CAMBRIDGE
International Examinations

Cambridge
IGCSE

SYLLABUS

Cambridge IGCSE®

Cambridge International Certificate*

Biology

0610

For examination in June and November 2015

This syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate (QN: ###/###/#).

Cambridge Secondary 2

5. Syllabus content

The syllabus content below is a guide to the areas on which candidates are assessed.

It is important that, throughout this course, teachers should make candidates aware of the relevance of the concepts studied to everyday life, and to the natural and man-made worlds.

Specific content has been limited in order to encourage this approach, and to allow flexibility in the design of teaching programmes.

Cambridge also provides schemes of work, which can be found on the Cambridge Teacher Support website.

Candidates may follow the **Core syllabus** only **or** they may follow the **Extended syllabus** which includes both the Core and the Supplement.

Candidates will be expected to give biologically correct definitions of any of the terms printed in italics.

Section I: Characteristics and classification of living organisms (5% of teaching time)	
1. Characteristics of living organisms	

Core
• List and describe the characteristics of living organisms
• Define the terms:
  • *nutrition* as taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them
  • *excretion* as removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration) and substances in excess of requirements
  • *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy
  • *sensitivity* as the ability to detect or sense changes in the environment (stimuli) and to make responses
  • *reproduction* as the processes that make more of the same kind of organism
  • *growth* as a permanent increase in size and dry mass by an increase in cell number or cell size or both
  • *movement* as an action by an organism or part of an organism causing a change of position or place	

2. Classification and diversity of living organisms	
2.1 Concept and use of a classificatory system **Core** • Define and describe the *binomial system* of naming species as a system in which the scientific name of an organism is made up of two parts showing the genus and species • List the main features of the following vertebrates: bony fish, amphibians, reptiles, birds and mammals	**Supplement** • Know that there are other classification systems e.g. cladistics (based on RNA/DNA sequencing data) • List the main features used in the classification of the following groups: viruses, bacteria and fungi, and their adaptation to the environment, as appropriate
2.2 Adaptations of organisms to their environment *(to be illustrated by examples wherever possible)* **Core** • List the main features used in the classification of the following groups: flowering plants (monocotyledons and eudicotyledons (dicotyledons)), arthropods (insects, crustaceans, arachnids and myriapods), annelids, nematodes and molluscs	
3. Simple keys	
Core • Use simple dichotomous keys based on easily identifiable features	

Section II: Organisation and maintenance of the organism (50% of teaching time)

1. Cell structure and organisation

Core

- State that living organisms are made of cells
- Identify and describe the structure of a plant cell (palisade cell) and an animal cell (liver cell), as seen under a light microscope
- Describe the differences in structure between typical animal and plant cells

Supplement

- Relate the structures seen under the light microscope in the plant cell and in the animal cell to their functions

2. Levels of organisation

Core

- Relate the structure of the following to their functions:
  - ciliated cells – in respiratory tract
  - root hair cells – absorption
  - xylem vessels – conduction and support
  - muscle cells – contraction
  - red blood cells – transport
- Define:
  - *tissue* as a group of cells with similar structures, working together to perform a shared function
  - *organ* as a structure made up of a group of tissues, working together to perform specific functions
  - *organ system* as a group of organs with related functions, working together to perform body functions

  using examples covered in Sections II and III

3. Size of specimens

Core

- Calculate magnification and size of biological specimens using millimetres as units

4. Movement in and out of cells	
4.1 Diffusion **Core** • Define *diffusion* as the net movement of molecules from a region of their higher concentration to a region of their lower concentration down a concentration gradient, as a result of their random movement • Describe the importance of diffusion of gases and solutes and of water as a solvent	
4.2 Active Transport	**Supplement** • Define *active transport* as movement of ions in or out of a cell through the cell membrane, from a region of their lower concentration to a region of their higher concentration against a concentration gradient, using energy released during respiration • Discuss the importance of active transport as an energy-consuming process by which substances are transported against a concentration gradient, e.g. ion uptake by root hairs and uptake of glucose by epithelial cells of villi
4.3 Osmosis **Core** • Define *osmosis* as the diffusion of water molecules from a region of their higher concentration (dilute solution) to a region of their lower concentration (concentrated solution), through a partially permeable membrane • Describe the importance of osmosis in the uptake of water by plants, and its effects on plant and animal tissues	**Supplement** • Describe and explain the importance of a water potential gradient in the uptake of water by plants

