



Scheme of work

Combined Science: Synergy
Explaining change

This resource provides guidance for teaching the Explaining change topic from our new GCSE in Combined Science: Synergy (8465). It has been updated from the draft version to reflect the changes made in the accredited specification. Changes have been made to sections; 4.4.1.1 Development of the Earth's atmosphere, 4.4.1.5 Climate change: impacts and mitigation, 4.4.1.8 Sources of potable water, 4.4.2.2 Interdependence and competition, 4.4.2.4 Field investigations, 4.4.3.2 Sex determination in humans, 4.4.3.3 Single gene inheritance, 4.4.4.2 Evolution through natural selection, 4.4.4.3 Evidence for evolution, 4.4.4.5 Selective breeding and 4.4.4.6 Genetic engineering. These changes are also reflected in the learning outcomes and opportunities to develop and apply practical and enquiry skills of most sections.

The scheme of work is designed to be a flexible medium term plan for teaching content and development of the skills that will be assessed.

It is provided in Word format to help you create your own teaching plan – you can edit and customise it according to your needs. This scheme of work is not exhaustive; it only suggests activities and resources you could find useful in your teaching.

4.4 Explaining change

4.4.1 The Earth's atmosphere

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4.4.1.1	<p>Evidence for the early atmosphere is limited because of the time scale of 4.6 billion years.</p> <p>One theory suggests that during the first billion years of the Earth's existence there was intense volcanic activity, which released gases that formed the early atmosphere and water vapour that condensed to form the oceans. At the start of this period the Earth's atmosphere may have been like the atmospheres of Mars and Venus today, consisting mainly of carbon dioxide with little or no oxygen gas.</p> <p>Volcanoes also produced nitrogen, which gradually built up in the atmosphere, and there may have been small proportions of methane and ammonia.</p>	Students should be able to, given appropriate information, interpret evidence and evaluate different theories about the Earth's early atmosphere.	1.5	<p>Describe the theory of the evolution of the Earth's early atmosphere in 60 seconds.</p> <p>Represent changes in the Earth's atmosphere over time in a diagram.</p> <p>Compare the Earth's atmosphere to that of Mars and Venus.</p> <p>Extended writing: explain how algae and plants have caused the concentrations of oxygen in the atmosphere to increase.</p> <p>Students make a presentation in which they explain how algae and plants have caused the concentrations of carbon dioxide in the atmosphere to decrease.</p> <p>Describe how sedimentary rocks formed and locked up carbon dioxide.</p>	<p>How have sedimentary rocks helped scientists piece together the history of the Earth's atmosphere?</p> <p>What are isotopes and why are they useful to geologists?</p> <p>Why has the proportion of CO₂ in the atmosphere decreased over time?</p> <p>What is a mass spectrometer and what is it used for?</p> <p>Sedimentary rocks in SW Greenland are 3.8 million years old. What does this tell us about the Earth?</p> <p>What happened to oxygen in the Earth's early atmosphere?</p>	<p>Video clips:</p> <p>YouTube: Earth and the Early Atmosphere</p> <p>YouTube: Evolution of the Earth's atmosphere</p> <p>Exampro user guide PowerPoint</p> <p>Ideas about ancient volcanoes, climate etc:</p> <p>NASA website</p> <p>Teachit Science resource (21262) 'Earth's atmosphere – spot the difference'</p> <p>Teachit Science resource (22247) Chemosynthesis – a new source of life</p>

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	<p>When the oceans formed, carbon dioxide dissolved in the water and carbonates were precipitated producing sediments, reducing the amount of carbon dioxide in the atmosphere.</p> <p>Algae and plants produced the oxygen that is now in the atmosphere by photosynthesis.</p> <p>Algae first produced oxygen about 2.7 billion years ago and soon after this oxygen appeared in the atmosphere. Over the next billion years plants evolved and the percentage of oxygen gradually increased to a level that enabled animals to evolve.</p> <p>Photosynthesis by algae and plants also decreased the percentage of carbon dioxide in the atmosphere. Carbon dioxide was also used up in the formation of sedimentary rocks, such as limestone, and fossil fuels such as coal,</p>			<p>WS 1.1 Given appropriate information, interpret evidence and evaluate different theories about the Earth's early atmosphere.</p> <p>WS 1.3 Explain why evidence is uncertain or incomplete in a complex context.</p> <p>MS 1c Use ratios, fractions and percentages.</p>	<p>Why is the atmosphere not full of hydrogen?</p> <p>What contribution has limestone made to changes in the atmosphere over time?</p> <p>How might the Earth's atmosphere continue to change over the next 100, 1000 and/or 1 000 000 years?</p>	

