Curriculum Planning

Enrich Academy

ENRICH ACADEMY

Nurturing inclusive learning communities

Science

"Science and everyday life cannot and should not be separated"

Rosalind Franklin

Curriculum Intent

We believe that our pupils deserve a broad and aspirational science curriculum rich in skills and knowledge preparing them for further education and employment. The science curriculum has been designed to provide pupils with a deep understanding of the scientific knowledge and ideas that impact them as individuals within a local and global context. As they move through the curriculum, pupils will be increasingly encouraged to develop their curiosity, work scientifically and appreciate the value of science in their everyday lives to improve their social and moral understanding of the world, and be able to form reasoned opinions around 'big' scientific questions.

Curriculum Implementation

The curriculum is designed to build and expand on previous skills and understanding over a 1 year period dependent on the course being studied. This is determined through use of appropriate baseline assessments and an understanding of the pupils SEND / SEMMH needs. We offer both Entry Level, Level 1 and Level 2 qualifications at Enrich depending upon a pupil's identified pathway through Key Stage 4. Pupils follow the appropriate pathway meeting both the rigour of the national curriculum and building a greater understanding of science moving forward into the wider world.

Delivery of the curriculum is underpinned by quality first teaching, informed by frequent 'low stakes' retrieval testing. Marking and feedback addresses misconceptions promptly and enables interventions that are timely and effective. Pupils are encouraged to develop their own scientific ideas and have opportunities to interact with scientists in the 'real world' to deepen their understanding.

Curriculum Impact:

The majority of pupils meet or exceed their targets in Science and required grades are attained to enable pupils to follow their chosen Post 16 pathways.

Year 1 Curriculum

Cycle 1

Animal and Plant Cells	Label diagrams of animal and plant cells. Describe the function of the main organelles. Prepare slides of plant and animal cells and describe the procedure. Correctly use a microscope to observe cells under different magnifications.
Prokaryotes vs Eukaryotic cells	Identify plant, animal and bacterial cells and classify them as eukaryotic or prokaryotic cells. Label diagrams of bacterial cells. Describe the differences between eukaryotic and prokaryotic cells in terms of structure and size. Describe the differences in magnification and resolution of light and electron microscopes. Explain how electron microscopy has increased understanding of organelles.
Cell specialisation and Differentiation	Explain the need for differentiation in a multicellular organism. Describe the differences between differentiation in plants and in animals. Explain how specialised cells are adapted for their function.
Light vs Electron Microscope and counting microorganisms	Describe the differences in magnification and resolution of light and electron microscopes. Explain how electron microscopy has increased understanding of organelles. Students should be able to calculate cross-sectional areas of colonies or clear areas around colonies using πr^2.Students should be able to calculate the number of bacteria in a population after a certain time if given the mean division time.
Culturing Microorganisms	Know that bacteria multiply by simple cell division. Know how bacteria can be grown. Know procedure to prepare an uncontaminated culture. Explain why cultures are incubated at a maximum temperature of 25°C. Describe why uncontaminated cultures are necessary in research.
Cell Division	Describe what a chromosome is and where chromosomes are found in the cell Draw and label diagrams showing cell, nucleus, chromosome and gene. Consider the scale of these structures. Arrange chromosome images into pairs. Describe simply how and why body cells divide by.
Stem Cells	A stem cell is an undifferentiated cell of an organism which is capable of

	giving rise to many more cells of the same type, and from which certain other cells can arise from differentiation. Students should be able to describe the function of stem cells in embryos, in adult animals and in the meristems in plants. Stem cells from human embryos can be cloned and made to differentiate into most different types of human cells. Stem cells from adult bone marrow can form many types of cells including blood cells. Meristem tissue in plants can differentiate into any type of plant cell, throughout the life of the plant. Knowledge and understanding of stem cell techniques are not required. Treatment with stem cells may be able to help conditions such as diabetes and paralysis.
Diffusion	Explain how temperature, concentration gradient and surface area affect the rate of diffusion. Give examples of substances that diffuse into and out of cells. area: volume ratios. Explain how the small intestine and lungs in mammals, and roots and leaves in plants, are adapted for exchange of substances. Describe and explain how an exchange surface is made more effective.
Osmosis and Required Practical	Define the term 'osmosis'. Observe and explain the effects of water and concentrated salt solution on cells of onion/ beetroot/ rhubarb. Use a model to show osmosis Make predictions with explanations.
Active transport	Define the term 'active transport'. Describe where active transport occurs in humans and plants and what is transported. Explain why active transport requires energy. Explain how active transport enables cells to absorb ions from very dilute solutions. Explain the relationship between active transport and oxygen supply and numbers of mitochondria in cells.
Organisation in the human body	Organ, organ system and organism, and be able to give examples of each. Have an understanding of the size and scale of cells, tissues, organs, organ systems and organisms. Describe the main systems in the human body and their functions.