5. Enzymes	
Core • Define the term *catalyst* as a substance that speeds up a chemical reaction and is not changed by the reaction • Define *enzymes* as proteins that function as biological catalysts • Investigate and describe the effect of changes in temperature and pH on enzyme activity	**Supplement** • Explain enzyme action in terms of the 'lock and key' model • Explain the effect of changes in temperature and pH on enzyme activity • Describe the role of enzymes in the germination of seeds, and their uses in biological washing products and in the food industry (including pectinase and fruit juice) • Outline the use of microorganisms and fermenters to manufacture the antibiotic penicillin and enzymes for use in biological washing powders • Describe the role of the fungus *Penicillium* in the production of antibiotic penicillin
6. Nutrition	
Core • Define *nutrition* as taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them	

6.1 Nutrients
Core
• List the chemical elements that make up:
  • carbohydrates
  • fats
  • proteins
• Describe the synthesis of large molecules from smaller basic units, i.e.
  • simple sugars to starch and glycogen
  • amino acids to proteins
  • fatty acids and glycerol to fats and oils	

• Describe tests for:
  • starch (iodine solution)
  • reducing sugars (Benedict's solution)
  • protein (Biuret test)
  • fats (ethanol)
• List the principal sources of, and describe the importance of:
  • carbohydrates
  • fats
  • proteins
  • vitamins (C and D only)
  • mineral ions (calcium and iron only)
  • fibre (roughage)
  • water
• Describe the deficiency symptoms for:
  • vitamins (C and D only)
  • mineral ions (calcium and iron only)
	• Describe the use of microorganisms in the food industry, with reference to yoghurt and single cell protein
	• Describe the uses, benefits and health hazards associated with food additives, including colourings

6.2 Plant nutrition	
6.2.1 Photosynthesis **Core** • Define *photosynthesis* as the fundamental process by which plants manufacture carbohydrates from raw materials using energy from light • State the word equation for the production of simple sugars and oxygen • Investigate the necessity for chlorophyll, light and carbon dioxide for photosynthesis, using appropriate controls • Describe the intake of carbon dioxide and water by plants • Explain that chlorophyll traps light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent storage	**Supplement** • State the balanced equation for photosynthesis in symbols $6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6O_2$ • Investigate and state the effect of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis (e.g. in submerged aquatic plants) • Define the term *limiting* factor as something present in the environment in such short supply that it restricts life processes • Explain the concept of limiting factors in photosynthesis • Explain the use of carbon dioxide enrichment, optimum light and optimum temperatures in glasshouse systems

6.2.2 Leaf structure **Core** • Identify and label the cuticle, cellular and tissue structure of a dicotyledonous leaf, as seen in cross-section under the light microscope, and describe the significance of these features in terms of functions, to include: • distribution of chloroplasts – photosynthesis • stomata and mesophyll cells – gas exchange • vascular bundles (xylem and phloem) – transport and support	

6.2.3 Mineral requirements
Core
• Describe the importance of:
  • nitrate ions for protein synthesis
  • magnesium ions for chlorophyll synthesis
• Describe the uses, and the dangers of overuse, of nitrogen fertilisers
	Supplement
	• Explain the effects of nitrate ion and magnesium ion deficiency on plant growth

6.3 Animal nutrition	
6.3.1 Diet **Core** • State what is meant by the term balanced diet and describe a balanced diet related to age, sex and activity of an individual • Describe the effects of malnutrition in relation to starvation, coronary heart disease, constipation and obesity	
6.3.2 Food supply **Core** • Discuss ways in which the use of modern technology has resulted in increased food production (to include modern agricultural machinery, chemical fertilisers, pesticides and herbicides, artificial selection)	**Supplement** • Discuss the problems of world food supplies • Discuss the problems which contribute to famine (unequal distribution of food, drought and flooding and increasing population)