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	natural gas and oil.					
4.4.1.2	<p>The element carbon is found as carbon dioxide in the atmosphere, dissolved in the water of the oceans, as calcium carbonate in sea shells, in fossil fuels and in limestone rocks, and as carbohydrates and other large molecules in all living organisms. Carbon cycles through the environment by processes that include photosynthesis, respiration, combustion of fuels and the industrial uses of limestone.</p> <p>Life depends on photosynthesis in producers such as green plants, which make carbohydrates from carbon dioxide in the air. Animals feed on plants, passing the carbon compounds along food chains. Animals and plants respire and release carbon dioxide back into the air.</p>	<p>Describe the carbon cycle.</p> <p>Interpret and explain the processes in diagrams of the carbon cycle.</p> <p>Explain the importance of the carbon cycle to living things.</p> <p>Explain the role of microorganisms in cycling materials through an ecosystem.</p>	1	<p>Discussion questions</p> <p>Link the 7 processes of life to the carbon cycle</p> <p>What are detritivores?</p> <p>If the rate of decay slowed to almost zero what effect would this have on us and on the carbon cycle?</p> <p>What's my role in the carbon cycle?</p> <p>WS 1.2</p> <p>Draw and interpret diagrams to represent the main stores of carbon and the flows of carbon between them in the cycle.</p> <p>This topic links with 4.4.2 (Ecosystems and biodiversity).</p>	<p>Give table of data for changes in; atmospheric CO₂, CO₂ in seawater and pH of seawater, over time (eg 1950–2015). Students plot graph(s), describe and explain any correlations and use graphs to predict changes over the next decade.</p> <p>Investigate organisms in leaf litter. Use keys to identify.</p> <p>Students research maggots in forensic science.</p>	<p>‘The carbon connection’ video http://www.discoveryeeducation.co.uk/video/item882921</p> <p>Teachit Science resources (19849) ‘Carbon cycle questions’, and (19850) ‘Carbon cycle jigsaw’</p> <p>Hand lenses, binocular microscopes, white trays, tweezers, specimen tubes, identification charts.</p> <p>http://news.nationalgeographic.com/news/2014/10/141029-maggot-flies-bodies-video-forensics-science/</p>

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	Decay of dead plants and animals by microorganisms returns carbon to the atmosphere as carbon dioxide and mineral ions to the soil.					
4.4.1.3	Greenhouse gases in the atmosphere maintain temperatures on Earth high enough to support life. They allow short wavelength radiation from the Sun to pass through the atmosphere to the Earth's surface but absorb the outgoing long wavelength radiation from the Earth's surface, causing an increase in temperature. Water vapour, carbon dioxide and methane are greenhouse gases that increase the absorption of outgoing, long wavelength radiation.	Describe the greenhouse effect in terms of the interaction of radiation with matter.	1	Ask students to model the greenhouse effect (provide them with a range of materials such as (fruit) netting, string, sticky notes, marbles/beads of different sizes, etc).	Investigate changing conditions on the effect of temperature in model greenhouses (use plastic bottles). Research methane as a greenhouse gas. How can temperature data be obtained from ice core samples?	Video clips: YouTube: Green house Effect and Global warming YouTube: Discovery Channel – Global Warming, What You Need To Know (long video) NASA JPL greenhouse investigation - https://sealevel.jpl.nasa.gov/files/archive/activities/ts1hiac1.pdf
4.4.1.4	Human activities that involve burning fossil fuels (coal, oil and gas) for generating electricity, transport and	Describe how greenhouse gases are produced.	1	Discussion question – is climate change new?	Use the internet to obtain data for concentrations of greenhouse gases.	Teachit Science resource (25424) ' Climate graphs '