Cycle 2

Required Practical Food Tests	Required practical activity 4: use qualitative reagents to test for a range of carbohydrates, lipids and proteins. To include: Benedict's test for sugars; iodine test for starch; and Biuret reagent for protein. AT skills covered by this practical activity: AT 2 and 8. This practical activity also provides opportunities to develop WS and MS.
Enzyme basics	Describe the functions of the digestive system to digest and absorb foods. Identify the positions of the main organs on a diagram of the digestive system. Know that food molecules must be small and soluble in order to be absorbed into the blood. Describe the functions of the organs in the system. Explain how the small intestine is adapted for its function. Define the terms 'catalyst' and 'enzyme'. Describe the properties of enzymes. Explain why enzymes are specific and are denatured by high temperatures and extremes of pH. Use the lock and key theory and collision theory to explain enzyme action.
Enzymes in digestion and Enzyme practical	Carry out a safe, controlled investigation to measure the rate of the catalase under different conditions. Draw a diagram of the apparatus and write a method. Identify variables. Present and analyse the results: calculate rates of reaction using raw data and graphs. Draw conclusions and give explanations for the results. Explain why foods need to be digested into small, soluble molecules. Describe the three types of enzymes involved in digestion, including the names of the substrates, products and where the enzymes are produced. Explain how bile helps in the digestion of fats. Interpret graphs to determine the optimum temperature or pH for an enzyme.
Circulatory system, blood components and Lung Structure	Explain how the blood vessels are adapted for their function. Describe problems associated with the heart and explain how they can be treated. Evaluate the use of drugs, mechanical devices and transplants to treat heart problems, including religious and ethical issues. Describe the four main components of blood. Explain how each component is adapted for its function. Identify pictures of the different blood cells
The Heart and Heart Dissection	Describe the functions of the heart and circulatory system. Describe and label a diagram of the heart showing four chambers, vena cava, pulmonary artery, pulmonary vein and aorta. Describe the flow of blood from the body, through the heart and lungs and back to the body. Explain how the heart is adapted for its function. Describe the heart as a double pump and explain why this is efficient.

	Describe the function of the pacemaker cells and coronary arteries. Label the main structures in the gas exchange system – trachea, bronchi, alveoli and capillary network around alveoli. Explain how the alveoli are adapted for efficient gas exchange.
Health Issues and Non Communicable Disease	Explain how diet, stress and life situations can affect physical and mental health. Give examples of communicable and non-communicable diseases. Describe examples of how diseases may interact. Describe the effects of diet, smoking, alcohol and exercise on health. Explain how and why the Government encourages people to lead a healthy lifestyle. Give risk factors associated with cardiovascular disease, Type 2 diabetes, lung diseases and cancers. Describe some causes of cancer, eg viruses, smoking, alcohol, carcinogens and ionising radiation. Describe the difference between benign and malignant tumours. Explain how cancer may spread from one site in the body to form a secondary tumour in another part of the body.
Plant Tissues and Organs	Identify the tissues in a leaf and describe their functions. Relate the structure of each tissue to its function in photosynthesis. Explain why there are more stomata on the lower surface of a leaf. Describe the role of stomata and guard cells to control water loss and gas exchange. Calculate stomatal density. Describe the organs that make up the plant transport system. Describe the role of xylem, phloem and root hair cells and explain how they are adapted for their functions. Define the terms 'transpiration' and 'translocation'.
Communicable Disease (Pathogens)	Define the term pathogen and state the four main groups of pathogen. Explain how pathogens can be spread to plants or animals and cause infection. Describe the main differences between bacteria and viruses. Explain how the spread of disease can be reduced or prevented.
Diseases	Explain how diet, stress and life situations can affect physical and mental health. Give examples of communicable and non-communicable diseases. Describe examples of how diseases may interact. Describe the effects of diet, smoking, alcohol and exercise on health. Explain how and why the Government encourages people to lead a healthy lifestyle. Give risk factors associated with cardiovascular disease, Type 2 diabetes, lung diseases and cancers.
Human Defence Systems	Describe the body's first line defences. Explain how microbes make us feel ill and how viruses damage cells. Explain how the immune system defends against disease. Describe what white blood cells do. Explain why antibodies are specific for one pathogen/ antigen. Describe what a vaccine contains.

