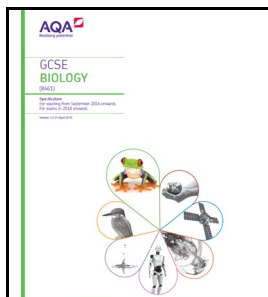


# Shenfield High School **BIOLOGY** AQA GCSE



## Paper 1: Topics 1 - 4

### Topic 1 Cell biology

Topic 2 Organisation

Topic 3 Infection and response

Topic 4 Bioenergetics

Specification

<https://www.aqa.org.uk/subjects/biology/gcse/biology-8461/specification>

PMT resource

<https://www.physicsandmathstutor.com/biology-revision/gcse-aqa/>

## 4.1 Cell biology

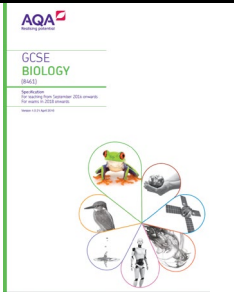
### 4.1.1 Cell structure

		Basic K&U	General K&U	Thorough K&U	Exam ready
4.1.1.1 Eukaryotes and prokaryotes	Name and identify the main parts present in a eukaryotic cell.				
	Name and identify the main parts present in a prokaryotic cell.				
	Describe how genetic material is stored in bacterial cells.				
	Compare the relative sizes of prokaryotic cells and eukaryotic cells.				
	Make order of magnitude calculations, including the use of standard form.				
4.1.1.2 Animal and plant cells	Name and identify the main parts present in most animal cells.				
	In addition to the parts found in animal cells, name and identify the main parts present in most plant cells.				
	Explain how the main sub-cellular structures are related to their functions.				
	Describe how to use a light microscope to observe, draw and label a selection of plant and animal cells (required practical activity 1).				
4.1.1 Cell structure		Basic K&U	General K&U	Thorough K&U	Exam ready
4.1.1.3 Cell specialisation	Give some examples of specialised animal cells.				
	Give some examples of specialised plant cells.				
	Explain how the structure of different types of cell relate to their function in a tissue, an organ or organ system, or the whole organism.				

4.1.1 Cell structure		Basic K&U	General K&U	Thorough K&U	Exam ready
4.1.1.4 Cell differentiation	Describe when differentiation occurs in most types of animal cells and in many types of plant cells.				
	Describe the main purpose of cell division in mature animals.				
	Explain the importance of cell differentiation.				
4.1.1.5 Microscopy	Understand how microscopy techniques have developed over time				
	Explain how electron microscopy has increased understanding of sub-cellular structures.				
	Carry out calculations involving magnification, real size and image size using the formula:  Magnification = $\frac{\text{size of image}}{\text{size of real object}}$				
	Express answers in standard form where appropriate.				
4.1.1.6 Culturing microorganisms	Describe how bacteria multiply by simple cell division (binary fission) and the conditions in which this happens.				
	Know that bacteria can be grown in a nutrient broth solution or as colonies on an agar gel plate.				
	Know that uncontaminated cultures of microorganisms are required for investigating the action of disinfectants and antibiotics.				
	Describe how to prepare an uncontaminated culture using aseptic technique.				
	Explain why:				
	<ul style="list-style-type: none"> <li>Petri dishes and culture media must be sterilised before use;</li> <li>inoculating loops used to transfer microorganisms to the media must be sterilised by passing them through a flame;</li> <li>the lid of the Petri dish should be secured with adhesive tape and stored upside down;</li> <li>in school laboratories, cultures should generally be incubated at 25°C.</li> </ul>				

4.1.1 Cell structure		Basic K&U	General K&U	Thorough K&U	Exam ready
4.1.1.6 Culturing microorganisms (continued)	Calculate the number of bacteria in a population after a certain time if given the mean division time.				
	Calculate cross-sectional areas of colonies or clear areas around colonies using $\pi r^2$				
	Be able to express the answer in standard form <b>(HT only)</b>				
	Describe an experiment to investigate the effect of antiseptics or antibiotics on bacterial growth using agar plates and measure zones of inhibition (required practical activity 2).				
4.1.2 Cell division		Basic K&U	General K&U	Thorough K&U	Exam ready
4.1.2.1 Chromosomes	Describe where chromosomes are located in a human body cell.				
	Explain the difference between chromosomes, DNA and genes.				
	Give the number of chromosomes present in a human body cell and how these are arranged.				
4.1.2.2 Mitosis and the cell cycle	Describe what happens to the genetic material in cells during the cell cycle.				
	Describe the stages of the cell cycle, including mitosis.				
	Explain why cell division by mitosis is important in multicellular organisms.				
	Recognise and describe situations in given contexts where mitosis is occurring.				
4.1.2.3 Stem cells	Give a definition for the term 'stem cell'.				
	Describe the function of stem cells in:				
	• embryos				
	• adult animals				
	• meristems in plants.				
	Describe how stem cells in embryos can be cloned and made to differentiate into most different types of human cells.				
	Describe the process of therapeutic cloning.				
	Explain how treatment with stem cells may be able to help conditions such as diabetes and paralysis.				
	Describe how stem cells from adult bone marrow can form many types of cells including blood cells.				
	Evaluate the practical risks and benefits, as well as social and ethical issues, of the use of stem cells in medical research and treatments.				
Describe how meristem tissue in plants can differentiate into any type of plant cell, throughout the life of the plant.					
Give examples of how stem cells from meristems in plants can be used.					