6.3.3 Human alimentary canal **Core** • Define *ingestion* as taking substances (e.g. food, drink) into the body through the mouth • Define *egestion* as passing out of food that has not been digested, as faeces, through the anus • Identify the main regions of the alimentary canal and associated organs including mouth, salivary glands, oesophagus, stomach, small intestine: duodenum and ileum, pancreas, liver, gall bladder, large intestine: colon and rectum, anus • Describe the functions of the regions of the alimentary canal listed above, in relation to ingestion, digestion, absorption, assimilation and egestion of food (cross reference 6.3.4, 6.3.5, 6.3.6 and 6.3.7)	
6.3.4 Mechanical and physical digestion **Core** • Define *digestion* as the break-down of large, insoluble food molecules into small, water-soluble molecules using mechanical and chemical processes • Identify the types of human teeth and describe their structure and functions • State the causes of dental decay and describe the proper care of teeth • Describe the process of chewing • Describe the role of longitudinal and circular muscles in peristalsis • Outline the role of bile in emulsifying fats, to increase the surface area for the action of enzymes	**Supplement** • Describe how fluoride reduces tooth decay and explain arguments for and against the addition of fluoride to public water supplies
6.3.5 Chemical digestion **Core** • State the significance of chemical digestion in the alimentary canal in producing small, soluble molecules that can be absorbed • State where, in the alimentary canal, amylase, protease and lipase enzymes are secreted • State the functions of a typical amylase, a protease and a lipase, listing the substrate and end-products	

6.3.6 Absorption **Core** • Define *absorption* as movement of digested food molecules through the wall of the intestine into the blood or lymph • Identify the small intestine as the region for the absorption of digested food • Describe the significance of villi in increasing the internal surface area of the small intestine	**Supplement** • Describe the structure of a villus, including the role of capillaries and lacteals • State the role of the hepatic portal vein in the transport of absorbed food to the liver • Identify the role of the small intestine and colon in absorption of water (the small intestine absorbs 5–10 dm^3 per day, the colon 0.3–0.5 dm^3 per day)
6.3.7 Assimilation **Core** • Define *assimilation* as movement of digested food molecules into the cells of the body where they are used, becoming part of the cells • Describe the role of the liver in the metabolism of glucose (glucose → glycogen) and amino acids (amino acids → proteins and destruction of excess amino acids) • Describe the role of fat as an energy storage substance	**Supplement** • Define *deamination* as removal of the nitrogen-containing part of amino acids to form urea, followed by release of energy from the remainder of the amino acid • State that the liver is the site of breakdown of alcohol and other toxins
7. Transportation	
7.1 Transport in plants **Core** • State the functions of xylem and phloem • Identify the positions of xylem and phloem tissues as seen in transverse sections of unthickened, herbaceous, dicotyledonous roots, stems and leaves	
7.1.1 Water uptake **Core** • Identify root hair cells, as seen under the light microscope, and state their functions • State the pathway taken by water through root, stem and leaf (root hair, root cortex cells, xylem, mesophyll cells) • Investigate, using a suitable stain, the pathway of water through the above-ground parts of a plant	**Supplement** • Relate the structure and functions of root hairs to their surface area and to water and ion uptake

7.1.2 Transpiration **Core** • Define *transpiration* as evaporation of water at the surfaces of the mesophyll cells followed by loss of water vapour from plant leaves, through the stomata • Describe how water vapour loss is related to cell surfaces, air spaces and stomata • Describe the effects of variation of temperature, humidity and light intensity on transpiration rate • Describe how wilting occurs	**Supplement** • Explain the mechanism of water uptake and movement in terms of transpiration producing a tension ('pull') from above, creating a water potential gradient in the xylem, drawing cohesive water molecules up the plant. • Discuss the adaptations of the leaf, stem and root to **three** contrasting environments, to include pond, garden and desert, with emphasis on local examples (where appropriate) and the factors described in the core

