Subject: GCSE Science – Biology **Key Stage: 4** **Year: 10**

Curriculum Intent. Biology is the science of living organisms (including animals, plants, fungi and microorganisms) and their interactions with each other and the environment. The study of biology involves collecting and interpreting information about the natural world to identify patterns and relate possible cause and effect. Biology is used to help humans improve their own lives and to understand the world around them.		
	Learning outcomes	**Assessment criteria**
1	**Cell Biology** Cells are the basic unit of all forms of life. In this section we explore how structural differences between types of cells enables them to perform specific functions within the organism. These differences in cells are controlled by genes in the nucleus. For an organism to grow, cells must divide by mitosis producing two new identical cells. If cells are isolated at an early stage of growth before they have become too specialised, they can retain their ability to grow into a range of different types of cells. This phenomenon has led to the development of stem cell technology. This is a new branch of medicine that allows doctors to repair damaged organs by growing new tissue from stem cells	**Eukaryotes and prokaryotes** Plant and animal cells (eukaryotic cells) have a cell membrane, cytoplasm and genetic material enclosed in a nucleus. **Animal and plant cells** Learners should be able to explain how the main sub-cellular structures, including the nucleus, cell membranes, mitochondria, chloroplasts in plant cells and plasmids in bacterial cells are related to their functions. **Cell specialisation** Learners should be able to, when provided with appropriate information, 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 **Cell differentiation** Learners should be able to explain the importance of cell differentiation. **Microscop**y Learners should be able to: • understand how microscopy techniques have developed over time • explain how electron microscopy has increased understanding of sub-cellular structures.
2	**Organisation** In this section we will learn about the human digestive system which provides the body with nutrients and the respiratory system that provides it with oxygen and removes carbon dioxide. In each case they provide dissolved materials that need to be moved quickly around the body in the blood by the circulatory system. Damage to any of these systems can be debilitating if not fatal. Although there has been huge progress in surgical techniques, especially with regard to coronary heart disease, many interventions would not be necessary if individuals reduced their risks through improved diet and lifestyle. We will also learn how the plant's transport system is dependent on environmental conditions to ensure that leaf cells are provided with the water and carbon dioxide that they need for photosynthesis.	**Principles of organisation** Cells are the basic building blocks of all living organisms. A tissue is a group of cells with a similar structure and function. Organs are aggregations of tissues performing specific functions **The human digestive system** This section assumes knowledge of the digestive system studied in Key Stage 3 science. The digestive system is an example of an organ system in which several organs work together to digest and absorb food. **The heart and blood vessels** Learners should know the structure and functioning of the human heart and lungs, including how lungs are adapted for gaseous exchange **Blood** Blood is a tissue consisting of plasma, in which the red blood cells, white blood cells and platelets are suspended. **Coronary heart disease: a non-communicable disease** Learners should be able to evaluate the advantages and disadvantages of treating cardiovascular diseases by drugs, mechanical devices or transplant.

		Health issues Learners should be able to describe the relationship between health and disease and the interactions between different types of disease. **The effect of lifestyle on some non-communicable diseases** Learners should be able to: • discuss the human and financial cost of these noncommunicable diseases to an individual, a local community, a nation or globally • explain the effect of lifestyle factors including diet, alcohol and smoking on the incidence of non-communicable diseases at local, national and global levels. **Cancer** Learners should be able to describe cancer as the result of changes in cells that lead to uncontrolled growth and division.
3	**Infection and response** Pathogens are microorganisms such as viruses and bacteria that cause infectious diseases in animals and plants. They depend on their host to provide the conditions and nutrients that they need to grow and reproduce. They frequently produce toxins that damage tissues and make us feel ill. This section will explore how we can avoid diseases by reducing contact with them, as well as how the body uses barriers against pathogens. Once inside the body our immune system is triggered which is usually strong enough to destroy the pathogen and prevent disease. When at risk from unusual or dangerous diseases our body's natural system can be enhanced by the use of vaccination. Since the 1940s a range of antibiotics have been developed which have proved successful against a number of lethal diseases caused by bacteria. Unfortunately many groups of bacteria have now become resistant to these antibiotics. The race is now on to develop a new set of antibiotics.	**Communicable (infectious) diseases** Learners should be able to explain how diseases caused by viruses, bacteria, protists and fungi are spread in animals and plants. **Viral diseases** Measles is a viral disease showing symptoms of fever and a red skin rash. Measles is a serious illness that can be fatal if complications arise. For this reason most young children are vaccinated against measles. The measles virus is spread by inhalation of droplets from sneezes and coughs. **Bacterial diseases** Salmonella food poisoning is spread by bacteria ingested in food, or on food prepared in unhygienic conditions. In the UK, poultry are vaccinated against salmonella to control the spread. Fever, abdominal cramps, vomiting and diarrhoea are caused by the bacteria and the toxins they secrete. **Fungal diseases** Rose black spot is a fungal disease where purple or black spots develop on leaves, which often turn yellow and drop early. It affects the growth of the plant as photosynthesis is reduced. It is spread in the environment by water or wind. Rose black spot can be treated by using fungicides and/or removing and destroying the affected leaves. **Protist diseases** The pathogens that cause malaria are protists. The malarial protist has a life cycle that includes the mosquito. Malaria causes recurrent episodes of fever and can be fatal. The spread of malaria is controlled by preventing the vectors, mosquitos, from breeding and by using mosquito nets to avoid being bitten. **Human defence systems**