4.1.3 Transport in cells		Basic K&U	General K&U	Thorough K&U	Exam ready
4.1.3.1 Diffusion	Describe how substances are transported into and out of cells by diffusion.				
	Give examples of some substances that are transported in and out of cells by diffusion.				
	Explain how different factors affect the rate of diffusion:				
	• difference in concentration (concentration gradient)				
	• temperature				
	• surface area of the membrane				
	Explain how the surface area to volume ratio of a single-celled organism allows sufficient transport of molecules into and out of the cell to meet the needs of the organism.				
	Calculate and compare surface area to volume ratios.				
	Explain the need for exchange surfaces and a transport system in multicellular organisms in terms of surface area to volume ratio.				
	Explain how the small intestine and lungs in mammals, gills in fish, and the roots and leaves in plants, are adapted for exchanging materials.				
	Explain why surfaces and organ systems in multicellular organisms are specialised.				
	Explain how the effectiveness of an exchange surface is increased by:				
	• having a large surface area;				
• a membrane that is thin, to provide a short diffusion path					
• (in animals) having an efficient blood supply					
• (in animals, for gaseous exchange) being ventilated					
4.1.3.2 Osmosis	Describe how substances are transported into and out of cells by osmosis.				
	Describe an experiment to investigate the effect of a range of concentrations of salt or sugar solutions on the mass of plant tissue (required practical activity 3).				
	Use simple compound measures of rate of water uptake.				
	Use percentages and calculate percentage gain and loss of mass of plant tissue.				
	Plot, draw and interpret graphs to show the gain or loss of mass of plant tissue.				
4.1.3.3 Active transport	Describe how substances are transported into and out of cells by diffusion, osmosis and active transport				
	Explain why active transport is used to absorb mineral ions into plant root hairs.				
	Explain why active transport is used to absorb sugar molecules from the gut into the blood.				
	Explain why active transport is used to absorb sugar molecules from the gut into the blood.				

	Shenfield High School <b>BIOLOGY</b> AQA GCSE						
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Topic 4 Bioenergetics							
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BBC resource	<a href="https://www.bbc.co.uk/bitesize/examspecs/zpgcbk7">https://www.bbc.co.uk/bitesize/examspecs/zpgcbk7</a>						
<b>Topic 2 Organisation</b>			<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>	
Principles of Organisation	Explain the differences between cells, tissues, organs and organ systems.						
<b>4.2.2 Animal Tissues, Organs and Organ Systems</b>			<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>	
4.2.2.1 The human digestive system	Describe how the organs of the digestive system work together to digest and absorb food.						
	Describe how to test for sugars, starch, proteins and lipids using qualitative reagents, including the expected results (required practical activity 4)						
	Describe the role of enzymes in digestion						
	Describe how enzyme activity is affected by temperature and pH changes.						
	Carry out rate calculations for chemical reactions.						
	Explain enzyme action using the 'lock and key theory', including the specificity of the active site.						
	Recall the sites of production and the action of amylase, proteases and lipases.						
	Give the reactants and products of the reactions catalysed by carbohydrases (including amylase), proteases and lipases.						
	Describe a method to investigate the effect of pH on the rate of reaction of amylase enzyme (required practical activity 5).						
	Explain what the products of digestion are used for in the body.						
	Give the sites of production and storage of bile.						
Describe the function of bile and explain why it is alkaline.							

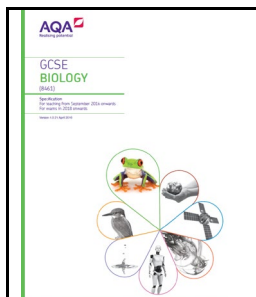
4.2.2 Animal Tissues, Organs and Organ Systems		Basic K&U	General K&U	Thorough K&U	Exam ready
4.2.2.2 The heart and blood vessels	Name and identify the main structures associated with the lungs.				
	Explain how the lungs are adapted for gaseous exchange.				
	Name and identify the four chambers of the heart.				
	Explain the role of the heart in a double circulatory system.				
	Name and identify the main blood vessels associated with the heart.				
	explain how resting heart rate is controlled.				
	Describe the function of artificial pacemakers.				
	Identify the three different types of blood vessel present in the body.				
	Explain how the structure of arteries, veins and capillaries relates to their function.				
Use simple compound measures such as rate and carry out rate calculations for blood flow.					
4.2.2.3 Blood	Name the four components of blood.				
	Describe the functions of each of the components of blood.				
	Recognise the different types of blood cells in a photograph or diagram.				
	Explain how the different types of blood cells are adapted to their functions.				
Evaluate the risks related to the use of blood products.					
4.2.2.4 Coronary heart disease: a non- communicable disease	Describe what happens to the coronary arteries in coronary heart disease and explain how this affects the heart muscle.				
	Describe how stents are used to treat coronary heart disease.				
	Describe how statins are used to treat coronary heart disease.				
	Describe how heart valves may become faulty and explain the consequences of faulty heart valves.				
	Describe how faulty heart valves can be replaced using biological or mechanical valves.				
	Describe how a donor heart, or heart and lungs can be transplanted in the case of heart failure.				
	Explain when an artificial heart might be used.				
Evaluate the advantages and disadvantages of treating cardiovascular diseases by drugs (statins), mechanical devices (stents) or transplant.					

