

UNIT 5: Coordination, Response and Homeostasis

Recommended Prior Knowledge: Knowledge of cell structure, osmosis, respiration and enzyme activity will help students to understand why homeostasis is important in mammals. It will also be helpful if they have some understanding of the behaviour of light, lenses, and how to draw simple ray diagrams before beginning work on the human eye. Extension candidates need a simple knowledge of the immune response in order to discuss the difficulties associated with kidney transplants.

Context: This Unit provides numerous opportunities to revisit ideas and facts covered in earlier Units.

Outline: The theme running throughout this unit is communication within the body, both through chemicals and the nervous system. Both plants and animals are dealt with, and students encouraged to see how similar are the mechanisms by which they achieve responses to stimuli. Once the basic function of the nervous system has been covered, the effects on it of drugs such as alcohol and heroin are considered. Homeostasis is illustrated for all candidates by temperature regulation in humans, while extension candidates take these ideas further, looking at the control of blood glucose concentration and taking an overview of how negative feedback is involved in control mechanisms. A simple treatment of excretion in humans completes the Unit.

	Learning Outcomes	Suggested Teaching Activities	Online Resources	Other resources
II 10.1	Define <i>hormone</i> . Describe the chemical control of metabolic activity by adrenaline.	Adrenaline makes a good introduction to the idea of hormones, as everyone is aware of its effects. Discussion will bring out most of these, and students should be able to suggest how they help to prepare the body for 'fight or flight'. A hormone can be defined as a chemical that is secreted from ductless (endocrine) glands, and that is transported in the blood system all around the body, where it has an effect on its target organs. This is also a suitable point at which to discuss the general need for communication systems in the body, and the ideas of receptors and effectors.		
II 10.1	Discuss the use of hormones in food production.	The use of BST in milk and meat production can be discussed.	Bovine Somatotropin http://project.bio.iastate.edu/courses/Gen308SS99/BIOTECH_INFO/nr488.html A balanced description of the use and effects of BST	

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			Posilac - an introduction http://www.monsantodairy.com/about/index.html A view from the firm that makes and sells BST	
II 10.2	Define geotropism and phototropism.	Having dealt with the idea of how animals may respond to stimuli (with respect to adrenaline), students can now think about how plants do this. Geotropism and phototropism should be investigated with simple experiments. It should be made clear that these are growth responses, in which the direction of growth is related to the direction of the stimulus. Once again, as in animals, receptors and effectors can be identified.		
II 10.2	Describe geotropism and phototropism in terms of auxins regulating differential growth describe the chemical control of plant growth by auxins and the effects of synthetic plant hormones used as weedkillers.	There is still some controversy over just how geotropism and phototropism are regulated. A relatively simple possible mechanism, involving unequal distribution of auxin, should be considered. If it is possible to obtain IAA, then simple investigations can be carried out into its effects. Students should also consider the similarities and differences between animal hormones such as adrenaline, and plant hormones such as auxins.	Investigating plant growth regulators http://www-saps.plantsci.cam.ac.uk/worksheet/activ/prac4.htm An experiment involving the use of IAA on mustard seedlings.	
II 10.2	Describe simple behaviour in terms of the taxic responses of invertebrates.	It is quite a jump from thinking about plant hormones to looking at simple behavioural responses in animals, but again the common factors of receptors and effectors, stimulus and response, can be		

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		emphasised. A taxic response in an animal is in many ways like a tropic response in plants, in that the direction of the response is related to the direction of the stimulus. The main difference is that in plants the response is growth, while in animals it is movement. Maggots (fly larvae) can be used for simple experiments investigating their directional response to light. (Note that the responses by woodlice, for example in choice chambers, do not illustrate taxis but kinesis; the response is the rate of movement or rate of turning, not a directional response.) Students need to be encouraged to think about these responses as automatic ones, that do not involve any 'thinking' by the animals.		
II 10.3	Describe the human nervous system in terms of the central nervous system (brain and spinal cord as areas of coordination) and the peripheral nervous system.	Diagrams or models can be used to illustrate the positions of brain, spinal cord and peripheral nerves in the human body. Ensure that there is no confusion between spinal cord and vertebral column. Lamb chops often have a small piece of spinal cord on them, lying in the groove of a vertebra, and this can be used to show students what the cord looks like, and also how it is protected by the surrounding vertebrae.	Neuroscience for kids http://faculty.washington.edu/chudler/neurok.html Despite the title, some of the material at this site is a little advanced for IGCSE students.	
II 10.3	Define sense organs as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals.	The idea of receptor and effector is returned to now, with a detailed look at what receptors do, and one example of a receptor in humans. Models of the eye are helpful in aiding understanding of its		

