

<b>BIOLOGY Biodiversity &amp; Ecosystems</b>	<i>(Substantive Knowledge)</i>  <b>Students will know and remember...</b>	<i>(Disciplinary and Procedural Knowledge)</i>  <b>So that they can...</b>
Explain the importance of Biodiversity	Definition of Biodiversity Organisation of an ecosystem Factors which affect the stability of an ecosystem and how this affects biodiversity Reasons why humans rely on Biodiversity Ways in which human activity affects biodiversity	Describe methods used to quantify biodiversity  Identify biodiversity hotspots and describe the differences between ecosystems
Discuss and describe the effects of human population growth	The human population has expanded rapidly in the last 200 years Humans use land and resources for agriculture, building, quarrying, energy, dumping waste.	Analyse data to describe trends in human population growth  Discuss and describe evidence which shows the impact of human population growth on biodiversity
Link human activities to the impact of land pollution on biodiversity	Improper waste disposal leads to pollution Toxic chemicals spread through the soil to pollute the land Definition of Bioaccumulation Structure of a food chain/web Toxic chemicals from herbicides and pesticides build up in the food chain	Construct food chains and food webs and use these to predict the impact of land pollution.  Analyse evidence to show the effect of toxic herbicides and pesticides on an ecosystem
Link human activities to the impact of water pollution on biodiversity	Improper waste disposal leads to pollution Definition of bioaccumulation Structure of a food chain/web Fertilisers contain NPK Fertilisers build up in lakes which leads to eutrophication Description of eutrophication	Construct food chains and food webs and use these to predict the impact of land pollution.  Analyse evidence to show the effect of toxic herbicides and pesticides on an ecosystem
Link human activities to the impact of air pollution on biodiversity	Vehicles and factories burn fossil fuels The sulphur dioxide produced when burning fossil fuels leads to the formation of acid rain Acid rain causes lakes and streams to become acidic	Analyse data to describe and explain the changes in SO <sub>2</sub> emissions in different countries.  Describe how to analyse and quantify the pH of lakes and streams (LINK: Atmospheric pollutants – Chemistry)
Analyse and evaluate the use of peat bogs	Peat is a substance made from plant material that cannot decay. Peat bogs are a significant carbon sink Peat is an important habitat Peat is burned for fuel and used as fertiliser	Describe the source of conflict between the need for cheap fertiliser and the need to conserve peat bogs  Analyse data to show the rate and impact of peat bog destruction

Evaluate the environmental implications of deforestation	<p>Forests are a significant carbon sink</p> <p>Deforestation occurs to produce timber, to clear land, to grow crops or to raise cattle</p> <p>Deforestation leads to a loss of Biodiversity</p>	Analyse data to show the rate and impact of peat bog destruction
Describe the biological consequences of global warming	<p>The Greenhouse Effect is vital for all life on Earth</p> <p>Burning fossil fuels releases greenhouse gases which increases the greenhouse effect.</p> <p>An increase in the greenhouse effect leads to global warming and climate change</p>	<p>The scientific consensus about global warming is based on thousands of datasets and peer reviewed research.</p> <p>Evidence may be uncertain or incomplete</p>
Identify and explain how human intervention can maintain biodiversity	<p>Scientists and concerned citizens have put measure in place to maintain biodiversity such as:</p> <ul style="list-style-type: none"> <li>- Breeding programmes</li> <li>- Conservation zones</li> <li>- Reintroduction of field margins and hedgerows</li> <li>- Reduction of deforestation</li> <li>- Recycling</li> </ul>	<p>Explain and evaluate the conflicting pressures on maintaining biodiversity.</p> <p>Evaluate information about methods that can be used to tackle negative human impact on the environment</p>
Evaluate the effect of environmental change on the distribution of organism	<p>A seasonal or geographical change in environment can impact the distribution of organisms</p> <p>Climate change has affected the distribution of British Birds</p>	<p>Quadrats and belt transects are used to measure the distribution of organisms</p> <p>Thermometers, oxygen meters, pH meters, rain gauges, are used to measure and track environmental changes</p>
<p><b>BIOLOGY ONLY</b></p> <p>Describe and construct pyramids of biomass to represent an ecosystem</p>	<p>Trophic levels represent the organisation in an ecosystem (there is a limit to the number of trophic levels)</p> <p>Pyramids of Biomass represent the relative amount of biomass at each trophic level</p> <p>Energy and Biomass is transferred between trophic levels</p> <p>Producers are mostly plants and algae which transfer about 1% of the incident energy from light</p>	<p>Construct pyramids of biomass and pyramids of numbers</p> <p>Biomass is measured as the dry mass of biological material in grams</p>
<p><b>BIOLOGY ONLY</b></p> <p>Explain how and why biomass is lost between trophic levels</p>	<p>Approximately 10% of the biomass from each trophic level is transferred to the level above it.</p> <p>Biomass is lost because:</p> <p>Not all ingested material is absorbed</p> <p>Some absorbed material is lost as waste</p>	<p>Calculate the efficiency of biomass transfer between trophic levels</p> <p>Explain how efficiency of biomass transfer affects the number of trophic levels in an ecosystem (and link to food production)</p> <p>Describe how to measure the loss of biomass in germinating peas</p>
<p><b>BIOLOGY ONLY</b></p> <p>Describe and evaluate factors which affect global food security</p>	<p>Food security means having enough food to feed a population</p> <p>Factors affecting food security include:</p> <ul style="list-style-type: none"> <li>- Increasing birth rates</li> <li>- Changing diets in developed countries</li> </ul>	Analyse data to describe and explain the impact of changes in Quinoa production in Bolivia