		Learners should be able to describe the non-specific defence systems of the human body against pathogens, including the: • skin • nose • trachea and bronchi • stomach. **Vaccination** Learners should be able to explain how vaccination will prevent illness in an individual, and how the spread of pathogens can be reduced by immunising a large proportion of the population. **Antibiotics and painkillers** Learners should be able to explain the use of antibiotics and other medicines in treating disease. **Discovery and development of drugs** Learners should be able to describe the process of discovery and development of potential new medicines, including preclinical and clinical testing.
4	**Bioenergetics** In this section we will explore how plants harness the Sun's energy in photosynthesis in order to make food. This process liberates oxygen which has built up over millions of years in the Earth's atmosphere. Both animals and plants use this oxygen to oxidise food in a process called aerobic respiration which transfers the energy that the organism needs to perform its functions. Conversely, anaerobic respiration does not require oxygen to transfer energy. During vigorous exercise the human body is unable to supply the cells with sufficient oxygen and it switches to anaerobic respiration. This process will supply energy but also causes the build-up of lactic acid in muscles which causes fatigue	**Photosynthetic reaction** Photosynthesis is represented by the equation **Rate of photosynthesis** Learners should be able to explain the effects of temperature, light intensity, carbon dioxide concentration, and the amount of chlorophyll on the rate of photosynthesis. **Uses of glucose from photosynthesis** The glucose produced in photosynthesis may be: • used for respiration • converted into insoluble starch for storage • used to produce fat or oil for storage • used to produce cellulose, which strengthens the cell wall • used to produce amino acids for protein synthesis. **Aerobic and anaerobic respiration** Learners should be able to describe cellular respiration as an exothermic reaction which is continuously occurring in living cells. **Response to exercise** During exercise the human body reacts to the increased demand for energy **Metabolism** Learners should be able to explain the importance of sugars, amino acids, fatty acids and glycerol in the synthesis and breakdown of carbohydrates, proteins and lipids.
5	**Homeostasis and response** Cells in the body can only survive within narrow physical and chemical limits. They require a constant temperature and pH as well as a constant supply of dissolved food and water do this the body requires control systems that constantly monitor and adjust the composition of the blood and tissues. These control systems include receptors which sense changes and effectors that bring about changes. In this section we will explore the structure and function of the nervous system and how it can bring about fast responses. We will also explore the hormonal system	**Homeostasis** Learners should be able to explain that homeostasis is the regulation of the internal conditions of a cell or organism to maintain optimum conditions for function in response to internal and external changes. **The human nervous system** Learners should be able to explain how the structure of the nervous system is adapted to its functions. **Human endocrine system** Learners should be able to describe the principles of hormonal coordination and control by the human endocrine system.

	which usually brings about much slower changes. Hormonal coordination is particularly important in reproduction since it controls the menstrual cycle. An understanding of the role of hormones in reproduction has allowed scientists to develop not only contraceptive drugs but also drugs which can increase fertility.	**Control of blood glucose concentration** Blood glucose concentration is monitored and controlled by the pancreas. **Hormones in human reproduction** Learners should be able to describe the roles of hormones in human reproduction, including the menstrual cycle. **Contraception** Learners should be able to evaluate the different hormonal and non-hormonal methods of contraception.