<b>4.2.2 Animal Tissues, Organs and Organ Systems</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.2.2.5 Health issues	Give a definition for the term 'health'.				
	Give some factors that contribute to ill physical and mental health.				
	Describe how different types of diseases may interact.				
	Construct and interpret frequency tables and diagrams, bar charts and histograms, and use a scatter diagram to identify a correlation between two variables.				
4.2.2.6 The effect of lifestyle on some non-communicable diseases	Discuss the human and financial cost of some non-communicable diseases to an individual, a local community, a nation or globally.				
	Give some examples of risk factors that are linked to an increased rate of a disease.				
	Explain the effect of lifestyle factors including diet, alcohol and smoking on the incidence of non-communicable diseases at local, national and global levels.				
	Explain that many diseases are caused by the interaction of a number of factors.				
	Extract and interpret information from charts, graphs and tables, and use a scatter diagram to identify a correlation between two variables in terms of risk factors.				
4.2.2.7 Cancer	Give a definition for the term 'cancer'.				
	Explain the difference between benign and malignant tumours.				
	Give some lifestyle and genetic risk factors for various types of cancer.				
<b>4.2.3 Plant Tissues, Organs and Systems</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.2.3.1 Plant Tissues	Name and identify the main tissues present in plants.				
	Explain how the structures of plant tissues are related to their functions.				
	Describe the structure of a leaf.				
4.2.3.2 Plant Organ System	Name the parts of a plant that form an organ system for the transport of substances around the plant.				
	Explain how the structure of root hair cells is adapted for the efficient uptake of water by osmosis, and mineral ions by active transport.				
	Describe the role of xylem tissue in plants.				
	Explain how the structure of xylem tissue is adapted for the transport of water in the transpiration stream.				
	Describe the role of stomata and guard cells in leaves.				

4.2.3 Plant Tissues, Organs and Systems		Basic K&U	General K&U	Thorough K&U	Exam ready
4.2.3.2 Plant Organ System (continued)	Explain the effect of the following factors on the rate of transpiration:				
	• temperature;				
	• humidity;				
	• air movement;				
	• light intensity."				
	Describe the role of phloem tissue in plants.				
	Explain how the structure of phloem tissue is adapted for the transport of sugars by translocation.				



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Revisely resource

<https://www.revisely.com/gcse/biology/aqa>

### 4.3.1 Communicable diseases

**Basic  
K&U**

**General  
K&U**

**Thorough  
K&U**

**Exam  
ready**

4.3.1.1  
Communicable  
(infectious)  
diseases

Give a definition for the term 'pathogen' and give some examples of pathogens.

Describe some ways that diseases caused by viruses, bacteria, protists and fungi are spread.

Explain how the spread of diseases can be reduced or prevented.

Describe how bacteria and viruses reproduce inside the body.

Explain how bacteria can make us feel ill.

Explain how viruses can cause cell damage.

4.3.1.2  
Viral diseases

Describe how measles is spread.

Describe the symptoms of measles.

Explain why most young children are vaccinated against measles.

Describe how HIV is spread.

Describe the initial symptoms of HIV infection.

Explain when late-stage HIV infection (AIDS) occurs.

Describe the signs of tobacco mosaic virus (TMV) infection in plants.

Explain how TMV affects the growth of plants.

4.3.1.3  
Bacterial  
diseases

Describe how *Salmonella* food poisoning is spread.

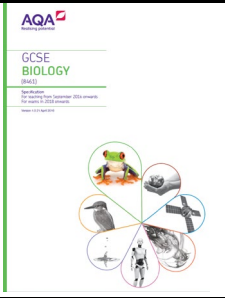
Describe the symptoms of *Salmonella* food poisoning and explain how they are caused.

Explain how the spread of *Salmonella* in poultry is controlled in the UK.

4.3.1 Communicable diseases		Basic K&U	General K&U	Thorough K&U	Exam ready
4.3.1.3 Bacterial diseases (continued)	Describe how gonorrhoea is spread.				
	Describe the symptoms of gonorrhoea.				
	Explain how the spread of gonorrhoea can be controlled.				
	Explain why gonorrhoea is no longer easily treated with the antibiotic penicillin.				
4.3.1.4 Fungal diseases	Describe how rose black spot is spread in the environment.				
	Describe the signs of rose black spot in plants.				
	Explain how rose black spot affects the growth of plants.				
	Explain how rose black spot can be treated.				
4.3.1.5 Protist diseases	Describe how malaria is spread.				
	Describe the symptoms of malaria.				
	Explain how the spread of malaria can be controlled.				
4.3.1.6 Human defence systems	Describe the non-specific defence systems of the human body against pathogens.				
	Explain the role of the immune system in the defence against disease.				
	Explain how white blood cells help to defend against pathogens by:				
	• phagocytosis;				
	• antibody production;				
• antitoxin production.					
4.3.1.7 Vaccination	Explain how vaccination prevents illness.				
	Explain how the spread of pathogens can be reduced by immunising a large proportion of the population (herd immunity).				
4.3.1.8 Antibiotics and painkillers	Describe how antibiotics, such as penicillin help to cure bacterial disease.				
	Explain why it is important that specific bacteria are treated using specific antibiotics.				
	Explain why the emergence of strains resistant to antibiotics is of great concern.				
	Explain why antibiotics cannot be used to treat viral infections.				
	Explain what painkillers are used for.				
	Explain why it is difficult to develop drugs that kill viruses.				