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	<p>industry all add carbon dioxide to the atmosphere. These activities have led to a large rise in the concentration of carbon dioxide in the air over the last 150 years. Over the same time the average temperature of the surface of the Earth has risen. The scientific consensus is that this is more than correlation and that the rise in greenhouse gas concentrations has caused the rise in temperature.</p> <p>Climate describes the long-term patterns of weather in different parts of the world. Climate change is shown by changes to patterns in measures of such things as air temperature, rainfall, sunshine and wind speed.</p> <p>Scientists analyse data on climate change using computer models based on the physics that describes the</p>	<p>Evaluate the use of models for predicting climate change.</p> <p>Evaluate the quality of evidence in a report about global climate change given appropriate information</p> <p>Describe uncertainties in the evidence base.</p> <p>Recognise the importance of peer review of results and of communicating results to a wide range of audiences.</p>		<p>Interpret climate graphs from different parts of the world.</p> <p>WS 1.6</p> <p>Explain the importance of scientists publishing their findings and theories so that they can be evaluated critically by other scientists.</p> <p>WS 1.6</p> <p>Understand that the scientific consensus about global warming and climate change is based on systematic reviews of thousands of peer reviewed publications.</p> <p>WS 1.3</p> <p>Explain why evidence is uncertain or incomplete in a complex context.</p> <p>MS 2c, 4a</p> <p>Extract and interpret information from charts, graphs and tables.</p> <p>MS 2h</p>	<p>Evaluate the reliability of the data available on the internet.</p> <p>Research the process of peer review in reporting results/data.</p>	<p>NCAR VETS Climate change simulation</p> <p>Video clip: YouTube: The Carbon Cycle</p> <p>National Geographic - Environment</p> <p>British Antarctic Survey – Search climate change</p> <p>FLIR Making the invisible visible video: http://www.discoveryeeducation.co.uk/video/item882924</p>

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	<p>movements of mass and energy in the climate system. Many complex changes on Earth affect the climate and detailed data about the scale of the changes is not available from all over the world. Also, when predicting climate change, scientists have to make assumptions about future greenhouse gas emissions. This means that there are uncertainties in the predictions.</p>			<p>Use orders of magnitude to evaluate the significance of data.</p>		
4.4.1.5	<p>Consequences of global warming and climate change include:</p> <ul style="list-style-type: none"> • sea-level rise • loss of habitat • changes to weather extremes • changes in the amount, timing and distribution of rainfall • temperature and water stress for humans and wildlife 	<p>Identify the effects of global warming.</p> <p>Explain the effects of climate change.</p> <p>Describe the scale, risk and environmental implications of global climate change.</p> <p>Describe how emissions can be reduced. Suggest the consequences of the</p>	1	<p>Students research the effects of global warming and climate change and prepare a class presentation.</p> <p>Students use the carbon cycle as a starting point to suggest ways that the effects of climate change can be mitigated.</p> <p>Discussion questions:</p> <ul style="list-style-type: none"> • Do vegetarians contribute less to climate change? 	<p>Using a globe identify capital cities. How many are located on the coast or river mouths?</p> <p>Students research the problems faced by Pacific island states such as the Marshall Islands.</p> <p>Research question - are tropical storms</p>	<p>Video clips:</p> <p>BBC Bitesize Causes of climate change</p> <p>WWF website http://www.wwf.org.au/our_work/people_and_the_environment/global_warming_and_climate_change/science/</p>

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	<ul style="list-style-type: none"> • changes in the distribution of species • changes in the food producing capacity of some regions <p>Steps can be taken to mitigate the effects of climate change by reducing the overall rate at which greenhouse gases are added to the atmosphere. Examples of mitigation include:</p> <ul style="list-style-type: none"> • using energy resources more efficiently • using renewable sources of energy in place of fossil fuels (see 4.8.2, Resources of materials and energy) • reducing waste by recycling • stopping the destruction of forests • regenerating forests • developing techniques to capture and store carbon 	<p>reductions on the Earth, atmosphere and everyday life.</p>		<ul style="list-style-type: none"> • How could you prove growing trees remove CO₂ from the atmosphere? • Who should pay farmers to regenerate forests on their land? <p>WS 1.4</p> <p>In the context of climate change, evaluate associated economic and environmental implications; and make decisions based on the evaluation of evidence and arguments.</p> <p>Write a persuasive newspaper article for the building of a new, local wind farm. Write letters of disagreement from readers.</p> <p>Students decide the benefits (include data) of recycling and present their ideas as a 'sales pitch'.</p>	<p>becoming stronger and/or more frequent?</p> <p>Collect data on the greenhouse gas emissions of a variety of countries. How much should each country be responsible for the consequences of global warming?</p> <p>What is a 'porous liquid' and why are scientists excited about it?</p>	<p>New Economics Foundation - environment</p> <p>BBC website - The Living Planet</p>