	Explain how vaccines prevent disease. Explain the idea of 'herd immunity'. Explain how antibiotics treat only bacterial diseases and how this has saved lives. Describe the problems associated with antibiotic resistance. See 4.6.3.7 Explain the difficulty in developing drugs that kill viruses without damaging body tissues.
Treating Diseases	Describe the symptoms, mode of transmission, prevention and treatment for measles, HIV and AIDS, salmonella and gonorrhoea. Describe colds and flu as viral diseases. Describe athlete's foot as a fungal disease. Describe the life cycle of the malarial protist. Describe the symptoms, mode of transmission, prevention and for malaria.
Drug development Painkillers and Antibiotics	State which drugs come from plants and microorganisms. Explain why drugs need to be tested before they can be prescribed. Describe the main steps in the development and testing of a new drug. Give reasons for the different stages in drug testing. Explain the terms placebo and double-blind trial.

Cycle 3

Disinfectants and bacterial growth	Plan and carry out a safe investigation into the effect of disinfectants or antibiotics on bacterial growth. Calculate the cross-sectional areas of clear zones around disinfectant/ antibiotic discs using $\pi r2$ Present and analyse the results. Give examples of painkillers and other medicines used to treat symptoms. Interpret data about painkillers and other medicines. Describe Fleming's discovery and explain its importance.
Plant Diseases and Defences	Describe the symptoms and effects of Tobacco mosaic virus and its effects. Describe the symptoms and effects of Rose black spot fungal infection Explain how aphids affect plant growth. Carry out a controlled investigation into the effects of nitrate and magnesium ion deficiencies and link to active transport (4.1.3.3 and see alternative investigations in 4.2.3.2). Describe the physical and chemical ways plants can resist microorganisms. Describe mechanical adaptations to deter animals.
Photosynthesis	Write the word and symbol equation for photosynthesis. Explain why photosynthesis is important for the survival of other organisms. Investigate the need for light, carbon dioxide and chlorophyll to make glucose. Explain why plants should be de-starched before photosynthesis experiments and describe how this is done.

	Describe experiments to show that plants produce oxygen in the light. Test to see if a leaf contains starch. Explain why the leaves are tested for starch and not for sugar. Describe the test for oxygen. Interpret results and relate to photosynthesis equation. State factors that can limit the rate of photosynthesis. Interpret data showing how factors affect the rate of photosynthesis. Required practical: plan a method. Required practical: carry out an investigation, collect, present and analyse the results. Calculate the rate using numerical information or graphs.
Respiration	State that all animals and plants produce carbon dioxide and water all the time as a by-product of aerobic respiration. Write the word equation for aerobic respiration. Define the term 'aerobic'. Describe what organisms need energy for. Describe tests for carbon dioxide and water. State the site of aerobic respiration and be able to give examples of cells that contain a lot of mitochondria (links with 4.1.1.2). Define the term 'anaerobic'. Explain why anaerobic respiration is less efficient than aerobic respiration. Write the word equation for anaerobic respiration in animal cells. Write the word and symbol equation for anaerobic respiration in yeast cells. State that anaerobic respiration in yeast is called fermentation. Explain why yeast is used to make bread and alcoholic drinks. Interpret data from yeast investigation.
Response to Exercise and Metabolism	Describe and explain the changes that occur in the body during exercise. Design and carry out an investigation about the effects of exercise on the body. Present and interpret data about heart rate, breathing rate and breath volume. Interpret data relating to the effects of exercise on the body, eg spirometer tracings. Describe the effects of long periods of vigorous exercise on the body. Define the term 'oxygen debt'. Explain what happens to lactic acid once exercise stops.