4.3.1 Communicable diseases		Basic K&U	General K&U	Thorough K&U	Exam ready
4.3.1.9 Discovery and development of drugs	Recall the plant or microorganism from which the following drugs were extracted:				
	• the heart drug digitalis;				
	• the painkiller aspirin;				
	• the antibiotic penicillin.				
	Describe how new drugs are synthesised.				
	Explain why new drugs have to be tested and trialled before being used.				
	Describe how preclinical testing is done in a laboratory.				
	Describe the stages of a clinical trial using healthy volunteers and patients.				
Explain the use of a placebo in a double-blind trial.					
4.3.2 Monoclonal antibodies (biology only) (HT only)		Basic K&U	General K&U	Thorough K&U	Exam ready
4.3.2.1 Producing monoclonal antibodies	Give a definition for the term 'monoclonal antibody'.				
	Describe how monoclonal antibodies are produced.				
	Explain why lymphocytes and tumour cells are used in the production of monoclonal antibodies.				
4.3.2.2 Uses of monoclonal antibodies	Describe some ways in which monoclonal antibodies can be used.				
	Explain how tests or treatments involving monoclonal antibodies work when given appropriate information.				
	Explain why monoclonal antibodies are not yet as widely used as everyone hoped when they were first developed.				
4.3.3 Plant disease		Basic K&U	General K&U	Thorough K&U	Exam ready
4.3.3.1 Detection and identification of plant diseases	<b>(HT only)</b> Describe some signs of plant diseases.				
	<b>(HT only)</b> Explain how plant diseases can be identified.				
	Give some of the causes of plant diseases.				
	Describe how plants are affected by tobacco mosaic virus (a viral disease).				
	Describe how plants are affected by rose black spot (a fungal disease).				
Describe how plants are affected by aphids (insects).					

4.3.3 Plant disease		Basic K&U	General K&U	Thorough K&U	Exam ready
4.3.3.1 (continued)	Explain how plants can be damaged by nitrate deficiency.				
	Explain how plants can be damaged by magnesium deficiency.				
4.3.3.2 Plant defence responses	Describe some physical plant defence responses to resist invasion of microorganisms.				
	Describe some chemical plant defence responses.				
	Describe some mechanical adaptations of plants.				

Shenfield High School <b>BIOLOGY</b> AQA GCSE		Basic K&U	General K&U	Thorough K&U	Exam ready
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AQA past papers	<a href="https://www.physicsandmathstutor.com/past-papers/gcse-biology/">https://www.physicsandmathstutor.com/past-papers/gcse-biology/</a>				
<b>4.4.1 Photosynthesis</b>					
4.4.1.1 Photosynthetic reaction	Write a word equation to represent photosynthesis.				
	Name the substances represented by the chemical symbols CO <sub>2</sub> , H <sub>2</sub> O, O <sub>2</sub> and C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> .				
	Explain why photosynthesis is an endothermic reaction.				
4.4.1.2 Rate of photosynthesis	Explain the effect of the following factors on the rate of photosynthesis:				
	• temperature;				
	• light intensity;				
	• carbon dioxide concentration;				
	• amount of chlorophyll.				
	Describe an experiment to investigate the effect of light intensity on the rate of photosynthesis using an aquatic organism such as pondweed (required practical activity 6).				
	Measure and calculate rates of photosynthesis.				
	Extract and interpret graphs of photosynthetic rate involving one limiting factor.				
	Plot and draw appropriate graphs, selecting an appropriate scale for axes.				
	<b>(HT only)</b> Explain graphs of photosynthesis rate involving two or three factors and decide which is the limiting factor.				
<b>(HT only)</b> Use inverse proportion – the inverse square law and light intensity in the context of photosynthesis.					
<b>(HT only)</b> Explain why limiting factors are important in the economics of enhancing the conditions in greenhouses.					

4.4.1 Photosynthesis (continued)		Basic K&U	General K&U	Thorough K&U	Exam ready
4.4.1.3 Uses of glucose from photosynthesis	Describe some ways that the glucose produced in photosynthesis may be used.				
	Explain how plants produce proteins.				
4.4.2 Respiration		Basic K&U	General K&U	Thorough K&U	Exam ready
4.4.2.1 Aerobic and anaerobic respiration	Explain why cellular respiration is an exothermic reaction.				
	Explain how the energy transferred by respiration in cells is used by the organism.				
	Compare the processes of aerobic and anaerobic respiration with regard to the need for oxygen, the differing products and the relative amounts of energy transferred.				
	Write a word equation to represent aerobic respiration.				
	Name the substances represented by the chemical symbols $C_6H_{12}O_6$ , $O_2$ , $CO_2$ and $H_2O$ .				
	Write a word equation to represent anaerobic respiration in muscles.				
	Explain the difference in the amount of energy transferred in anaerobic respiration compared to aerobic respiration.				
	Write a word equation to represent anaerobic respiration in plant and yeast cells.				
4.4.2.2 Response to exercise	Describe some commercial uses of anaerobic respiration in yeast cells (fermentation).				
	Describe how the human body reacts to the increased demand for energy during exercise.				
	Explain what type of respiration takes place if insufficient oxygen is supplied and the effect this has on muscles.				
	<b>(HT only)</b> Describe what happens to accumulated lactic acid after exercise.				
4.4.2.3 Metabolism	<b>(HT only)</b> Give a definition for the term 'oxygen debt'.				
	Explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of carbohydrates, proteins and lipids.				
	Give a definition for the term 'metabolism'.				
	Give some examples of metabolism in living organisms.				

4.5 Homeostasis and response		Basic K&U	General K&U	Thorough K&U	Exam ready
4.5.1 Homeostasis	Give a definition for the term 'homeostasis'.				
	Explain why homeostasis is important for the body.				
	Give some examples of conditions in the body that are automatically controlled by nervous or chemical responses.				
	Describe the role of receptors, coordination centres and effectors in automatic control systems.				
4.5.2 The human nervous system		Basic K&U	General K&U	Thorough K&U	Exam ready
4.5.2.1 Structure and function	Describe the function of the nervous system in humans.				
	Describe how information is passed through the nervous system.				
	Explain how the structure of the nervous system is adapted to its functions.				
	Explain how the structures in a reflex arc relate to their functions.				
	Explain the importance of reflex actions.				
	Describe a method to investigate the effect of a factor on human reaction time (required practical activity 7).				
	Extract and interpret data about the functioning of the nervous system from graphs, charts and tables.				
	Translate information about reaction times between numerical and graphical forms.				
4.5.2.2 The brain	Describe the role of the brain.				
	Identify the cerebral cortex, cerebellum and medulla on a diagram of the brain.				
	Describe the functions of the cerebral cortex, cerebellum and medulla.				
	<b>(HT only)</b> Explain some of the difficulties of investigating brain function and treating brain damage and disease.				
	<b>(HT only)</b> Describe some techniques that have been used by neuroscientists to map the regions of the brain to particular functions.				
<b>(HT only)</b> Evaluate the benefits and risks of procedures carried out on the brain and nervous system.					