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	dioxide released from fossil fuel power stations.					
4.4.1.6	<p>The combustion of fuels is a major source of atmospheric pollutants that can be harmful to health and the environment.</p> <p>Carbon monoxide is formed by the incomplete combustion of hydrocarbon fuels when there is not enough air. Carbon monoxide is a toxic gas that combines very strongly with haemoglobin in the blood. At low doses it puts a strain on the heart by reducing the capacity of the blood to carry oxygen. At high doses it kills.</p> <p>Sulfur dioxide is produced by burning fuels that contain some sulfur. These include coal in power stations and some diesel fuel burnt in ships and heavy vehicles.</p>	<p>Predict the products of combustion of a fuel given appropriate information about the composition of the fuel and the conditions in which it is used.</p> <p>Explain the problems caused by increased amounts of pollutants in the air.</p> <p>Describe the effect of the following products:</p> <ul style="list-style-type: none"> • carbon monoxide on the human body • sulfur dioxide and oxides of nitrogen on acidity of rain water • sulfur dioxide and oxides of nitrogen on respiratory system 	1	<p>Write word equations for complete and incomplete combustion.</p> <p>Use these equations to describe the reactions in terms of reactants, products made and number of each present.</p> <p>Should carbon monoxide monitors in every home be compulsory?</p> <p>Explain why the following can be produced in combustion:</p> <ul style="list-style-type: none"> • carbon dioxide • carbon monoxide • soot • water vapour • sulfur dioxide • oxides of nitrogen. <p>WS 1.4</p> <p>Describe, explain or evaluate ways in which human activities affect the environment.</p>	<p>Why is carbon monoxide particularly dangerous?</p> <p>Why do children and young people succumb more readily to carbon monoxide poisoning?</p> <p>How do CO monitors compare to smoke alarms?</p> <p>CO detectors use one of three types of sensor. Students investigate the types and decide which branch of Science they stem from.</p> <p>Students view graphs showing acid rain emission 1960s–present day. Interpret the graphs and suggest/research reasons for the patterns.</p>	<p>Video clips</p> <p>YouTube: What is combustion?</p> <p>YouTube: Coal Combustion and Acid Rain</p>

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	<p>Sulfur dioxide turns to sulfuric acid in moist air.</p> <p>Oxides of nitrogen are produced by the reaction of nitrogen and oxygen from the air at the high temperatures involved when fuels are burned.</p> <p>Sulfur dioxide and oxides of nitrogen cause respiratory problems in humans and cause acid rain. Acid rain damages plants and buildings. It also harms living organisms in ponds, rivers and lakes.</p> <p>Particulates in the air include soot (carbon) from diesel engines and dust from roads and industry. The smaller particulates can go deep into people's lungs and cause damage that can lead to heart disease and lung cancer.</p>	<ul style="list-style-type: none"> • particulates on human global dimming • particulates on human health problems. 			<p>What is causing acidification of the world's oceans?</p>	