	<ul style="list-style-type: none"> <li>- New pests and pathogens</li> <li>- Environmental changes</li> <li>- Global conflicts</li> <li>- Cost of agricultural inputs</li> </ul>	Interpret population and food production statistics to evaluate food security.
<b>BIOLOGY ONLY</b> Describe and evaluate methods of food production	<p>The efficiency of food production can be improved by restricting energy (biomass) transfer from animals to the environment</p> <p>Controlling net size and use of fishing quotas are important in sustainable fishing practices</p>	Analyse and evaluate the ethical and environmental implications of different methods of improving food security
<b>BIOLOGY ONLY</b> Explain the role of biotechnology and genetic engineering in ensuring food security	<p><i>Fusarium</i> is a fungus which is used for making mycoprotein (which is used to make Quorn).</p> <p>Bacteria can be genetically modified to produce human Insulin</p> <p>Golden rice is a Genetically Modified crop which has an increased Vitamin A content.</p>	<p><i>Fusarium</i> is grown using a batch growth method. The fungus is grown on glucose syrup in aerobic conditions. The biomass can then be harvested.</p> <p>(<a href="#">LINK back to Genetic Engineering process</a>)</p>

<b>BIOLOGY</b> <b>The Human</b> <b>Nervous System</b>	<i>(Substantive Knowledge)</i>  <b>Students will know and remember...</b>	<i>(Disciplinary and Procedural Knowledge)</i>  <b>So that they can...</b>
Describe the organisation of control systems and their importance for homeostasis	<p>All living organisms must be able to respond to changes in external and internal conditions.</p> <p>Homeostasis is the regulation of the internal conditions of a cell or organism (this includes temperature, pH and glucose concentration)</p> <p><b>Homeostasis involves automatic control systems which may involve a nervous response or a chemical (hormonal) response</b></p> <p>All control systems include receptors, co-ordination centres and effectors</p>	
Describe the structure and function of the human nervous system	<p>The nervous system uses electrical impulses to enable you to react to your surroundings and coordinate behaviour</p> <p>Cells called receptors detect stimuli.</p>	Identify structures associated with the nervous system using micrographs.
Explain how the nervous system allows an organism to respond to changes	Receptors send an impulse along sensory neurons, to the central nervous system (brain and spinal cord), the brain coordinates the response and sends an impulse along the motor neurone to the effector organs.	
Investigate the effect of caffeine on reaction times	<p>A ruler drop test can be used to measure reaction times</p> <p>A hypothesis is an idea or question to be investigated.</p> <p>The independent variable is the one that is changed by the investigator</p> <p>The dependent variable is measured for each change in the independent variable</p> <p>Control variables must be kept the same</p>	<p>Plan and carry out a safe and accurate scientific investigation using the ruler drop test</p> <p>Translate information about reaction times between numerical and graphical forms</p>
Describe the structure and function of a reflex arc	<p>Reflex actions are automatic and rapid, they do not involve the conscious part of the brain.</p> <p>Reflex actions are important in helping organisms to avoid danger. They also control basic bodily functions such as breathing and digestion.</p>	
Explain how reflexes work	The main stages of a reflex arc are:	