4.5.2 The human nervous system (continued)		Basic K&U	General K&U	Thorough K&U	Exam ready
4.5.2.3 The eye	Identify the following structures on a diagram of the eye:				
	• retina;				
	• optic nerve;				
	• sclera;				
	• cornea;				
	• iris;				
	• ciliary muscles;				
	• suspensory ligaments.				
	Explain how the structures of the eye relate to their functions.				
	Describe the process of accommodation to focus on near objects.				
	Describe the process of accommodation to focus on distant objects.				
	Describe how the eye adapts to dim light.				
	Describe how myopia (short sightedness) affects the eye.				
	Describe how hyperopia (long sightedness) affects the eye.				
Describe how myopia can be treated.					
Describe how hyperopia can be treated.					
Interpret a ray diagram showing myopia and demonstrate how it can be corrected.					
Interpret a ray diagram showing hyperopia and demonstrate how it can be corrected.					
4.5.2.4 Control of body temperature	Name the part of the brain that monitors and controls body temperature.				
	Describe how body temperature is controlled by the nervous system.				
	Describe the changes that take place in the body if the body temperature is too high.				
	Describe the changes that take place in the body if the body temperature is too low.				
	<b>(HT only)</b> Explain how the changes that take place in the body lower or raise body temperature in a given context.				



4.5.3 Hormonal coordination in humans		Basic K&U	General K&U	Thorough K&U	Exam ready
4.5.3.1 Human endocrine system	Name and identify the main glands that make up the human endocrine system.				
	Describe the function of the human endocrine system.				
	Describe how hormones are transported to a target organ.				
	Compare the effects of the endocrine system to the effects of the nervous system in terms of speed and length of action.				
	Describe the function of the pituitary gland.				
4.5.3.2 Control of blood glucose concentration	Name the gland that monitors and controls blood glucose concentration.				
	Explain the changes that take place in the body if the blood glucose concentration is too high.				
	<b>(HT only)</b> Explain the changes that take place in the body if the blood glucose concentration is too low.				
	<b>(HT only)</b> Explain how glucagon interacts with insulin in a negative feedback cycle to control blood glucose levels in the body.				
	Compare the causes of Type 1 and Type 2 diabetes and explain how they can be treated.				
	Extract information and interpret data from graphs that show the effect of insulin on blood glucose levels in both people with diabetes and people without diabetes.				
4.5.3.3 Maintaining water and nitrogen balance in the body	Describe some ways that water, ions and urea leave the body.				
	Describe what happens to body cells if they lose or gain too much water by osmosis.				
	(HT only) Describe how excess amino acids are excreted from the body safely.				
	Describe the function of the kidneys in maintaining the water balance of the body.				
	<b>(HT only)</b> Describe the effect of ADH on the permeability of the kidney tubules.				
	<b>(HT only)</b> Explain how the water level in the body is controlled by ADH in a negative feedback cycle.				
	Describe some ways that kidney failure can be treated.				
	Describe the basic principles of dialysis for treating kidney failure.				
Evaluate the advantages and disadvantages of treating organ failure by mechanical device or transplant.					

4.5.3 Hormonal coordination in humans (continued)		Basic K&U	General K&U	Thorough K&U	Exam ready
4.5.3.4 Hormones in human reproduction	Describe the role of reproductive hormones in puberty.				
	Name the main female reproductive hormone and state where it is produced.				
	Describe the main stages in the menstrual cycle.				
	Name the hormones involved in the menstrual cycle.				
	Describe the role of each hormone in the menstrual cycle.				
	Name the main male reproductive hormone and state where it is produced.				
	Describe the role of the main male reproductive hormone in human reproduction.				
4.5.3.5 Contraception	Give some examples of hormonal methods of contraception and explain how they work.				
	Give some examples of non-hormonal methods of contraception and explain how they work.				
	Evaluate the different hormonal and non-hormonal methods of contraception.				
4.5.3.6 The use of hormones to treat infertility (HT only)	Explain the use of hormones in modern reproductive technologies to treat infertility.				
	Describe the main steps in the process of in vitro fertilisation (IVF).				
	Explain how the development of microscopy techniques has enabled IVF treatments to develop.				
	Describe some social and ethical issues associated with IVF treatments.				
	Evaluate from the perspective of patients and doctors the methods of treating infertility.				
4.5.3.7 Negative feedback (HT only)	Name the gland that produces adrenaline.				
	Describe the role of adrenaline in the body.				
	Name the gland that produces thyroxine.				
	Describe the role of thyroxine in the body.				
	Explain how thyroxine levels are controlled by negative feedback.				
	Interpret and explain simple diagrams of negative feedback control.				
4.5.4 Plant hormones		Basic K&U	General K&U	Thorough K&U	Exam ready
4.5.4.1 Control and coordination	Explain why plants produce hormones.				
	Describe the growth of plants in response to light.				
	Describe the growth of plants in response to gravity.				
	Explain how auxins cause unequal growth rates in roots and shoots.				