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4.4.1.7	<p>Water is found in the solid state in glaciers and ice sheets, in the liquid state in the oceans, rivers, lakes and aquifers and in the gas state in the atmosphere. Water cycles through the environment by processes that include melting, freezing, evaporation and condensation. Precipitation of water from the atmosphere can take the form of rain, sleet or snow.</p> <p>Life on Earth depends on water on land and in the seas. Water acts as the solvent for chemical reactions in cells. It also helps transport dissolved compounds into and out of cells. Water is either a reactant or a product of biochemical changes such as respiration, photosynthesis and digestion. Rivers, lakes and seas</p>	<p>Interpret and explain the processes in diagrams of the water cycle.</p> <p>Explain the importance of the water cycle to living things.</p> <p>Explain the water cycle.</p>	1	<p>Starter question – what is dihydrogen monoxide?</p> <p>Give students a diagram of the water cycle with missing labels, ask students to discuss and annotate.</p> <p>Sum up the role of water in photosynthesis and respiration making connections with circulatory, digestive, excretory, respiratory organ systems</p> <p>WS 1.2</p> <p>Draw and interpret diagrams to represent the main stores of water and the flows of water between them in the cycle.</p>	<p>Design and evaluate a model to represent the water cycle.</p> <p>Link the water cycle to energy transfers.</p> <p>Research the importance of glacial melt water to rivers such as the Yangtze and Indus. Use peer assessment to decide if more information would need to be collected for a conclusion to be reached.</p>	<p>Teachit Science resource (25369) 'the water cycle'</p> <p>Northumbrian water blank water cycle diagram</p>

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	provide habitats for many living organisms.					
4.4.1.8	<p>Water that is safe to drink is called potable water. Potable water is not pure water in the chemical sense because it contains dissolved substances.</p> <p>The methods used to produce potable water depend on available supplies of water and local conditions. In the UK, rain provides water with low levels of dissolved substances (fresh water) that collects in the ground and in lakes and rivers and most potable water is produced by:</p> <ul style="list-style-type: none"> • choosing an appropriate source of fresh water • passing the water through filter beds to remove any solids • sterilising to kill microbes. <p>Sterilising agents used for potable water include</p>	<p>Define the terms potable water and pure water.</p> <p>Explain the differences between the two terms.</p> <p>Describe the differences in treatment of ground water and salty water.</p>	1	<p>Discussion question – what does 'potable' mean?</p> <p>What are the similarities and differences between potable water and pure water?</p> <p>Students find out about solar disinfection and outline the advantages and disadvantages of water purification at the point of use.</p> <p>How can we know that water is safe to drink?</p> <p>Make notes from information leaflets about sewage treatment processes and use to draw a diagram to summarise.</p> <p>How do reed beds work as water treatment systems?</p> <p>WS 1.4</p> <p>Explain everyday and technological applications of science; evaluate associated</p>	<p>Required practical 11: analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.</p> <p>Chemistry AT2, 3 and 4</p> <p>Students design a sustainable drainage system (SuDS), eg for their school. Links to reducing risk of flooding and preventing water pollution.</p> <p>On average, adults produce 200 g faeces/day; a stool is 75% water. Students use these figures to make estimations regarding the quantity produced by a local conurbation over given periods of time.</p>	<p>Video clip</p> <p>YouTube: UTEK – Potable Water Generator</p> <p>Resources for schools - Thames Water Tools for Schools</p> <p>Several water companies provide resources for schools regarding sewage treatment, eg Northumbrian water</p> <p>Video clip</p> <p>YouTube: Water and You: The Water Treatment Process</p> <p>Information about SuDS. netregs.org.uk/library_of_topics/water/sustainable_urban</p>

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	<p>chlorine, ozone or ultraviolet light.</p> <p>If supplies of fresh water are limited, desalination of salty water or sea water may be required. Desalination can be done by distillation or by processes that use membranes such as reverse osmosis. Energy resources have to be used to run these processes.</p> <p>Urban lifestyles and industrial processes produce large amounts of waste water that require treatment before being released into the environment. Sewage and agricultural waste water require removal of organic matter and harmful microbes. Industrial waste water may require removal of organic matter and harmful chemicals.</p> <p>Sewage treatment includes:</p>			personal, social, economic and environmental implications.	Students find out how urine and faeces could be used to generate electricity.	drain_system/what_a_re_suds.aspx

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	<ul style="list-style-type: none"> • screening and grit removal • sedimentation to produce sewage sludge and effluent • anaerobic digestion of sewage sludge • aerobic biological treatment of effluent. 					