	<p>Stimulus → receptor → sensory neurone → relay neurone → motor neurone → effector → response</p> <p>Synapses are the gaps between two neurons. Neurotransmitters cross the synapse and start the impulse in the next neuron.</p> <p>In a reflex action, the coordinator is a relay neuron located either in the spinal cord or the unconscious part of the brain (this is why it is so fast)</p>	
<p><b>BIOLOGY ONLY</b></p> <p>Identify and describe the functions of key structures in the human brain</p>	<p>The brain controls complex behaviour. Different regions of the brain carry out different functions (including the cerebral cortex, cerebellum and medulla)</p>	<p>Explain how scientists find out about the structure and function of the different parts of the brain</p> <p>Explain the difficulties in investigating brain function and treating brain damage/disease.</p>
<p><b>BIOLOGY ONLY</b></p> <p>Identify and describe the structure and function of the human eye</p>	<p>The eye is a sensory organ containing receptors sensitive to light intensity.</p> <p>The structure and function of the retina, optic nerve, sclera, cornea, iris, ciliary muscles, suspensory ligaments.</p> <p>Accommodation is the process of changing the shape of the lens to focus on near and distant objects</p>	<p>Compare the structure of a human eye to that of an octopus and a fly</p>
<p><b>BIOLOGY ONLY</b></p> <p>Describe how a visual stimulus is translated to a visual image in the brain</p>	<p>The muscular iris controls the size of the pupil and the amount of light entering the eye</p> <p>The ciliary muscles and suspensory ligaments change the shape of the lens to focus light onto the retina</p> <p>The optic nerve carries impulses from the retina to the brain</p>	<p>Construct ray diagrams to show how an image is formed on the retina</p>
<p><b>BIOLOGY ONLY</b></p> <p>Compare myopia with hyperopia and explain how this can be corrected</p>	<p>In Myopia the light is focussed in front of the retina and can be corrected with a concave lens.</p> <p>In Hyperopia the light is focussed behind the retina and can be corrected with a convex lens.</p> <p>Sight defects can be treated using spectacles, hard/soft contact lenses, laser surgery and replacement lenses.</p>	<p>Construct ray diagrams to explain myopia and hyperopia</p> <p>Construct ray diagrams to explain vision correction</p> <p>Evaluate options for vision correction</p>

<b>BIOLOGY</b> <b>Hormonal</b> <b>Coordination</b>	<i>(Substantive Knowledge)</i>  <b>Students will know and remember...</b>	<i>(Disciplinary and Procedural Knowledge)</i>  <b>So that they can...</b>
Compare the role and action of nerves and hormones	<p>Homeostasis is the regulation of the internal conditions of a cell or organism (this includes temperature, pH and glucose concentration)</p> <p><b>Homeostasis involves automatic control systems which may involve a nervous response or a chemical (hormonal) response</b></p> <p>The endocrine system is composed of glands which secrete hormones into the bloodstream. Blood carries hormones to the target organ which produces an effect.</p>	<p>Identify organs of the human endocrine system from diagrams and micrographs</p> <p>Compare the role and action of nerves and hormones</p>
Identify and describe the role of glands in the human endocrine system	<p>The position and role of the following:</p> <ul style="list-style-type: none"> <li>Pituitary gland (master gland)</li> <li>Pancreas</li> <li>Thyroid</li> <li>Adrenal gland</li> <li>Ovary</li> <li>Testes</li> </ul>	<p>Observe glands as they appear in micrographs and on MRI scans</p>
HT ONLY Give examples and describe the importance of of negative feedback systems	<p>Negative feedback systems help to maintain a steady state. A negative feedback loop occurs when the response to a change leads to a decrease in that change.</p> <p>Positive feedback loops also exist (e.g. oxytocin and contractions when giving birth)</p>	
Describe and explain the role of hormones in glucose homeostasis	<p>The pancreas monitors and controls blood glucose concentration.</p> <p>Insulin causes increased uptake of glucose by cells Insulin causes glucose to be stored in the liver as glycogen Glucagon causes the breakdown of glycogen back into glucose</p> <p>Glucose homeostasis is an example of a negative feedback loop</p>	<p>Explain how to measure and monitor blood glucose concentration</p> <p>Identify and explain the symptoms of hypoglycaemia and hyperglycaemia</p>
Explain and evaluate the treatments for Type I and Type II Diabetes	<p>In Type I diabetes the pancreas does not secrete enough Insulin. Type I diabetes is usually controlled by injecting insulin.</p> <p>In Type II diabetes the body stops responding to its own insulin. Type II diabetes is often controlled by diet and exercise.</p> <p>Transplants can be used to cure diabetes</p>	<p>Extract information and interpret data from graphs to explain the effect of insulin on people with and without diabetes</p> <p>Correctly determine the difference between a treatment and a cure</p>
Describe the role of the human	<p>During puberty reproductive hormones cause secondary sex characteristics to develop.</p> <p>Oestrogen is produced in the ovaries.</p>	