7.1.3 Translocation
Core
• Define *translocation* in terms of the movement of sucrose and amino acids in phloem;
  • from regions of production
  • to regions of storage OR to regions of utilisation in respiration or growth
	Supplement
	• Describe translocation throughout the plant of applied chemicals, including systemic pesticides
	• Compare the role of transpiration and translocation in the transport of materials from sources to sinks, within plants at different seasons

7.2 Transport in humans **Core** • Describe the circulatory system as a system of tubes with a pump and valves to ensure one-way flow of blood • Describe the double circulation in terms of a low pressure circulation to the lungs and a high pressure circulation to the body tissues and relate these differences to the different functions of the two circuits	
7.2.1 Heart **Core** • Describe the structure of the heart including the muscular wall and septum, chambers, valves and associated blood vessels • Describe the function of the heart in terms of muscular contraction and the working of the valves • Investigate, state and explain the effect of physical activity on pulse rate • Describe coronary heart disease in terms of the blockage of coronary arteries and state the possible causes (diet, stress and smoking) and preventive measures	

7.2.2 Arteries, veins and capillaries **Core** • Name the main blood vessels to and from the heart, lungs, liver and kidney • Describe the structure and functions of arteries, veins and capillaries	**Supplement** • Explain how structure and function are related in arteries, veins and capillaries • Describe the transfer of materials between capillaries and tissue fluid

7.2.3 Blood
Core
• Identify red and white blood cells as seen under the light microscope on prepared slides, and in diagrams and photomicrographs
• List the components of blood as red blood cells, white blood cells, platelets and plasma
• State the functions of blood:
  • red blood cells – haemoglobin and oxygen transport
  • white blood cells – phagocytosis and antibody formation
  • platelets – causing clotting (no details)
  • plasma – transport of blood cells, ions, soluble nutrients, hormones, carbon dioxide, urea and plasma proteins
	Supplement
	• Describe the immune system in terms of antibody production, tissue rejection and phagocytosis
	• Describe the function of the lymphatic system in circulation of body fluids, and the production of lymphocytes
	• Describe the process of clotting (fibrinogen to fibrin only)

8. Respiration	
Core • Define *respiration* as the chemical reactions that break down nutrient molecules in living cells to release energy • State the uses of energy in the body of humans: muscle contraction, protein synthesis, cell division, active transport, growth, the passage of nerve impulses and the maintenance of a constant body temperature	
8.1 Aerobic respiration **Core** • Define *aerobic respiration* as the release of a relatively large amount of energy in cells by the breakdown of food substances in the presence of oxygen • State the word equation for aerobic respiration	**Supplement** • State the equation for aerobic respiration using symbols ($C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$)

8.2 Anaerobic respiration **Core** • Define *anaerobic respiration* as the release of a relatively small amount of energy by the breakdown of food substances in the absence of oxygen • State the word equation for anaerobic respiration in muscles during hard exercise (glucose → lactic acid) and the microorganism yeast (glucose → alcohol + carbon dioxide) • Describe the role of anaerobic respiration in yeast during brewing and bread-making • Compare aerobic respiration and anaerobic respiration in terms of relative amounts of energy released	**Supplement** • State the balanced equation for anaerobic respiration in muscles ($C_6H_{12}O_6 \rightarrow 2C_3H_6O_3$) and the microorganism yeast ($C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$), using symbols • Describe the effect of lactic acid in muscles during exercise (include oxygen debt in outline only)
8.3 Gas exchange **Core** • List the features of gas exchange surfaces in animals • Identify on diagrams and name the larynx, trachea, bronchi, bronchioles, alveoli and associated capillaries • State the differences in composition between inspired and expired air • Use lime water as a test for carbon dioxide to investigate the differences in composition between inspired and expired air • Investigate and describe the effects of physical activity on rate and depth of breathing	**Supplement** • Describe the role of the ribs, the internal and external intercostal muscles and the diaphragm in producing volume and pressure changes leading to the ventilation of the lungs • Explain the role of mucus and cilia in protecting the gas exchange system from pathogens and particles • Explain the link between physical activity and rate and depth of breathing in terms of changes in the rate at which tissues respire and therefore of carbon dioxide concentration and pH in tissues and in the blood