4.4.2 Ecosystems and biodiversity

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4.4.2.1	<p>An ecosystem is made up of all the living organisms in a particular environment together with the non-living components such as soil, air and water. A habitat is where a particular organism lives in an ecosystem. A population is made up of all the individuals of the same species in a habitat. A community is made up of all the populations of different organisms that live in the same habitat.</p> <p>Feeding relationships within a community can be represented by food chains. All food chains begin with a producer that synthesises molecules. This is usually a green plant, which absorbs light to make glucose by photosynthesis.</p> <p>A food web can be used to understand the interdependence of species</p>	<p>Understand and use the terms ecosystem, community, competition, habitat, interdependence.</p> <p>Describe factors that affect the survival of organisms in their habitat.</p> <p>Explain how one species depends on others for survival.</p> <p>Describe a stable community as one where all the species and environmental factors are in balance, so population sizes remain fairly constant. Give an example of a stable community.</p> <p>Explain what a food chain shows.</p> <p>Explain that photosynthetic</p>	1	<p>Look at pictures of different habitats and think-pair-share factors that affect the survival of organisms in a habitat.</p> <p>Discuss how organisms depend on each other for survival and introduce the term 'interdependence'.</p> <p>Are humans hosts to parasites?</p> <p>Is the mosquito a parasite?</p> <p>Watch BBC video clip about food chains and interdependence (see resources).</p> <p>Construct food chains and identify the producer and consumers.</p> <p>Research producers that are not green plants.</p> <p>Interpret population curves.</p> <p>WS 1.2</p>	<p>Investigate the symbiotic relationship between plants and fungi (Mycorrhiza and lichens).</p> <p>Assess the importance of Mycorrhiza.</p> <p>How are human contraceptives arriving in the food chain?</p> <p>Observe organisms in their habitats and suggest inter-relationships.</p> <p>Use a model to describe food chains.</p> <p>Interpret population curves and explain predator-prey relationships.</p>	<p>BBC Bitesize – Ecosystems Videos</p> <p>kew.org/science-conservation</p> <p>BBC Bitesize Activity – Food chains</p> <p>Teachit Science resource (22247) 'Chemosynthesis – a new source of life'</p>

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	<p>within an ecosystem in terms of food sources.</p> <p>Producers are eaten by primary consumers, which in turn may be eaten by secondary consumers and then tertiary consumers.</p> <p>Consumers of animals are predators of the other animals they eat, and those eaten are prey. In a community the numbers of predators and prey rise and fall in cycles.</p>	<p>organisms are the producers of biomass for life on Earth.</p> <p>Identify producers, primary, secondary and tertiary consumers in a food chain.</p> <p>Interpret and explain population curves, eg hare and lynx, red and grey squirrels, and native and American crayfish.</p>		Interpret graphs used to model predator–prey cycles.		
4.4.2.2	<p>To survive and reproduce, organisms require a supply of materials from their surroundings and from the other living organisms in an ecosystem.</p> <p>Plants often compete with each other for light and space, and for water and nutrients from the soil.</p> <p>Animals often compete with</p>	Describe resources that plants and animals compete for in a given habitat.	1	<p>Starter activity - competition for resources – hide resource cards (eg water, light etc) around room – students need to find three different resources to survive.</p> <p>Investigate competition in radish or cress seedlings.</p>	<p>Investigate the effect of planting density on height of seedlings.</p> <p>Measure height and calculate mean averages. Present and analyse the results.</p>	<p>Competition investigation:</p> <ul style="list-style-type: none"> • radish or cress seeds • seed trays • compost • ruler.

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	<p>each other for food, mates and territory.</p> <p>Within a community each species depends on other species for food, shelter, pollination, seed dispersal etc. If one species is removed it affects the whole community. A stable community is one where all the species and environmental factors are in balance so that population sizes remain fairly constant.</p>					
4.4.2.3	<p>Abiotic factors that can affect a community are:</p> <ul style="list-style-type: none"> • light intensity • temperature • moisture levels • soil pH and mineral content • wind intensity and direction • carbon dioxide levels for plants 	<p>Name biotic factors in a habitat and explain how a change in a biotic factor might affect a community, eg:</p> <ul style="list-style-type: none"> • availability of food • new predators arriving • new disease organisms • one species out-competing another so the numbers are 	1	<p>Discuss factors that may affect the numbers or distribution of plants and animals in a habitat.</p> <p>Use interactive modelling to change an environment and explore the impact of factors on the interdependence of organisms, eg poisons, disease, food shortages etc.</p> <p>WS 1.2</p> <p>Predict how a change in an abiotic, or biotic, factor would</p>	<p>Model changes in an environment.</p> <p>Students plan how they would investigate the effect of hedge boundaries on crop yield. What biotic and abiotic factors might affect the crop?</p>	