Year 2 Curriculum

Cycle 1

Homeostasis and response Introduction	Explain what homeostasis is and why it is important. Describe examples of conditions that need to be controlled. Describe the roles of the nervous system and the endocrine system in homeostasis. Describe the main components of a control system and their functions. Explain the importance of being able to respond to environmental changes and coordinate behaviour. Explain how the nervous system is adapted for its functions. Describe the functions of the main structures in the nervous system. Explain the role of chemicals at synapses. Describe and use different methods to measure reaction time. Required practical Make a plan to investigate a factor on human reaction time. Carry out a controlled investigation, present and analyse the results.
Homeostasis and response- reflex actions	Explain the importance of reflex actions and give examples. Describe the differences between voluntary and reflex actions. Describe the stages of a reflex action .Identify the cerebral cortex, cerebellum and medulla on a diagram and describe the function of each. Label a diagram of the eye and describe the function of each structure. Define the term 'accommodation'. Describe how the eye changes to focus on near and distant objects. Complete simple ray diagrams to show normal vision, long-sightedness and short-sightedness.
Homeostasis and response endocrine system	Describe different methods to measure body temperature. Explain how body temperature is monitored and controlled. Describe and explain the changes that happen when body temperature is too high or too low. Explain why we drink more fluid during hot weather. Plot cooling curves Describe the endocrine system and define the term hormone. Label a diagram of the organs in the endocrine system. Explain why the pituitary gland is often called the master gland. Compare the actions of the nervous and endocrine systems.
Homeostasis and response diabetes	Describe how blood glucose concentration is monitored and controlled. Explain when insulin is produced and how it helps to control blood glucose levels. Describe glycogen as a stored carbohydrate. Explain the cause, effects, treatment and problems associated with Type 1 diabetes. Interpret glucose tolerance test results. Evaluate modern methods of treating diabetes.

	Explain the cause, treatment and problems associated with Type 2 diabetes. Compare the causes, and treatments of Type 1 and Type 2 diabetes. Describe where water, ions and urea are lost from the body. Explain why there is no control over water, ion and urea loss by the lungs and skin. Explain when cells might gain or lose too much water, in terms of osmosis (links with 4.1.3.2). Describe the effect of too much or too little water on cells. Explain how the body responds to different temperature and osmotic challenges in terms of sweat and urine release.
Homeostasis and response excretory system	Label a diagram of the excretory system. Describe how urine is produced. Describe the absorption of glucose and ions by diffusion and active transport.
Homeostasis and response kidney structure and function	Describe the advantages and disadvantages of a kidney transplant. Explain how a kidney machine works. Explain why dialysis fluid contains sugar and ions at the same concentration as normal blood, but no urea. Evaluate the use of kidney transplants and dialysis to treat kidney failure
Homeostasis and response sex hormones	Describe secondary sexual characteristics of boys and girls. Explain the cause of these changes in boys and girls and their relevance in reproduction. Describe the menstrual cycle and fertility including the role of hormones Oestrogen is secreted by the ovaries. It inhibits production of FSH and stimulates release of LH. It makes the uterus lining grow again after menstruation. Progesterone is secreted by the empty follicle in the ovary after ovulation. It inhibits FSH and LH production and maintains the lining of the uterus during the second half of the cycle. Describe hormonal and non-hormonal methods of contraception. Explain how hormonal and non-hormonal contraceptives work. Evaluate their use.
Homeostasis and response hormones continued	Describe the use of fertility drugs in women with low FSH levels. Use a model, eg a flow diagram to explain the process of In Vitro Fertilisation (IVF). Evaluate the use of fertility treatments. Describe where and when adrenaline is released and its target organs. Describe the effects of adrenaline on the body. Draw a diagram to explain how levels of adrenaline are controlled by a negative feedback system. Describe where thyroxine is produced and its effects on the body. Draw a diagram to explain how its release is stimulated by thyroid stimulating hormone and the levels of these two hormones are controlled by a negative feedback system
Homeostasis and response plant hormones	Describe how plant shoots and roots respond to light and gravity. Draw diagrams to explain the role of auxin in plant responses in terms of unequal distribution in shoots and roots. Required practical: plan and carry out an investigation into the effect of light on plant shoots.