9. Excretion in humans	
Core	**Supplement**
• Define *excretion* as the removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration) and substances in excess of requirements. Substances should include carbon dioxide, urea and salts	

• Describe the function of the kidney in terms of the removal of urea and excess water and the reabsorption of glucose and some salts (details of kidney structure and nephron are **not** required)
• State the relative positions of ureters, bladder and urethra in the body
• State that urea is formed in the liver from excess amino acids
• State that alcohol, drugs and hormones are broken down in the liver
	• Outline the structure of a kidney (cortex, medulla, and the start of the ureter) and outline the structure and functioning of a kidney tubule including:
	  • role of renal capsule in filtration from blood of water, glucose, urea and salts
	  • role of tubule in reabsorption of glucose, most of the water and some salts back into the blood, leading to concentration of urea in the urine as well as loss of excess water and salts
	• Explain dialysis in terms of maintenance of glucose and protein concentration in blood and diffusion of urea from blood to dialysis fluid
	• Discuss the application of dialysis in kidney machines
	• Discuss the advantages and disadvantages of kidney transplants, compared with dialysis

10. Coordination and response	
10.1 Nervous control in humans **Core** • 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 which together serve to coordinate and regulate body functions • Identify motor (effector), relay (connector) 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 automatically and rapidly integrating and coordinating stimuli with responses • State that muscles and glands can act as effectors • Describe the action of antagonistic muscles to include the biceps and triceps at the elbow joint • Define sense *organs* as groups of receptor cells responding to specific stimuli: light, sound, touch, temperature and chemicals • Describe the structure and function of the eye, including accommodation and pupil reflex	**Supplement** • Distinguish between voluntary and involuntary actions • Distinguish between rods and cones, in terms of function and distribution
10.2 Hormones **Core** • Define a *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 • State the role of the hormone adrenaline in chemical control of metabolic activity, including increasing the blood glucose concentration and pulse rate • Give examples of situations in which adrenaline secretion increases • Compare nervous and hormonal control systems	**Supplement** • Discuss the use of hormones in food production
10.3 Tropic responses **Core** • Define and investigate *geotropism* (as a response in which a plant grows towards or away from gravity) and *phototropism* (as a response in which a plant grows towards or away from the direction from which light is coming)	**Supplement** • Explain the chemical control of plant growth by auxins including geotropism and phototropism in terms of auxins regulating differential growth, and the effects of synthetic plant hormones used as weedkillers

10.4 Homeostasis **Core** • Define *homeostasis* as the maintenance of a constant internal environment • Identify, on a diagram of the skin: hairs, sweat glands, temperature receptors, blood vessels and fatty tissue • 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, vasodilation and vasoconstriction of arterioles supplying skin-surface capillaries and the coordinating role of the brain	**Supplement** • Explain the concept of control by negative feedback • Describe the control of the glucose content of the blood by the liver, and by insulin and glucagon from the pancreas
10.5 Drugs **Core** • Define a drug as any substance taken into the body that modifies or affects chemical reactions in the body • Describe the medicinal use of antibiotics for the treatment of bacterial infection • Describe the effects of the abuse of heroin: a powerful depressant, problems of addiction, severe withdrawal symptoms and associated problems such as crime and infection e.g. HIV/AIDS • Describe the effects of excessive consumption of alcohol: reduced self-control, depressant, effect on reaction times, damage to liver and social implications • Describe the effects of tobacco smoke and its major toxic components (tar, nicotine, carbon monoxide, smoke particles) on the gas exchange system	**Supplement** • Explain why antibiotics kill bacteria but not viruses