4.5.4 Plant hormones (continued)		Basic K&U	General K&U	Thorough K&U	Exam ready
4.5.4.1 Control and coordination (continued)	Describe a method to investigate the effect of light on the growth of newly germinated seedlings (required practical activity 8).				
	<b>(HT only)</b> Explain the importance of gibberellins.				
	<b>(HT only)</b> Describe the role of ethene in plants.				
4.5.4.2 Use of plant hormones (HT only)	Describe how the following hormones are used to control plant growth in agriculture and horticulture:				
	• auxins;				
	• ethene;				
	• gibberellins.				
	Explain how the everyday use of hormones as weed killers affects biodiversity.				
4.6 Inheritance, variation and evolution					
4.6.1 Reproduction		Basic K&U	General K&U	Thorough K&U	Exam ready
4.6.1.1 Sexual and asexual reproduction	Name the male and female gametes in animals.				
	Name the male and female gametes in flowering plants.				
	Name the type of cell division involved in the formation of gametes.				
	Explain how sexual reproduction leads to variety in the offspring.				
	Name the type of cell division involved in asexual reproduction.				
	Explain how asexual reproduction leads to genetically identical offspring (clones).				
4.6.1.2 Meiosis	Describe what happens when a cell divides to form gametes.				
	Explain how the number of chromosomes changes when gametes are formed.				
	Explain how fertilisation restores the normal number of chromosomes.				
4.6.1.3 Advantages and disadvantages of sexual and asexual reproduction	Describe some advantages and disadvantages of sexual reproduction.				
	Describe some advantages and disadvantages of asexual reproduction.				
	Give some examples of organisms that reproduce by both methods depending on the circumstances.				

4.6.1 Reproduction (continued)		Basic K&U	General K&U	Thorough K&U	Exam ready
4.6.1.4 DNA and the genome	State what DNA is and describe the shape formed by a DNA molecule.				
	Describe how DNA is stored in cells.				
	Describe the function of a gene.				
	Give a definition for the term 'genome'.				
	Explain the importance of understanding the human genome.				
4.6.1.5 DNA structure	Describe the structure of DNA in detail, including how the different components are attached to one another.				
	Interpret a diagram of DNA structure.				
	Give the letters used to represent the four bases in DNA.				
	<b>(HT only)</b> Describe complementary base pairing.				
	Explain how the order of bases in DNA controls the synthesis of a particular protein.				
	Recall a simple description of protein synthesis.				
	<b>(HT only)</b> Explain simply how a change in DNA structure may result in a change in the protein synthesised by a gene.				
	<b>(HT only)</b> Describe how genetic variants (mutations) in coding and non-coding DNA may influence phenotype.				
<b>(HT only)</b> Model insertions and deletions in chromosomes to illustrate mutations.					
4.6.1.6 Genetic inheritance	Explain the terms gamete, chromosome, gene, allele, dominant, recessive, homozygous, heterozygous, genotype and phenotype.				
	Explain when dominant and recessive alleles are expressed.				
	Explain that most characteristics are a result of the interaction of multiple genes.				
	Predict the probability of a particular outcome as a result of a single gene cross.				
	Use direct proportion and simple ratios to express the outcome of a genetic cross.				
	Complete a Punnett square diagram and extract and interpret information from genetic crosses and family trees.				
4.6.1.7 Inherited disorders	Give some examples of disorders caused by the inheritance of a dominant or recessive allele.				
	Discuss the economic, social and ethical issues concerning embryo screening, given appropriate information.				

<b>4.6.1 Reproduction (continued)</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.6.1.8 Sex determination	Recall the number of chromosomes in an ordinary human body cell.				
	Recall the sex chromosomes found in the cells of biological females.				
	Recall the sex chromosomes found in the cells of biological males.				
	Carry out a genetic cross to show sex inheritance.				
<b>4.6.2 Variation and evolution</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.6.2.1 Variation	Describe how the genome and its interaction with the environment influence the phenotype of an organism.				
	Give a definition for the term 'variation'.				
	Describe the factors that may lead to variation.				
	State that there is usually extensive genetic variation within a population of a species.				
	Recall that all variants arise from mutations and describe the effect these have on the phenotype.				
	Explain what can happen if a new phenotype is suited to an environmental change.				
4.6.2.2 Evolution	Describe what is meant by the term 'evolution'.				
	Explain how evolution occurs through natural selection of variants that give rise to phenotypes best suited to their environment.				
	Explain how new species may be formed by natural selection.				
4.6.2.3 Selective breeding	Describe the process of selective breeding.				
	Suggest some characteristics that are chosen for selective breeding.				
	Explain the impact of selective breeding of food plants and domesticated animals.				
	Explain the benefits and risks of selective breeding given appropriate information.				
	Consider ethical issues related to selective breeding.				
4.6.2.4 Genetic engineering	Describe the process of genetic engineering.				
	Explain some reasons that plant crops may be genetically engineered.				
	Explain some reasons that bacterial cells may be genetically engineered.				
	Explain the potential benefits and risks of genetic engineering in agriculture and in medicine.				
	Suggest why some people have objections to genetic engineering.				