	Observe, present and analyse the results in a later lesson. Interpret results of plant hormone experiments using secondary sources.
Inheritance, variation and evolution.	Explain why sexual reproduction produces variation in the offspring, but asexual reproduction does not. Describe sexual reproduction in animals and plants. Define the term clone. Describe cuttings as clones of plants. Explain the term gametes and describe their genetic material. Explain why sexual reproduction results in variety. Draw diagrams to explain how gametes are formed in meiosis. Explain the number of chromosomes in the gametes during meiosis and fertilisation. Describe how an embryo is formed. Compare mitosis and meiosis (links with 4.1.2.1 and 4.1.2.2).
Inheritance, variation and evolution	Describe advantages and disadvantages of sexual and asexual reproduction. Describe some organisms that can reproduce by both methods: • malarial parasites reproduce asexually in the human host, and sexually in the mosquito • many fungi reproduce asexually by spores, but asexually to produce variation • many plants reproduce sexually to produce seeds and asexually by runners, eg strawberry plants, or bulb division, eg daffodils. Explain using a Punnett square and genetic diagram how sex is determined in humans. Explain the probability of having a child that is a boy or a girl.
Inheritance, variation and evolution	Describe the structure of chromosomes, DNA and genes. Explain that a gene is a small section of DNA that codes for a particular sequence of amino acids to make a specific protein. Describe what the genome is. Explain how knowledge of the human genome will help medicine in the future, eg identifying genes linked to cancers, understanding and treating inherited disorders. It will also help trace human migration patterns. Explain the ethical issues related to DNA sequencing. Describe the structure of DNA using diagrams and models. Explain how the bases on the two strands link together. Describe in simple terms how a protein is synthesised. Explain the importance of the shape of a protein for enzyme action (links with 4.2.2.1) and function.
Inheritance, variation and evolution	Describe what a mutation is and how a mutation could affect the formation of a protein. Explain that most mutations have little effect but a few have more serious effects on the function of the protein. Describe the function of non-coding parts of DNA and the possible effect of a mutation in a non-coding section of DNA Assessment point - past paper questions.

Cycle 2

Inheritance, variation and evolution	Give examples of characteristics controlled by a single gene and describe their alleles. Give examples of characteristics controlled by multiple genes. Define and use the terms: gametes, genotype, phenotype, dominant recessive, homozygous and heterozygous. Complete a Punnett square to show the outcomes of genetic crosses. Interpret the results of a genetic cross diagram and use direct proportion and simple ratios to express the outcomes. Describe the genotypes and phenotypes of the offspring. Describe the inherited disorders polydactyly and cystic fibrosis. Use genetic cross diagrams to explain inheritance and carriers. Make informed judgements about the economic, social and ethical issues concerning embryo screening. Discuss the use of genetic modification to treat genetic disorders
Inheritance, variation and evolution	Describe some of the experiments carried out by Mendel using pea plants. Explain why Mendel proposed the idea of separately inherited factors and why the importance of this discovery was not recognised until after his death. Predict and explain the outcome of crosses using genetic diagrams based on Mendel's experiments and using unfamiliar information. Describe a timeline showing the main developments in the understanding of inheritance Define the term genetic engineering. Describe the process of genetic engineering and its advantages. HT: describe in detail the process of genetic engineering. Evaluate the use of genetic engineering in medicine, eg in gene therapy and production of hormones and some vaccines. Interpret information about genetic engineering techniques. Make informed judgements about the economic, social and ethical issues concerning genetic engineering and GM crops. Explain advantages and disadvantages of genetic engineering. Define the term clone. Describe plant cloning techniques to include: • taking plant cuttings • tissue culture. Explain the importance of cloning to plant growers. Interpret information about plant cloning techniques. Explain advantages and disadvantages of plant cloning techniques. Explain why identical twins are clones.