Section III: Development of the organism and the continuity of life (25% of teaching time)	
1. Reproduction	
1.1 Asexual reproduction **Core** • Define *asexual reproduction* as the process resulting in the production of genetically identical offspring from one parent • Describe asexual reproduction in bacteria, spore production in fungi and tuber formation in potatoes	**Supplement** • Discuss the advantages and disadvantages to a species of asexual reproduction
1.2 Sexual reproduction **Core** • Define *sexual reproduction* as the process involving the fusion of haploid nuclei to form a diploid zygote and the production of genetically dissimilar offspring	**Supplement** • Discuss the advantages and disadvantages to a species of sexual reproduction
1.2.1 Sexual reproduction in plants **Core** • Identify and draw, using a hand lens if necessary, the sepals, petals, stamens, anthers, carpels, ovaries and stigmas of one, locally available, named, insect-pollinated, dicotyledonous flower, and examine the pollen grains under a light microscope or in photomicrographs • State the functions of the sepals, petals, anthers, stigmas and ovaries • Use a hand lens to identify and describe the anthers and stigmas of one, locally available, named, wind-pollinated flower, and examine the pollen grains under a light microscope or in photomicrographs	**Supplement**

• Candidates should expect to apply their understanding of the flowers they have studied to unfamiliar flowers • Define *pollination* as the transfer of pollen grains from the male part of the plant (anther of stamen) to the female part of the plant (stigma) • Name the agents of pollination • Compare the different structural adaptations of insect-pollinated and wind-pollinated flowers • Describe the growth of the pollen tube and its entry into the ovule followed by fertilisation (production of endosperm and details of development are **not** required) • Investigate and describe the structure of a non-endospermic seed in terms of the embryo (radicle, plumule and cotyledons) and testa, protected by the fruit • Outline the formation of a seed (limited to embryo, cotyledons, testa and role of mitosis) and fruit (produced from the ovary wall) • State that seed and fruit dispersal by wind and by animals provides a means of colonising new areas • Describe, using named examples, seed and fruit dispersal by wind and by animals	• Distinguish between self-pollination and cross-pollination • Discuss the implications to a species of self-pollination and cross-pollination

1.2.2 Sexual reproduction in humans **Core** • Identify on diagrams of the male reproductive system, the testes, scrotum, sperm ducts, prostate gland, urethra and penis, and state the functions of these parts • Identify on diagrams of the female reproductive system, the ovaries, oviducts, uterus, cervix and vagina, and state the functions of these parts • Describe the menstrual cycle in terms of changes in the uterus and ovaries • Outline sexual intercourse and describe fertilisation in terms of the joining of the nuclei of male gamete (sperm) and the female gamete (egg) • Outline early development of the zygote simply in terms of the formation of a ball of cells that becomes implanted in the wall of the uterus • Outline the development of the fetus • Describe the function of the placenta and umbilical cord in relation to exchange of dissolved nutrients, gases and excretory products (no structural details are required) • Describe the ante-natal care of pregnant women including special dietary needs and maintaining good health • Outline the processes involved in labour and birth	**Supplement** • Compare male and female gametes in terms of size, numbers and mobility • Explain the role of hormones in controlling the menstrual cycle (including FSH, LH, progesterone and oestrogen) • Indicate the functions of the amniotic sac and amniotic fluid • Describe the advantages and disadvantages of breast-feeding compared with bottle-feeding using formula milk
1.3 Sex hormones **Core** • Describe the roles of testosterone and oestrogen in the development and regulation of secondary sexual characteristics at puberty	**Supplement** • Describe the sites of production and the roles of oestrogen and progesterone in the menstrual cycle and in pregnancy (cross reference 1.2.2)

1.4 Methods of birth control
Core
• Outline the following methods of birth control:
  • natural (abstinence, rhythm method)
  • chemical (contraceptive pill, spermicide)
  • mechanical (condom, diaphragm, femidom, IUD)
  • surgical (vasectomy, female sterilisation)
	Supplement
	• Outline artificial insemination and the use of hormones in fertility drugs, and discuss their social implications