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	Learning outcomes	**Assessment criteria**
1	**Inheritance, variation and evolution** In this section we will discover how the number of chromosomes are halved during meiosis and then combined with new genes from the sexual partner to produce unique offspring. Gene mutations occur continuously and on rare occasions can affect the functioning of the animal or plant. These mutations may be damaging and lead to a number of genetic disorders or death. Very rarely a new mutation can be beneficial and consequently, lead to increased fitness in the individual. Variation generated by mutations and sexual reproduction is the basis for natural selection; this is how species evolve. An understanding of these processes has allowed scientists to intervene through selective breeding to produce livestock with favoured characteristics. Once new varieties of plants or animals have been produced it is possible to clone individuals to produce larger numbers of identical individuals all carrying the favourable characteristic. Scientists have now discovered how to take genes from one species and introduce them in to the genome of another by a process called genetic engineering. In spite of the huge potential benefits that this technology can offer, genetic modification still remains highly controversial.	**Sexual and asexual reproduction** Learners should understand that meiosis leads to non-identical cells being formed while mitosis leads to identical cells being formed. **Meiosis** Learners should be able to explain how meiosis halves the number of chromosomes in gametes and fertilisation restores the full number of chromosomes. **DNA and the genome** Learners should be able to describe the structure of DNA and define genome. **Genetic inheritance** Learners should be able to explain the terms: • gamete • chromosome • gene • allele • dominant • recessive • homozygous • heterozygous • genotype • phenotype. **Inherited disorders** Some disorders are inherited. These disorders are caused by the inheritance of certain alleles. **Sex determination** Ordinary human body cells contain 23 pairs of chromosomes. 22 pairs control characteristics only, but one of the pairs carries the genes that determine sex. **Variation** Learners should be able to describe simply how the genome and its interaction with the environment influence the development of the phenotype of an organism **Evolution** Learners should be able to describe evolution as a change in the inherited characteristics of a population over time through a process of natural selection which may result in the formation of a new species.

		Selective breeding Learners should be able to explain the impact of selective breeding of food plants and domesticated animals. **Genetic engineering** Learners should be able to describe genetic engineering as a process which involves modifying the genome of an organism by introducing a gene from another organism to give a desired characteristic. **Evidence for evolution** Learners should be able to describe the evidence for evolution including fossils and antibiotic resistance in bacteria. **Fossils** Fossils are the 'remains' of organisms from millions of years ago, which are found in rocks **Extinction** Extinctions occur when there are no remaining individuals of a species still alive. **Resistant bacteria** Bacteria can evolve rapidly because they reproduce at a fast rate **Classification of living organisms** Traditionally living things have been classified into groups depending on their structure and characteristics in a system developed by Carl Linnaeus.
2	**Ecology** The Sun is a source of energy that passes through ecosystems. Materials including carbon and water are continually recycled by the living world, being released through respiration of animals, plants and decomposing microorganisms and taken up by plants in photosynthesis. All species live in ecosystems composed of complex communities of animals and plants dependent on each other and that are adapted to particular conditions, both abiotic and biotic. These ecosystems provide essential services that support human life and continued development. In order to continue to benefit from these services humans need to engage with the environment in a sustainable way. In this section we will explore how humans are threatening biodiversity as well as the natural systems that support it. We will also consider some actions we need to take to ensure our future health, prosperity and well-being.	**Communities** Learners should be able to describe: • different levels of organisation in an ecosystem from individual organisms to the whole ecosystem • the importance of interdependence and competition in a community **Abiotic factors** Learners should be able to explain how a change in an abiotic factor would affect a given community given appropriate data or context. **Biotic factors** Learners should be able to explain how a change in a biotic factor might affect a given community given appropriate data or context. **Adaptations** Learners should be able to explain how organisms are adapted to live in their natural environment, given appropriate information. **Levels of organisation** Learners should understand that photosynthetic organisms are the producers of biomass for life on Earth. **How materials are cycled** Learners 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. **Biodiversity**

		Biodiversity is the variety of all the different species of organisms on earth, or within an ecosystem. **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. **Land use** Humans reduce the amount of land available for other animals and plants by building, quarrying, farming and dumping waste **Deforestation** Large-scale deforestation in tropical areas has occurred to: • provide land for cattle and rice fields • grow crops for biofuels **Global warming** Learners should be able to describe some of the biological consequences of global warming. **Maintaining biodiversity** Learners should be able to describe both positive and negative human interactions in an ecosystem and explain their impact on biodiversity.