reproductive hormones	<p>During puberty an egg matures and is released from the ovaries approximately every 28 days – this is ovulation.</p> <p>The main female reproductive hormones are: FSH; Oestrogen; LH; Progesterone</p> <p>Testosterone is the main male reproductive hormone. It is produced by the testes and causes the release of sperm.</p>	
Explain the role of hormones in controlling the menstrual cycle	<p>FSH causes the maturation of an egg in the ovary Oestrogen causes the lining of the uterus to develop LH triggers ovulation Progesterone maintains the lining of the uterus</p> <p>HT ONLY: Female reproductive hormones interact to control the menstrual cycle</p>	Interpret graphs to explain the relative levels of female reproductive hormones throughout the menstrual cycle
Explain and evaluate the use of hormones in the artificial control of fertility	<p>Fertility can be artificially controlled by several hormonal and non-hormonal methods. Methods of contraception include: Oral contraception (hormonal) Implants (hormonal) Condoms/diaphragms (non-hormonal) Hormonal Injections (hormonal) Spermicidal agents (non-hormonal)</p>	Explain how hormonal contraception decreases fertility
<b>SEPARATE BIOLOGY ONLY</b> Evaluate Infertility treatments	<p>FSH and LH can be used as a fertility drug to stimulate egg production.</p> <p>IVF uses FSH and LH</p>	<p>Explain how LH levels can be measured</p> <p>Evaluate the advantages and disadvantages of infertility treatments</p>
Explain how plants use hormones to respond to light and gravity	<p>Plants can respond to light (phototropism) and gravity (gravitropism)</p> <p>Auxins stimulate cell elongation in shoots and inhibit cell elongation in roots to control phototropism and gravitropism.</p> <p>Light causes auxins to collect on the shaded side of a shoot</p>	<p>Interpret the experimental observations to explain the role of auxins in phototropism.</p> <p>Observe the effect of gravity on shoot growth.</p>
<b>SEPARATE BIOLOGY ONLY</b> Explain how plant hormones are used in agriculture and horticulture	<p>Auxins are used as weed killers, rooting powders and in tissue culture.</p> <p>Ethene is used to control fruit ripening</p> <p>Gibberellins can be used to increase fruit size, promote flowering, cause germination and increase the yield of sugar cane</p>	Evaluate the use of plant hormones to ensure food security



<p><b>BIOLOGY</b> <i>Homeostasis in Action</i></p>	<p><i>(Substantive Knowledge)</i></p> <p><b>Students will know and remember...</b></p>	<p><i>(Disciplinary and Procedural Knowledge)</i></p> <p><b>So that they can...</b></p>
<p><b>SEPARATE BIOLOGY ONLY</b> Explain how and why the body maintains a constant core temperature</p>	<p>Thermoregulation is the control of body temperature. Most mammals require a core body temperature of 37.5°C</p> <p>The thermoregulatory centre in the brain monitors and controls body temperature.</p> <p>Receptors in the thermoregulatory centre detect changes in blood temperature. Receptors in the skin send nerve impulses to the thermoregulator centre</p> <p>Vasodilation and sweating lead to cooling. Vasoconstriction and shivering lead to warming</p>	<p>Explain how homeostatic mechanisms lower or raise body temperature.</p> <p>Apply knowledge of enzymes to describe the importance of thermoregulation.</p>
<p>Explain how and why the body must remove metabolic waste (excretion)</p>	<p>Removal of metabolic waste is an important aspect of homeostasis</p> <p>Excess water, ions and urea are removed via the kidneys in the urine.</p> <p>If body cells gain or lose too much water by osmosis, they will not function efficiently</p>	<p>Apply knowledge of osmosis and the liver to outline the importance of removing metabolic waste</p>
<p><b>SEPARATE BIOLOGY ONLY</b>  Describe the structure and function of the kidney</p>	<p>Structure and functions of the kidney (and nephron)</p> <p>The kidneys produce urine by filtration of the blood and selective reabsorption of useful substances</p>	<p>Observe the glomerulus, Bowman's capsule and kidney tubules using a microscope</p> <p>Translate tables and bar charts or glucose, ions and urea before and after filtration</p>
<p><b>SEPARATE BIOLOGY ONLY</b>  Describe osmoregulation in terms of ADH and negative feedback</p>	<p>Osmoregulation is the control of water levels in the body.</p> <p>Osmoreceptors near the hypothalamus detect the water content of the blood.</p> <p>The water level in the body is controlled by the hormone ADH which acts on the kidney tubules to control how much urine is produced – this is an example of negative feedback</p>	
<p><b>SEPARATE BIOLOGY ONLY</b>  Explain how metabolic waste is removed in kidney dialysis</p>	<p>Dialysis uses a membrane and a counter current flow mechanism to remove waste substances from the blood</p>	<p>Describe how kidney dialysis works</p> <p>Compare the removal of metabolic waste in the glomerulus and in kidney dialysis</p>
<p><b>SEPARATE BIOLOGY ONLY</b></p>	<p>Glomerular Filtration Rate is often used to assess kidney function.</p>	<p>Evaluate the advantages and disadvantages of treating organ failure by transplant or dialysis</p>