	Describe animal cloning techniques to include: • embryo transplants • adult cell cloning. Present arguments for and against human cloning. Make informed judgements about the economic, social and ethical issues concerning cloning. Classify characteristics as being due to genetic, environmental or a combination of these causes. Give examples of continuous and discontinuous variation. Decide the best way to present information about variation in tables and charts. Explain why humans selectively breed plants and animals. Describe selective breeding as a type of sexual reproduction. Describe the process of selective breeding and give examples. Explain the benefits and risks of selective breeding in plants and animals. Describe Darwin's theory of evolution by natural selection. Describe the main stages of natural selection as: • individual organisms within a particular species may show a wide range of phenotype variation because of differences in their genes • individuals with characteristics most suited to the environment are more likely to survive to breed successfully • the genes that have enabled these individuals to survive are then passed on to the next generation. Define the term mutation. Explain why mutation may lead to more rapid change in a species. Define the term species. Identify organisms that are of different species. Interpret evolutionary trees. Describe the work of Wallace. Explain how new species arise using the terms: • isolation • genetic variation • natural selection • speciation State when Darwin published his theory and explain why it was only gradually accepted. Describe the work of Alfred Russel Wallace on natural selection. Describe the work of Jean-Baptiste Lamarck. Identify differences between Darwin's theory of evolution and conflicting theories. Suggest reasons for the different theories. Explain the terms inherited and acquired characteristics Describe the evidence for the theory of evolution by natural selection. Define the term 'fossil'.

	Describe how fossils may be formed: • from parts of organisms that have not decayed because one or more of the conditions needed for decay are absent • when parts of the organism are replaced by other materials as they decay • as preserved traces of organisms, eg footprints, burrows and rootlet traces. Explain why scientists cannot be certain how life began on Earth. Explain how fossils provide evidence for evolution. Explain what we should do to slow down the rate of development of resistant strains of bacteria. Describe the impact of antibiotic resistance. Define the term extinction. Explain how extinction may be caused. Explain that organisms become extinct because something changes and the species cannot adapt quickly enough to the new circumstances. Describe the evidence for the theory of evolution by natural selection. Define the term 'fossil'. Describe how fossils may be formed: • from parts of organisms that have not decayed because one or more of the conditions needed for decay are absent • when parts of the organism are replaced by other materials as they decay • as preserved traces of organisms, eg footprints, burrows and rootlet traces. Explain why scientists cannot be certain how life began on Earth. Explain how fossils provide evidence for evolution. Explain what we should do to slow down the rate of development of resistant strains of bacteria. Describe the impact of antibiotic resistance.
Communities	Different levels of organisation in an ecosystem from individual organisms to, the whole ecosystem the importance of interdependence and competition in a community. Students should be able to, when provided with appropriate information: suggest the factors for which organisms are competing in a given habitat suggest how organisms are adapted to the conditions in which they live.
Abiotic factors/ Biotic factors	Abiotic (non-living) factors which can affect a community are: • light intensity • temperature • moisture levels • soil pH and mineral content • wind intensity and direction • carbon dioxide levels for plants • oxygen levels for aquatic animals.

	Students should be able to extract and interpret information from charts, graphs and tables relating to the effect of abiotic factors on organisms within a community. Biotic (living) factors which can affect a community are: • availability of food • new predators arriving • new pathogens • one species outcompeting another so the numbers are no longer sufficient to breed. Students should be able to extract and interpret information from charts, graphs and tables relating to the effect of biotic factors on organisms within a community.
Adaptations	Students should be able to explain how organisms are adapted to live in their natural environment, given appropriate information. Organisms have features (adaptations) that enable them to survive in the conditions in which they normally live. These adaptations may be structural, behavioural or functional. Some organisms live in environments that are very extreme, such as at high temperature, pressure, or salt concentration. These organisms are called extremophiles. Bacteria living in deep sea vents are extremophiles.
Levels of organisation	Students should understand that photosynthetic organisms are the producers of biomass for life on Earth. Feeding relationships within a community can be represented by food chains. All food chains begin with a producer which synthesises molecules. This is usually a green plant or alga which makes glucose by photosynthesis. A range of experimental methods using transects and quadrats are used by ecologists to determine the distribution and abundance of species in an ecosystem.
How materials are cycled/ Decomposition	Students should: • recall that many different materials cycle through the abiotic and biotic components of an ecosystem • explain the importance of the carbon and water cycles to living organisms. All materials in the living world are recycled to provide the building blocks for future organisms. The carbon cycle returns carbon from organisms to the atmosphere as carbon dioxide to be used by plants in photosynthesis. The water cycle provides fresh water for plants and animals on land before draining into the seas. Water is continuously evaporated and precipitated. Students are not expected to study the nitrogen cycle. Students should be able to explain the role of microorganisms in cycling materials through an ecosystem by returning carbon to the atmosphere as carbon dioxide and mineral ions to the soil. Students should be able to explain how temperature, water and availability of oxygen affect the rate of decay of biological material. Students should be able to: • 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.