1.5 Sexually transmissible diseases **Core** • Describe the symptoms, signs, effects and treatment of gonorrhoea • Describe the methods of transmission of human immunodeficiency virus (HIV), and the ways in which HIV/AIDS can be prevented from spreading	**Supplement** • Outline how HIV affects the immune system in a person with HIV/AIDS
2. Growth and development	
Core • Define *growth* in terms of a permanent increase in size and dry mass by an increase in cell number or cell size or both • Define *development* in terms of increase in complexity • Investigate and state the environmental conditions that affect germination of seeds: requirement for water and oxygen, suitable temperature	
3. Inheritance	
Core • Define *inheritance* as the transmission of genetic information from generation to generation	

3.1 Chromosomes
Core
• Define the terms:
  • *chromosome* as a thread of DNA, made up of a string of genes
  • *gene* as a length of DNA that is the unit of heredity and codes for a specific protein. A gene may be copied and passed on to the next generation
  • *allele* as any of two or more alternative forms of a gene
  • *haploid nucleus* as a nucleus containing a single set of unpaired chromosomes (e.g. sperm and egg)
  • *diploid nucleus* as a nucleus containing two sets of chromosomes (e.g. in body cells)
• Describe the inheritance of sex in humans (XX and XY chromosomes)	

3.2 Mitosis **Core** • Define *mitosis* as nuclear division giving rise to genetically identical cells in which the chromosome number is maintained by the exact duplication of chromosomes (details of stages are **not** required) • State the role of mitosis in growth, repair of damaged tissues, replacement of worn out cells and asexual reproduction	
3.3 Meiosis **Core** • Define *meiosis* as reduction division in which the chromosome number is halved from diploid to haploid (details of stages are **not** required) • State that gametes are the result of meiosis • State that meiosis results in genetic variation so the cells produced are not all genetically identical	

3.4 Monohybrid inheritance
Core
• Define the terms:
  • *genotype* as genetic makeup of an organism in terms of the alleles present (e.g. Tt or GG)
  • *phenotype* as the physical or other features of an organism due to both its genotype and its environment (e.g. tall plant or green seed)
  • *homozygous* as having two identical alleles of a particular gene (e.g. TT or gg). Two identical homozygous individuals that breed together will be pure-breeding
  • *heterozygous* as having two different alleles of a particular gene (e.g. Tt or Gg), not pure-breeding
  • *dominant* as an allele that is expressed if it is present (e.g. T or G)
  • *recessive* as an allele that is only expressed when there is no dominant allele of the gene present (e.g. t or g)
• Calculate and predict the results of monohybrid crosses involving 1 : 1 and 3 : 1 ratios
	Supplement
	• Explain codominance by reference to the inheritance of ABO blood groups – phenotypes, A, B, AB and O blood groups and genotypes I^A, I^B, and I^O

3.5 Variation **Core** • State that continuous variation is influenced by genes and environment, resulting in a range of phenotypes between two extremes, e.g. height in humans • State that discontinuous variation is caused by genes alone and results in a limited number of distinct phenotypes with no intermediates e.g. A, B, AB and O blood groups in humans • Define *mutation* as a change in a gene or chromosome • Describe mutation as a source of variation, as shown by Down's syndrome • Outline the effects of ionising radiation and chemicals on the rate of mutation	**Supplement** • Describe sickle cell anaemia, and explain its incidence in relation to that of malaria
3.6 Selection **Core** • Describe the role of artificial selection in the production of varieties of animals and plants with increased economic importance • Define *natural selection* as the greater chance of passing on of genes by the best adapted organisms	**Supplement** • Describe variation and state that competition leads to differential survival of, and reproduction by, those organisms best fitted to the environment • Assess the importance of natural selection as a possible mechanism for evolution • Describe the development of strains of antibiotic resistant bacteria as an example of natural selection
3.7 Genetic Engineering **Core** • Define *genetic engineering* as taking a gene from one species and putting it into another species	**Supplement** • Explain why, and outline how, human insulin genes were put into bacteria using genetic engineering