Describe and evaluate treatments for kidney failure	Dialysis or kidney transplant is often used to treat patients who are suffering from kidney failure	
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<b>BIOLOGY</b> <b>Reproduction and Inheritance</b>	<i>(Substantive Knowledge)</i>  <b>Students will know and remember...</b>	<i>(Disciplinary and Procedural Knowledge)</i>  <b>So that they can...</b>
Define and identify the differences between sexual and asexual reproduction	Sexual reproduction involves the fusion of two gametes (sperm and ova/pollen and ova) Asexual reproduction does not require gamete fusion and requires just mitosis for cell division. Sexual reproduction produces variation. Asexual reproduction produces genetically identical cells/organisms	Recognise why clones are produced and how this is used to replace worn out tissues in the body  Explain why propagation techniques work  Explain why variation is useful to organisms and could promote characteristics such as tolerance.
Consider and explain how gametes are produced in the process of meiosis	Sexual reproduction involves the fusion of two gametes  Gametes are produced in the ovaries and testes (or ovule of plants) in a process called meiosis  Meiosis has two divisions and during the process, crossing over can occur, which together with random shuffling, promotes variation  Meiosis produces 4 new cells which are haploid	Explain how meiosis differs from mitosis  Explain how meiosis creates variation
<b>SEPARATE BIOLOGY ONLY</b>  Explain the advantages and disadvantages of sexual and asexual reproduction  Provide and explain the benefit to organisms who perform both sexual and asexual reproduction	Variation produced by sexual reproduction is favourable for the process of natural selection, if the environment changes (Tolerances/resistances)  Selective breeding mechanisms can promote the outcome of favourable characteristics  Asexual reproduction is faster and more efficient – Many more organisms can be produced  Malarial parasites reproduce asexually in the host but sexually in mosquito  Fungi produce spores but can also reproduce via hyphae strands  Strawberries can reproduce via seeds or runners	Evaluate which process is preferable dependant on the organism and the conditions.  Explain why seed banks are maintained (genetic diversity and unknown traits such as potential tolerances to drought etc)  Explain why plant propagation uses tissue culture/cuttings to produce new plants  Explain the benefit of both mechanisms in organisms that can reproduce in either manner

<p>Define genome and describe how its knowledge is beneficial in medicine</p> <p>Describe the structure of DNA</p>	<p>The genome is the entire genetic material of an individual</p> <p>Our DNA provides the instruction for all proteins in the body, thereby all characteristics</p> <p>DNA is a polymer comprised of two polynucleotide strands held together in a double helix</p> <p>DNA is coiled up to form chromosomes.</p> <p>Genes are small sections of DNA on chromosomes and are the instructions for proteins (they provide the base sequence for amino acids)</p>	<p>Describe how DNA determines the amino acid sequence, which in turn, determines the protein that is made.</p> <p>Mistakes in this process lead to mutations which can give rise to disease</p> <p>Evaluate how knowledge of the genome and faults in the sequencing can be used to create targeted medicines and the risk/benefits of this approach.</p>
<p><b>SEPARATE BIOLOGY ONLY</b></p> <p>Describe the structure of DNA as a polynucleotide</p>	<p>DNA is a molecule that determines all characteristics by providing the instruction for protein formation and folding</p> <p>DNA is built from multiple nucleotides, consisting of a phosphate group, a ribose sugar and a nitrogenous base (A,C,G,T)</p> <p>DNA bases are complementary (C and G, A and T)</p> <p>The sequence of bases determines the polypeptide sequence of amino acids</p>	<p>Draw and label a nucleotide</p> <p>Recognise how the sequence of amino acids is vital in determining the protein which is produced</p> <p>Evaluate how the production of a protein is vital to its function eg. Enzyme specificity and Immunoglobulins</p>
<p><b>SEPARATE BIOLOGY ONLY</b></p> <p>Describe and explain the process of protein synthesis</p>	<p>Sections of DNA are copied using mRNA which is small enough to leave the nucleus via a pore.</p> <p>Protein synthesis occurs at ribosomes. Carrier molecules bring in specific amino acids based on their complementary fit to a triple code on the mRNA molecule.</p> <p>Once the polypeptide strand is built, it then folds to form a unique shape, which determines its function</p>	<p>Evaluate why a change in base sequence can have no effect, through to significant effect.</p> <p>Evaluate why proteins depend on their unique build for function eg. Collagen made of 3 intertwining polypeptide strands for high tensile strength</p>

