Locomotion
12(b)	Describe the type of movement permitted by the ball and socket joint and the hinge joint of the forelimb.	Students may locate the prescribed joints on a diagram of the human skeleton and annotate the diagram to show the type of joint and the type of movement permitted in each case. Ask students to identify other examples of ball and socket and of hinge joints in the body and to add labels to their diagrams to show their location.	Human skeleton (labelled): http://www.learning-connections.co.uk/curric/cur_pri/h_body/handson/images/skelet2.gif Hinge joint anatomy and movement: http://kidshealth.org/misc/movie/bodybasics/bodybasics_knee.html	
12(c)	Describe the action of the antagonistic muscles at the hinge joint.	These muscles show similarities to those already described in the iris in 11(f). Muscles work only when they contract - they can pull but never push. Note that inelastic tendons transmit force to the bones. Use the suggested online resource to review the action of muscles at the hinge joint. Students may be provided with two copies of a similar diagram and annotate each to indicate the role of muscles and tendons when the arm is in raised and lowered.	Hinge joint animation: http://www.purchon.com/biology/flash/elbow.swf	