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	<ul style="list-style-type: none"> oxygen levels for aquatic animals. <p>Biotic factors that can affect a community are:</p> <ul style="list-style-type: none"> availability of food new predators arriving new diseases one species out-competing another. 	<p>no longer sufficient to breed.</p> <p>Name abiotic factors in a habitat and explain how a change in an abiotic factor might affect a community, eg:</p> <ul style="list-style-type: none"> light intensity temperature moisture levels soil pH and mineral content wind intensity and direction carbon dioxide levels for plants oxygen levels for aquatic animals. 		<p>affect a given community given appropriate data or context.</p> <p>MS 2c, 4a</p> <p>Extract and interpret information from charts, graphs and tables.</p>		
4.4.2.4	<p>Ecologists use a range of investigation methods using transects and quadrats to determine the distribution and abundance of species in an ecosystem.</p>	<p>Describe how to carry out a field investigation into the distribution and abundance of organisms in an ecosystem.</p> <p>Explain how to determine their</p>	1	<p>MS 2b</p> <p>Calculate arithmetic means.</p> <p>MS 4a, 4c</p> <p>Plot and draw appropriate graphs, selecting appropriate scales for the axes.</p>	<p>Required practical 12: measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the</p>	<p>Teachit Science resource (20087) ‘Plant pops’</p>

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		numbers in a given area.		MS 2d Understand the principles of sampling.	distribution of this species. Biology AT 1, 3, 4, and 6 Extend the practical to investigate the effect of an abiotic factor on distribution of species. MS 2b, 2d, 4a, 4c	
4.4.2.5	<p>Biodiversity is greater in ecosystems that provide a bigger range of different habitats which are home to larger populations of a variety of organisms.</p> <p>Small populations are in greater danger of dying out if an ecosystem is disrupted in some way.</p> <p>Ecosystems with high levels of biodiversity help to provide the resources needed to sustain life, including human life.</p> <p>Ecosystems with higher biodiversity offer economic</p>	<p>Define the term biodiversity.</p> <p>Explain how great biodiversity maintains food supplies and shelter for organisms, and maintains the physical environment.</p> <p>Describe examples of how a reduction in biodiversity can affect climate, food supplies for humans, useful chemical for the future etc.</p>	1	<p>Exhibition or video clips to show the variety of life, to include microorganisms and different plants and animals (links with 4.4.4.4, Identification and classification of living things) (see resources).</p> <p>Discuss how some of these help humans, directly and indirectly.</p> <p>Suggest human activities that are reducing biodiversity.</p>	Evaluate environmental effects and ethical issues related to human activities.	<p>BBC Bitesize – Biodiversity</p> <p>Natural History Museum – Biodiversity</p> <p>Teachit Science Biodiversity resources .</p>

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	benefits by sustaining the resources needed for agriculture, fishing and forestry.					
4.4.2.6	<p>Examples of human interactions with local ecosystems that can diminish or destroy biodiversity include:</p> <ul style="list-style-type: none"> • building, quarrying, farming, clearing woods and other activities that destroy habitats • the destruction of peat bogs, and other areas of peat, to produce garden compost • pollution of streams, rivers and lakes by sewage, toxic wastes and fertilisers. <p>An example of a global impact of human activities is global warming leading to climate change (Links to</p>	<p>Explain what peat is and why it is important to preserve areas of peat.</p> <p>Explain why peat should not be burnt.</p> <p>Evaluate the use of fertiliser on plant growth and oxygen levels.</p> <p>Describe what herbicides and pesticides are used for.</p>	1	<p>Students research and discuss the concept of 'the tragedy of the commons' and how it applies to rainforests, the Arctic and the oceans.</p> <p>Observe a block of peat and some peat compost. Discuss what peat is used for and why.</p> <p>Demo burning peat.</p> <p>Show images of a peat bog, peat drying and peat being burnt.</p> <p>Explain why the destruction of peat bogs is harmful to the environment.</p> <p>Investigate the growth of plants in 'peat free' and peat based composts.</p> <p>Discuss the sources and effects of toxic chemicals; what</p>	<p>Consider the need for cheap fuel and cheap compost for food production, against the need to conserve peat bogs as habitats and reduce carbon dioxide emissions</p> <p>Using prior understanding, students synthesise the importance of Mycorrhiza with the use of fungicides in agriculture and gardening.</p> <p>Ask students to plan an experiment to measure the water retention properties of peat and peat-free composts.</p>	<p>bbc.co.uk/news/world-asia-31738867</p> <p>discoveryeducation.co.uk/video/item882930 - Why sharks matter</p> <p>Demo: Block of peat and compost.</p> <p>Composts:</p> <ul style="list-style-type: none"> • 'peat free' compost • peat-based compost • plant pots • seedlings. <p>Demo:</p> <ul style="list-style-type: none"> • beakers containing different concentrations of fertiliser