<p><b>SEPARATE BIOLOGY ONLY</b></p> <p>Explain how mutations may occur and the resulting potential impact</p> <p>Explain the function of coding/non coding sections of DNA</p>	<p>Describe a mutation as a change/deletion or addition in the base sequence</p> <p>Recall the purpose of the triplet code in determining the base sequence of amino acids</p> <p>Evaluate how a mutation can affect the reading, production and folding of a protein and the resulting impact on function</p> <p>Define genotype and phenotype and determine that DNA has coding and non-coding parts. Non-coding parts switch genes on/off</p>	<p>Evaluate how mutations could give rise to protein malfunctions</p> <p>Apply this to working knowledge of enzymes and/or other proteins</p>
<p>Define inheritance terminology</p> <p>Use terminology to predict if genes are expressed or not</p> <p>Recognise that many characteristics are the result of multiple gene expressions</p>	<p>Define the following terms;</p> <p><i>Gamete</i></p> <p><i>Chromosome</i></p> <p><i>Gene</i></p> <p><i>Allele</i></p> <p><i>Dominant</i></p> <p><i>Recessive</i></p> <p><i>Homozygous</i></p> <p><i>Heterozygous</i></p> <p><i>Genotype</i></p> <p><i>Phenotype</i></p> <p>Explain that resulting expression of characteristics is called the phenotype and the genome sequence that determined it, is the genotype.</p> <p>Explain that our genotype is the version of gene (Allele) that we have - This is inherited from our parents)</p> <p>Explain that alleles can be dominant (always expressed in the phenotype) or recessive (you need two recessive alleles for them to be expressed in the phenotype)</p> <p>Two of the same alleles represents a homozygous genotype.</p> <p>Different versions of the allele in a genotype represents a heterozygous genotype</p>	<p>Recognise how characteristics are determined by the genotype which yields the resulting phenotype</p> <p>Make predictions as to whether a characteristic will be present or not</p> <p>Apply this to why you can either tongue roll or you cannot</p> <p>Can understand how Mendelian genetics is still used today to determine likelihood of inheritance</p>

<p>Produce a punnet square and extrapolate proportions and ratios of outcomes</p> <p>Utilise family trees to interpret information regarding inheritance of disease</p>	<p>Most phenotypic features are the result of multiple genes, but single gene inheritance can be predicted using a punnet square</p> <p>Draw a punnet square, identifying whether parents/offspring are homo or heterozygous and the likely outcomes for offspring</p> <p>Interpret information from punnet squares/family trees to ascertain probability of inheritance</p> <p>Use a punnet square to determine inheritance of sex (XX for females, XY for males)</p> <p>Ascertain likelihood of inheritance for diseases such as cystic fibrosis/Huntington's.</p> <p>Evaluate the outcome of a dominant/recessive disorder</p>	<p>Recognise where inheritance of a disease may be more likely and thereby consider alternate options</p> <p>Understand how scientists can utilise genomic information to advance medicines</p>
<p>Evaluate the economic, social and ethical issues around embryo screening</p>	<p>Some disorders are inherited – Polydactyly, cystic fibrosis, sickle cell anaemia</p> <p>Understand the outcomes of these 3 diseases and why embryonic screening may be sought/advised</p> <p>Consider the issues surrounding embryonic screening and evaluate the advantages/disadvantages of its use</p>	<p>Consider the emotional impacts of receiving information from screening</p> <p>Evaluate how the advancement of science is reducing risk and enabling informed choices/actions</p>

<b>BIOLOGY</b> <b>Variation &amp; Evolution</b>	<i>(Substantive Knowledge)</i>  <b>Students will know and remember...</b>	<i>(Disciplinary and Procedural Knowledge)</i>  <b>So that they can...</b>
<p>Identify how variation can both be caused by genes and/or the environment</p> <p>Recall that mutations can give rise to changes in the phenotype</p>	<p>Variation through the environment can occur and associated examples: scars, muscular tone</p> <p>Variation is also attributed to genetics and associated examples: eye colour, tongue rolling</p> <p>Some variation is down to both: height and weight</p> <p>Mutations occur continuously, with few affecting the phenotype – however, in a new environment, a change of phenotype can be advantageous – use the example of the horse to see how change suited new environments</p>	<p>Recognise characteristics as being attributed to genetics, environment, both and investigate these through collection of data</p> <p>Apply this knowledge to understanding how GM crops could be produced to have tailored characteristics or how selective breeding is utilised to give favourable characteristics eg. Wheat</p> <p>Recognise that longitudinal twin studies can provide useful information about variation and its causes</p>
<p>Explain how evolution by natural selection was proposed by Charles Darwin and utilise this theory to explain how organisms have changed over time</p>	<p>Darwin proposed his theory of natural selection by studying organisms on the Galapagos – in particular, the varying finch species.</p> <p>Darwin observed that differing species had adaptations that favoured the different environments they were found in</p> <p>Natural selection is the result of random mutations, which give rise to adaptations and where these favour a new environment, those adaptations are selected for and passed onto offspring.</p> <p>A new species is produced when it can interbreed and produce fertile offspring</p> <p>This can arise from geographical isolation</p>	<p>Apply the laws of natural selection to understand changes to organisms over time and relate this to concepts such as bacterial resistance.</p> <p>Evaluate how natural selection compares to acquired characteristics (Lamarck) and how evidence from fossils and observations supported Darwin's theory and understand why it was controversial when it was first launched</p>
<p>Explain how selective breeding (artificial selection) can be used to create favourable characteristics over time</p>	<p>Identify that artificial selection involves humans selecting the best characteristics and then cross-breeding to produce offspring with desired characteristics, which are then cross-bred over many generations until the entirety of the population has the required characteristics.</p> <p>Suggest advantages of this, to include increases in yield or quality or production of resistance/tolerance</p> <p>Identify the disadvantage as being the potential for inbreeding and enhanced likelihood of disease</p>	<p>Recognise how this mechanism has been used over the years to enhance milk and meat yield in cattle</p> <p>Apply to Mendel's use of cross pollinating pea plants to identify 'genes'</p> <p>Consider the ethical issues associated with inbreeding</p>