Section IV: Relationships of organisms with one another and with their environment (20% of teaching time)

1. Energy flow

Core

- State that the Sun is the principal source of energy input to biological systems
- Describe the non-cyclical nature of energy flow

2. Food chains and food webs (emphasis on examples occurring locally)

Core

- Define the terms:
  - *food chain* as a chart showing the flow of energy (food) from one organism to the next beginning with a producer (e.g. mahogany tree → caterpillar → song bird → hawk)
  - *food web* as a network of interconnected food chains showing the energy flow through part of an ecosystem
  - *producer* as an organism that makes its own organic nutrients, usually using energy from sunlight, through photosynthesis
  - *consumer* as an organism that gets its energy by feeding on other organisms
  - *herbivore* as an animal that gets its energy by eating plants
  - *carnivore* as an animal that gets its energy by eating other animals
  - *decomposer* as an organism that gets its energy from dead or waste organic matter
  - *ecosystem* as a unit containing all of the organisms and their environment, interacting together, in a given area e.g. decomposing log or a lake
  - *trophic level* as the position of an organism in a food chain, food web or pyramid of biomass, numbers or energy
- Describe energy losses between trophic levels
- Draw, describe and interpret pyramids of biomass and numbers

Supplement

- Explain why food chains usually have fewer than five trophic levels
- Explain why there is an increased efficiency in supplying green plants as human food and that there is a relative inefficiency, in terms of energy loss, in feeding crop plants to animals

3. Nutrient cycles	

Core
• Describe the carbon and the water cycles
	Supplement
	• Describe the nitrogen cycle in terms of:
	  • the role of microorganisms in providing usable nitrogen-containing substances by decomposition and by nitrogen fixation in roots
	  • the absorption of these substances by plants and their conversion to protein
	  • followed by passage through food chains, death, decay
	  • nitrification and denitrification and the return of nitrogen to the soil or the atmosphere
	(names of individual bacteria are not required)
	• Discuss the effects of the combustion of fossil fuels and the cutting down of forests on the oxygen and carbon dioxide concentrations in the atmosphere

4. Population size	
Core • Define *population* as a group of organisms of one species, living in the same area at the same time • State the factors affecting the rate of population growth for a population of an organism (limited to food supply, predation and disease), and describe their importance • Identify the lag, exponential (log), stationary and death phases in the sigmoid population growth curve for a population growing in an environment with limited resources • Describe the increase in human population size and its social implications • Interpret graphs and diagrams of human population growth	**Supplement** • Explain the factors that lead to the lag phase, exponential (log) phase and stationary phase in the sigmoid curve of population growth making reference, where appropriate, to the role of limiting factors
5. Human influences on the ecosystem	
Core • Outline the effects of humans on ecosystems, with emphasis on examples of international importance (tropical rain forests, oceans and important rivers)	

5.1 Agriculture **Core** • List the undesirable effects of deforestation (to include extinction, loss of soil, flooding, carbon dioxide build up) • Describe the undesirable effects of overuse of fertilisers (to include eutrophication of lakes and rivers)	

5.2 Pollution
Core
• Describe the undesirable effects of pollution to include:
  • water pollution by sewage and chemical waste
  • air pollution by sulfur dioxide
  • air pollution by greenhouse gases (carbon dioxide and methane) contributing to global warming
  • pollution due to pesticides including insecticides and herbicides
  • pollution due to nuclear fall-out
	Supplement
	• Discuss the effects of non-biodegradable plastics in the environment
	• Discuss the causes and effects on the environment of acid rain, and the measures that might be taken to reduce its incidence
	• Explain how increases in greenhouse gases (carbon dioxide and methane) are thought to cause global warming

5.3 Conservation
Core
• Describe the need for conservation of:
  • species and their habitats
  • natural resources (limited to water and non-renewable materials including fossil fuels)
	Supplement
	• Explain how limited and non-renewable resources can be recycled (including recycling of paper and treatment of sewage to make the water that it contains safe to return to the environment or for human use)