Cycle 3

Waste management	Rapid growth in the human population and an increase in the standard of living mean that increasingly more resources are used and more waste is produced. Unless waste and chemical materials are properly handled, more pollution will be caused. Pollution can occur: • in water, from sewage, fertiliser or toxic chemicals • in air, from smoke and acidic gases • on land, from landfill and from toxic chemicals. Pollution kills plants and animals which can reduce biodiversity.
Land use/Deforestation	The destruction of peat bogs, and other areas of peat to produce garden compost, reduces the area of this habitat and thus the variety of different plant, animal and microorganism species that live there (biodiversity). The decay or burning of the peat releases carbon dioxide into the atmosphere. Humans reduce the amount of land available for other animals and plants by building, quarrying, farming and dumping waste. Large-scale deforestation in tropical areas has occurred to: • provide land for cattle and rice fields • grow crops for biofuels.
Global warming	Students should be able to describe some of the biological consequences of global warming. Levels of carbon dioxide and methane in the atmosphere are increasing, and contribute to 'global warming'.
Biodiversity/ Maintaining biodiversity	Students should be able to describe both positive and negative human interactions in an ecosystem and explain their impact on biodiversity. Scientists and concerned citizens have put in place programmes to reduce the negative effects of humans on ecosystems and biodiversity. These include: • breeding programmes for endangered species • protection and regeneration of rare habitats • reintroduction of field margins and hedgerows in agricultural areas where farmers grow only one type of crop • reduction of deforestation and carbon dioxide emissions by some governments • recycling resources rather than dumping waste in landfill. Biodiversity is the variety of all the different species of organisms on earth, or within an ecosystem. A great biodiversity ensures the stability of ecosystems by reducing the dependence of one species on another for food, shelter and the maintenance of the physical environment. The future of the human species on Earth relies on us maintaining

	a good level of biodiversity. Many human activities are reducing biodiversity and only recently have measures been taken to try to stop this reduction.
Trophic levels	Students should be able to describe the differences between the trophic levels of organisms within an ecosystem. Trophic levels can be represented by numbers, starting at level 1 with plants and algae. Further trophic levels are numbered subsequently according to how far the organism is along the food chain. Level 1: Plants and algae make their own food and are called producers. Level 2: Herbivores eat plants/algae and are called primary consumers. Level 3: Carnivores that eat herbivores are called secondary consumers. Level 4: Carnivores that eat other carnivores are called tertiary consumers. Apex predators are carnivores with no predators. Decomposers break down dead plant and animal matter by secreting enzymes into the environment. Small soluble food molecules then diffuse into the microorganism. WS 1.4, 1.5 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.
Pyramids of biomass/ Transfer of biomass	Pyramids of biomass can be constructed to represent the relative amount of biomass in each level of a food chain. Trophic level 1 is at the bottom of the pyramid. Students should be able to describe pyramids of biomass explain how biomass is lost between the different trophic levels. Students should be able to calculate the efficiency of biomass transfers between trophic levels by percentages or fractions of mass. Students should be able to explain how this affects the number of organisms at each trophic level.
Factors affecting food security	Students should be able to describe some of the biological factors affecting levels of food security.
Farming techniques/Sustainable fisheries and the role of Role of biotechnology	The efficiency of food production can be improved by restricting energy transfer from food animals to the environment. This can be done by limiting their movement and by controlling the temperature of their surroundings. Understand how application of different fishing techniques promotes recovery of fish stocks. Students should be able to describe and explain some possible biotechnical and agricultural solutions, including genetic modification, to the demands of the growing human population.