<p>Describe the process of genetic engineering</p> <p>Give an example of how genetic engineering has been deployed to improve an outcome <i>HT only – Define the steps in genetic engineering</i></p> <p>Evaluate the advantages and disadvantages of GM products – particularly, crops.</p>	<p>Consider how treatments for diabetes and xerophthalmia have been changed by the advent of GM.</p> <p>Consider examples of crops that have been enhanced through GM</p> <p>Explain that GM is achieved through combining genetic sequences from other organisms – HT explain the use of vectors to carry the desired genes.</p> <p>Describe the stages in GM to include identification, isolation, removal of and insertion in vector/organisms DNA – to include reference to restriction enzymes and Ligase.</p> <p>Consider how GM insulin removes risk of rejection and ethical issue of pig insulin.</p> <p>Consider how ‘super weeds’ may be created through transmission of GM genes and why concerns over use exist.</p>	<p>Understand why insulin and golden rice were created and the benefits of these</p> <p>Consider its use in creating resistances – E.g. Banana plant wilt</p> <p>Consider how GM could be utilised to treat disorders like Parkinson’s</p> <p>Identify and explore ethical issues in utilising vectors to transmit genes</p>
<p><b>SEPARATE BIOLOGY ONLY</b></p> <p>Describe and explain how cloning produces genetically identical species</p>	<p>Recall the use of cuttings and tissue culture in the propagation of new plants</p> <p>Consider the use of embryo transplants into surrogates</p> <p>Define the stages of adult cell cloning</p>	<p>Evaluate the use of tissue culture over cuttings in terms of efficiency/yield</p> <p>Consider the ethical issues surrounding cloning and embryo transplantation</p> <p>Consider how and why Dolly was created and the difficulties met with</p>



<b>BIOLOGY</b> <b>Genetics and</b> <b>Evolution</b>	<i>(Substantive Knowledge)</i>  <b>Students will know and remember...</b>	<i>(Disciplinary and Procedural Knowledge)</i>  <b>So that they can...</b>
<p>Consider how our understanding of genes and dominance originates from Gregor Mendel's work</p> <p>Use punnet squares to demonstrate monohybrid inheritance</p> <p>Explain how Crick and Watson's model of DNA furthered understanding and supported Mendelian genetics</p>	<p>Genes have versions called alleles, which give rise to different varieties of phenotype</p> <p>Mendel investigated allele dominance by cross pollinating pea plants and identified patterns of inheritance</p> <p>Mendel's work was poorly understood and not accepted for some time, due to the absence of further study/technology</p> <p>Understanding the model of DNA yielded further evidence to support our understanding of genetics</p>	<p>Explore how contributing work of other scientists and advances in technology provide support for existing theories</p>
<p><b>SEPARATE BIOLOGY ONLY</b></p> <p>Understand the factors that made Darwin's law of natural selection difficult to accept at its launch</p> <p>Consider other research, findings and the results of other scientists and evaluate how these led to acceptance</p>	<p>Lamarck had a theory of evolution called 'Acquired selection'</p> <p>Acquired selection suggested that traits were acquired through behaviours – giraffes gained long necks through stretching</p> <p>Darwin launched his theory later on Natural selection</p> <p>Darwin's ideas were difficult to accept due to;</p> <ul style="list-style-type: none"> <li>a) It challenged the 'creationist' view</li> <li>b) lack of wider evidence</li> <li>c) mechanisms of inheritance not known or understood</li> </ul> <p>Darwin's work was published following his observations of fossils, animal adaptations and was contributed to by Alfred Russel Wallace.</p> <p>Wallace also gathered evidence for evolution based on observation</p>	<p>Understand that scientific collaboration is essential for sourcing supportive evidence</p>
<p><b>SEPARATE BIOLOGY ONLY</b></p> <p>Understand the concept of speciation and use it to explain how it can contribute to the formation of new species</p>	<p>Wallace collaborated with Darwin and had theorised the concept of speciation</p> <p>Speciation can be reproductive but is most often geographic</p> <p>Speciation can lead to the evolution of new species – when species are geographically isolated and following variation and adaptations, they become so different, that they can no longer interbreed and produce fertile offspring</p>	<p>Consider how Darwin's finches provided real evidence for evolution by natural selection</p> <p>You can investigate how beak shape is an adaptation that enables feeding to be achieved successfully and qualify your findings</p>