<b>4.6.2 Variation and evolution (continued)</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.6.2.5 Cloning	Describe the process of cloning plants by tissue culture.				
	Describe the process of cloning plants by taking cuttings.				
	Describe the process of cloning animals by embryo transplant.				
	Describe the process of adult cell cloning.				
	Explain the potential benefits and risks of cloning in agriculture and medicine.				
	Explain why some people have ethical objections to cloning.				
<b>4.6.3 The development of understanding of genetics and evolution</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.6.3.1 Theory of evolution	Recall the name of the scientist who proposed the theory of evolution by natural selection.				
	Appreciate that the theory of evolution by natural selection developed over time and from information gathered by many scientists.				
	Describe the theory of evolution by natural selection.				
	Explain why the theory of evolution by natural selection was only gradually accepted.				
	Describe the basis of other theories of evolution that have now been disproved.				
4.6.3.2 Speciation	Describe the work of Darwin and Wallace in the development of the theory of evolution by natural selection.				
	Explain the impact of these ideas on biology.				
	Describe the steps which give rise to new species.				
4.6.3.3 The understanding of genetics	Describe the work of Mendel in the development of our understanding of genetics.				
	Explain why the importance of Mendel's discovery was not recognised until after his death.				
	Describe some key discoveries that contributed to our understanding of genetics.				
4.6.3.4 Evidence for evolution	Describe some examples of evidence for Darwin's theory of evolution.				
4.6.3.5 Fossils	Give a definition for the term 'fossil'.				
	Describe how fossils may be formed.				
	Explain why scientists cannot be certain how life began on Earth.				
	Explain how fossils can tell us how different organisms have changed as life developed on Earth.				
	Extract and interpret information from charts, graphs and tables such as evolutionary trees.				

<b>4.6.3 The development of understanding of genetics and evolution (continued)</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.6.3.6 Extinction	Give a definition for the term 'extinction'.				
	Describe factors which may contribute to the extinction of a species.				
4.6.3.7 Resistant bacteria	Explain why bacteria are able to evolve rapidly.				
	Describe how antibiotic resistant strains of bacteria arise.				
	Explain how the rate of development of antibiotic resistant strains of bacteria can be reduced.				
	Explain why the development of new antibiotics is unlikely to keep up with the emergence of new resistant strains.				
<b>4.6.4 Classification of living organisms</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.6.4 Classification of living organisms	Describe how organisms are classified in the system developed by Carl Linnaeus.				
	Explain the binomial system of naming organisms.				
	Describe the impact of developments in biology on classification systems.				
	Describe the 'three-domain system' developed by Carl Woese.				
	Explain how evolutionary trees can be used to show how organisms are related.				
	Extract and interpret information about how organisms are related from evolutionary trees.				
<b>4.7 Ecology</b>					
<b>4.7.1 Adaptations, interdependence and competition</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.7.1.1 Communities	Describe the levels of organisation in an ecosystem.				
	Explain the importance of interdependence and competition in a community.				
	Suggest the factors that organisms compete for in a given habitat, when provided with appropriate information.				
	Suggest how organisms are adapted to the conditions in which they live, when provided with appropriate information.				
	Explain what is meant by a stable community.				
	Extract and interpret information from charts, graphs and tables relating to the interaction of organisms within a community.				
	Describe the levels of organisation in an ecosystem.				

<b>4.7.1 Adaptations, interdependence and competition (continued)</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.7.1.2 Abiotic factors	Give a definition for the term 'abiotic'.				
	Give some examples of abiotic factors that can affect a community.				
	Explain how a change in an abiotic factor would affect a given community, when given appropriate data or context.				
	Extract and interpret information from charts, graphs and tables relating to the effect of abiotic factors on organisms within a community.				
4.7.1.3 Biotic factors	Give a definition for the term 'biotic'.				
	Give some examples of biotic factors that can affect a community.				
	Explain how a change in a biotic factor would affect a given community, when given appropriate data or context.				
	Extract and interpret information from charts, graphs and tables relating to the effect of biotic factors on organisms within a community.				
4.7.1.4 Adaptations	Give a definition for the term 'adaptation'.				
	Explain how organisms are adapted to live in their natural environment, given appropriate information.				
	Categorise adaptations as structural, behavioural or functional.				
	Explain what an extremophile is.				
	Give some examples of extremophiles and the conditions in which they live.				
<b>4.7.2 Organisation of an ecosystem</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.7.2.1 Levels of organisation	Explain the importance of photosynthetic organisms for all life on Earth.				
	Describe the role of producers in food chains.				
	Give some examples of organisms that act as producers in food chains.				
	Describe the role of primary consumers, secondary consumers and tertiary consumers in food chains.				
	Give a definition for the terms 'predator' and 'prey'.				
	Describe how the numbers of predators and prey fluctuate in a stable community.				
	Interpret graphs used to model predator-prey cycles.				
	Describe a method using transects and quadrats to determine the distribution and abundance of species in an ecosystem (required practical activity 9).				
	Describe how to calculate mean, mode and median.				
	Calculate the mean from a set of data.				
	Plot and draw appropriate graphs, selecting appropriate scales for the axes.				



4.7.2 Organisation of an ecosystem (continued)		Basic K&U	General K&U	Thorough K&U	Exam ready
4.7.2.2 How materials are cycled	Name some different materials that cycle through abiotic and biotic components of an ecosystem.				
	Describe the processes in the carbon cycle.				
	Explain the importance of the carbon cycle to living organisms.				
	Describe the processes in the water cycle.				
	Explain the importance of the water cycle to living organisms.				
	Explain the role of microorganisms in cycling materials through an ecosystem.				
4.7.2.3 Decomposition	Explain how the following factors affect the rate of decay of biological material:				
	• temperature;				
	• water;				
	• availability of oxygen.				
	Describe a method to investigate the effect of temperature on the rate of decay of fresh milk by measuring pH changes (required practical activity 10).				
	Calculate rate changes in the decay of biological material.				
	Translate information between numerical and graphical form.				
	Plot and draw appropriate graphs, selecting appropriate scales for the axes.				
4.7.2.4 Impact of environmental change (HT only)	Explain how gardeners and farmers provide optimum conditions for rapid decay of biological material.				
	Explain how biogas generators make use of anaerobic decay.				
	Evaluate the impact of environmental changes on the distribution of species in an ecosystem, given appropriate information.				
	Describe how the distribution of species may be affected by:				
	• temperature;				
• availability of water;					
• composition of atmospheric gases.					
	Explain that changes may be seasonal, geographic or caused by human interaction.				