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	Describe the structure and function of the eye including accommodation.	structure and function. A round flask of fluorescein with a convex lens at the front can be used to show how light is focussed on to the retina (the back of the flask). It may be possible to dissect an eye, for example from a sheep. Students can also draw and interpret views of their own eyes, using a mirror.		
II 10.3	Distinguish between rods and cones in terms of function and distribution.	Rods and cones should be considered as examples of receptor cells.		
II 10.3	Describe effectors in terms of muscles and glands describe the action of antagonistic muscles in terms of biceps and triceps and associated bones.	As for receptors, one example of effectors is considered in detail. They can feel the biceps and triceps muscles in their own arm, and think about what each of them is doing as the arm is bent and straightened. It is important to understand that muscles can contract and relax, but cannot make themselves shorter - hence the need for two antagonistic muscles to work together.		
II 10.3	Identify motor and sensory neurones from diagrams. Describe a simple reflex arc in terms of sensory, relay and motor neurones and a reflex action as a means of integrating and coordinating stimuli with responses. Describe the pupil reflex.	Having looked at receptors and effectors, the way in which communication is achieved between them through the nervous system is now considered. Students can think about examples of reflex actions, in each case identifying the stimulus and response, and the receptor and effector that are involved. The pupil reflex is a good example of a reflex action, and students can see this in their own eyes, by covering one or both eyes with something dark and then allowing light to fall on them.		
II 10.3	Distinguish between voluntary and involuntary actions.	By now, a number of simple responses have been covered, and extension candidates should begin to realise that many of these are involuntary. They should be able to suggest a number of voluntary		

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		and involuntary actions, listing stimulus and response in each case.		
II 10.3	Compare nervous and hormonal control systems.	Students can now be asked to think back over the work covered so far in this Unit, and to identify similarities and differences between the examples they have dealt with involving communication by hormones, and by them nervous system. A table summarising these can be built up.		
II 10.5	Describe the effects of alcohol and heroin and the dangers of their misuse. Describe the personal and social problems arising from drug abuse, by reference to alcohol and heroin.	Most of the effects of alcohol and heroin involve the nervous system, although they do both affect other body organs.	Alcohol http://www.health.org/features/kidsarea/funstuff/brain/default.aspx Despite the title, some of the material at this site is a little advanced for IGCSE students. FAQs on alcohol abuse http://www.niaaa.nih.gov/faq/faq.htm	
II 10.4	Define homeostasis as the maintenance of a constant internal environment.	For most cells in the human body, their immediate environment is the tissue fluid that surrounds them. Students should think about why it is important to keep this environment relatively constant, and what features of it are controlled. Thinking back to earlier work on osmosis, enzyme activity and respiration will help with this.		
II 10.4	Describe temperature regulation and explain the effects of sweating, vasodilation and vasoconstriction only.	This can be introduced as an example of homeostasis, in which communication is achieved through the nervous system. A simple diagram of the skin can be drawn, showing the responses of sweat glands, arterioles and capillaries when the body temperature is too high and too low. Make sure that students do not think that the blood capillaries move up and down in the skin! Emphasise that the cooling effect of sweating is due to the evaporation of water.	Homeostasis http://www.bbc.co.uk/schools/gcsebitesize/biology/humansasorganisms/6homeostasisrev1.shtml	

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II 10.4	Describe the control of the glucose content of the blood by the liver and by insulin and glucagon from the pancreas.	Extension candidates now look at another example of homeostasis, in this case with hormones achieving coordination between receptor and effector. They may also like to know something of diabetes, a relatively common disorder in many countries. They should consider why it is important to control blood glucose content, thinking back to what they know about osmosis and respiration. Correct spelling is essential to distinguish between glycogen and glucagon.	Understanding diabetes http://www.diabetes.org.uk/diabetes/index.html	
II 10.4	Discuss the general role of negative feedback in homeostasis.	Negative feedback will have featured in both temperature regulation and control of glucose content. Teachers could explain the role of negative feedback in one of these, drawing a flow diagram to show how it is achieved. Students can then draw a similar flow diagram to illustrate negative feedback in the second example.		
II 9	Define excretion as the removal of toxic materials, the waste products of metabolism and substances in excess requirements from organisms.	Excretion can be considered as another way in which the environment of cells is controlled, by removing waste products of metabolism. Ensure that they understand the difference between egestion (the removal of substances from the alimentary canal, that have never been part of the body at all) and excretion.		
II 6.3.6	Define deamination as removal of the nitrogen containing part of amino acids as urea, followed by release of energy from the remainder of the amino acid	Only a simple understanding of the formation of urea from excess amino acids is required.		
II 9	Describe the formation of urea and the breakdown of alcohol, drugs and hormones in the liver.	The role of the liver in breaking down alcohol and drugs may already have been touched on earlier in this Unit.		
II 9	Describe the function of the kidney simply in terms of removal of urea and excess water and reabsorption of	This, too, should be dealt with very simply as even extension students will find details of nephron structure and function		

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	<p>glucose and some salts (details of kidney structure and nephron not required)</p> <p>The relative positions of ureters, bladder and urethra in the body.</p>	confusing.		
II 9	Describe the function of the kidney as the filtration of water, glucose and salts out of the blood, followed by re-absorption of glucose, most of the water and some of the salts back in to the blood, leading to the concentration of urea in the urine, and loss of excess water.	The importance of retaining glucose must be emphasised and it is excess water and salts which are excreted in urine. This will link back to section II 10.4 earlier in the unit which considers diabetes.		
II 9	<p>Explain dialysis and discuss its application in kidney machines.</p> <p>Discuss the advantages and disadvantages of kidney transplants, compared with dialysis.</p>	Extension students will need to remember what they know about osmosis and diffusion in order to understand how dialysis works. They will also need to think back to their earlier work on the immune system and tissue rejection, when considering kidney transplants.	<p>About kidney disease and dialysis http://www.kdf.org.sg/health.htm</p> <p>The treatment of kidney failure http://www.kidneypatientguide.org.uk/site/dialysis.html</p>	