<p><b>SEPARATE BIOLOGY ONLY</b> Consider and evaluate how Gregor Mendel's work supported Darwin's theories</p> <p>Consider how the work of contributing scientists over time, has developed our understanding of genetics</p>	<p>Understand how Mendel investigated genetic 'units' in pea plants, leading to an understanding of dominance and recessiveness</p> <p>The use of microscopy and observing cell division gathered further evidence to support Mendel</p> <p>The model of DNA provided further evidence</p>	<p>Evaluate how scientific theories are produced and launched</p> <p>Understand how the work of Mendel and others lend further evidence and support for our understanding of the genome</p>
<p>Consider how the fossil record provides evidence for evolution</p> <p>Evaluate how fossilisation occurs and factors needed for the process</p>	<p>Fossils are formed in the absence of microbial action and mineralisation over time</p> <p>Fossils can be found whole or as imprints (preserved traces)</p> <p>Fossils provide evidence for evolution as they show change over time eg. The horse</p> <p>The fossil record is incomplete and does not provide conclusive evidence</p>	<p>Investigate fossil remains and geological evidence to surmise how they provide evidence for evolution</p> <p>Use evolutionary trees to see the connections and timelines between organisms</p>
<p>Consider factors which may contribute to the extinction of a species</p> <p>Evaluate different theories of mass extinction</p>	<p>Extinctions occur when there are no remaining individuals of a species still alive</p> <p>Extinctions may occur when selection pressures are too great</p> <p>Extinctions may occur due to changing environments/human interactions/diseases and new competition factors</p> <p>There are theories for mass extinction, which are difficult to prove</p>	<p>Consider how evolution and extinction co-exist</p> <p>Decipher evidence as to extinction rates or reasons for being placed on endangered lists</p> <p>Evaluate data and research for mass extinctions and analyse supporting evidence for these theories to make reasoned judgements about their validity</p>
<p>Consider how bacterial resistance is an example of natural selection</p> <p>Evaluate how and why this presents a concern to medicine</p>	<p>Antibiotics can only be used for bacterial infections</p> <p>Bacteria reproduce by binary fission, which is much faster than mitosis</p> <p>Bacterial DNA can mutate and cause changes in the base sequence of DNA which can alter the resulting phenotype</p> <p>As a result of phenotypic change, bacteria can become resistant to antibiotics</p> <p>There are 2 factors which increase the likelihood of bacterial resistance: Over-use/over prescription (which includes use in agriculture) and not completing a course of antibiotics</p>	<p>Analyse data on the number of resistant strains of bacteria to draw conclusions as to how trends over time</p> <p>Consider and recall how inhibition zones can be an effective measure of the efficiency of antibiotics</p> <p>Explain why hospital hygiene is so important</p> <p>Explain why antibiotics should be used carefully</p> <p>Consider the emergence of synthetic antibiotics and why these are being developed</p>

<p>Describe and define Carl Linnaeus' classification hierarchy</p> <p>Explain why classification systems are useful</p>	<p>Organisms are classified into a hierarchical organisation by; Kingdom – Phylum – Class -Order – Family – Genus – species</p> <p>There are 6 kingdoms and 3 domains: Animals – Plants – Fungi – Protista – Prokaryotes – Archaeobacteria</p> <p>All organisms have a binomial name – A Genus (stated with a capital letter) and a species (which is all lower case)</p>	<p>Identify how new species are identified and the systems that are deployed to investigate them</p> <p>Give identifying characteristics of the different types</p> <p>Explain why Latin is the universal language of science and why the binomial system is used around the world</p>
<p>Consider why biochemical processes and enhanced microscopy led to an update of the classification system</p> <p>Explain how Carl Woese's system has enhanced classification of organisms</p>	<p>Organisms are either eukaryotic (have membrane bound organelles) or are prokaryotic (have no membrane bound organelles)</p> <p>Archaeobacteria are now included as a domain – These are sometimes known as extremophiles. They are primitive bacteria that exist in remote environments</p> <p>All organisms are classified on their morphology and their internal cellular structures, as well as DNA lineage</p> <p>Evolutionary trees can display evolutionary relationships between organisms</p>	<p>Understand how scientific developments can enhance existing scientific work</p> <p>You can read and interpret an evolutionary tree to identify a common ancestor</p>