<b>4.7.3 Biodiversity and the effect of human interaction on ecosystems</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.7.3.1 Biodiversity	Give a definition for the term 'biodiversity'.				
	Explain how a great biodiversity ensures the stability of ecosystems.				
	Explain why it is important to maintain a good level of biodiversity.				
	Describe some human activities that have an impact on biodiversity.				
4.7.3.2 Waste management	Explain the factors contributing to increased waste production.				
	Describe some different ways that pollution can occur.				
	Explain how pollution can reduce biodiversity.				
4.7.3.3 Land use	Give some ways that humans reduce the amount of land available for other animals.				
	Explain how the destruction of peat bogs reduces biodiversity.				
	Explain how the decay or burning of peat contributes to global warming.				
4.7.3.4 Deforestation	Give some reasons why large-scale deforestation in tropical areas has occurred.				
	Evaluate the environmental implications of deforestation.				
4.7.3.5 Global warming	Explain some of the causes of global warming.				
	Describe some of the biological consequences of global warming.				
	Explain why we can trust the evidence for global warming and climate change.				
	Explain why evidence is uncertain or incomplete in a complex context.				
4.7.3.6 Maintaining biodiversity	Describe both positive and negative human interactions in an ecosystem.				
	Explain the impact of human interactions in an ecosystem on biodiversity.				
	Describe some programmes that have been put in place to reduce the negative effects of humans on ecosystems and biodiversity.				
	Evaluate given information about methods that can be used to tackle problems caused by human impacts on the environment.				
	Explain and evaluate the conflicting pressures on maintaining biodiversity given appropriate information.				

4.7.4 Trophic levels in an ecosystem		Basic K&U	General K&U	Thorough K&U	Exam ready
4.7.4.1 Trophic levels	Describe the differences between the trophic levels of organisms within an ecosystem.				
	Explain that trophic levels can be represented by numbers and recall the types of organisms found at each level.				
	Describe the role of decomposers in the food chain.				
4.7.4.2 Pyramids of biomass	Describe what is represented by a pyramid of biomass.				
	Construct accurate pyramids of biomass from appropriate data.				
4.7.4.3 Transfer of Biomass	Describe how biomass changes between different trophic levels.				
	Explain the reasons for losses of biomass between different trophic levels.				
	Calculate the efficiency of biomass transfers between trophic levels by percentages or fractions of mass.				
	Explain how changes in biomass affect the number of organisms at each trophic level.				
4.7.5 Food production		Basic K&U	General K&U	Thorough K&U	Exam ready
4.7.5.1 Factors affecting food security	Give a definition for the term 'food security'.				
	Describe some of the biological factors affecting food security.				
	Interpret population and food production statistics to evaluate food security.				
	Explain why sustainable methods of food production must be found.				
4.7.5.2 Farming techniques	Explain how the efficiency of food production can be improved by intensive farming methods.				
	Explain why some animals are fed high protein foods.				
	Discuss the ethical objections that some people have to some modern intensive farming methods.				
	Evaluate the advantages and disadvantages of modern farming techniques.				
4.7.5.3 Sustainable fisheries	Describe what is happening to fish stocks in the oceans.				
	Explain why it is important to maintain fish stocks at a level where breeding continues.				
	Describe some ways that fish stocks can be conserved at a sustainable level.				
	Explain how the application of different fishing techniques promotes recovery of fish stocks.				

<b>4.7.5 Food production (continued)</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
4.7.5.4 Role of biotechnology	Describe and explain some possible biotechnical and agricultural solutions to the demands of the growing human population.				
	Describe how mycoprotein, a protein-rich food suitable for vegetarians, is produced.				
	Describe how bacteria can be genetically modified to produce human insulin to treat people with diabetes.				
	Describe how crops can be genetically modified to provide more food or produce food with an improved nutritional value.				
<b>4.8 Key ideas</b>		<b>Basic K&amp;U</b>	<b>General K&amp;U</b>	<b>Thorough K&amp;U</b>	<b>Exam ready</b>
These key ideas are of universal application, and we have embedded them throughout the subject content. They underpin many aspects of the science assessment. They include:					
<ul style="list-style-type: none"> <li>life processes depend on molecules whose structure is related to their function</li> </ul>					
<ul style="list-style-type: none"> <li>the fundamental units of living organisms are cells, which may be part of highly adapted structures including tissues, organs and organ systems, enabling living processes to be performed effectively</li> </ul>					
<ul style="list-style-type: none"> <li>living organisms may form populations of single species, communities of many species and ecosystems, interacting with each other, with the environment and with humans in many different ways</li> </ul>					
<ul style="list-style-type: none"> <li>living organisms are interdependent and show adaptations to their environment</li> </ul>					
<ul style="list-style-type: none"> <li>life on Earth is dependent on photosynthesis in which green plants and algae trap light from the Sun to fix carbon dioxide and combine it with hydrogen from water to make organic compounds and oxygen</li> </ul>					
<ul style="list-style-type: none"> <li>organic compounds are used as fuels in cellular respiration to allow the other chemical reactions necessary for life</li> </ul>					
<ul style="list-style-type: none"> <li>the chemicals in ecosystems are continually cycling through the natural world</li> </ul>					
<ul style="list-style-type: none"> <li>the characteristics of a living organism are influenced by its genome and its interaction with the environment</li> </ul>					
<ul style="list-style-type: none"> <li>evolution occurs by a process of natural selection and accounts both for biodiversity and how organisms are all related to varying degrees.</li> </ul>					