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	4.4.1, The Earth's atmosphere).			<p>pesticides and herbicides are used for.</p> <p>Demo to investigate the effect of fertiliser on growth of duckweed and oxygen levels. Monitor results over next few lessons.</p> <p>WS 1.4</p> <p>Evaluate given information about ways in which human activities affect the environment.</p>	Discuss appropriate graph to show results	<ul style="list-style-type: none"> • duckweed plants • oxygen sensors • data loggers.
4.4.2.7	<p>There are programmes to reduce these negative effects on ecosystems and biodiversity. These include:</p> <ul style="list-style-type: none"> • breeding programmes for endangered species • protecting and regenerating habitats • reintroducing wider field margins and hedgerows in areas of monoculture • recycling resources rather than dumping waste in landfill 	<p>Describe programmes introduced to maintain biodiversity:</p> <ul style="list-style-type: none"> • breeding programmes for endangered species • protection and regeneration of rare habitats, eg coral reefs, mangroves, heathland 	1	<p>Recap what biodiversity is.</p> <p>Students report on the reintroduction and breeding programmes for spoon-billed sandpipers and/or Madagascan pochard. How do these interventions help local communities?</p> <p>Research the list of programmes that could help to maintain biodiversity.</p> <p>Think-pair-share what individuals, businesses and</p>	<p>Search images of 'wildlife corridors'. Is there any evidence that such corridors enhance biodiversity?</p> <p>Students draw what they would expect to see in a graph showing changes to woodland as a percentage of land area in UK from 1000 AD – 2015. Then research and discover if their predictions were correct.</p>	<p>bbc.co.uk/nature/life/Large Blue (butterfly) #p00lypsv</p> <p>discoveryeducation.co.uk/video/item882927</p> <p>ejfoundation.org/msc.org/ (Marine Stewardship Council)</p>

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	<ul style="list-style-type: none"> production of peat-free composts reducing deforestation and carbon dioxide emissions. 	<ul style="list-style-type: none"> reintroduction of field margins and hedgerows in agricultural areas reduction of deforestation and carbon dioxide emissions by some governments recycling resources rather than dumping waste in landfill. <p>Explain and evaluate conflicting pressures on maintaining biodiversity.</p>		<p>governments could do to slow down the reduction in biodiversity.</p> <p>Which near-extinct species would you save and why?</p> <p>Discuss why it is difficult to make changes that will maintain biodiversity.</p> <p>WS 1.4</p> <p>Evaluate given information about methods that can be used to tackle problems caused by human impacts on the environment.</p>	<p>Many scientists are beginning to discuss 'bio-abundance' How is this different from biodiversity? Is it as important as biodiversity?</p> <p>Find out about the work of the Marine stewardship council. Could/should this model be extended to other natural resources?</p>	

4.4.3 Inheritance

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4.4.3.1	<p>Sexual reproduction involves the joining (fusion) of male and female gametes (sperm and egg cells in animals). In sexual reproduction there is mixing of genetic information, which leads to variety in the offspring. The formation of gametes involves meiosis.</p> <p>The genetic material in the nucleus of a cell is composed of a chemical called DNA contained in the chromosomes. Human body cells contain 23 pairs of chromosomes. DNA is made of very large molecules in long strands, twisted to form a double helix.</p> <p>A gene is a small section of DNA on a chromosome. Each gene contains the code for a particular combination of amino acids to make a specific protein. The genome of an organism is made up of</p>	<p>Explain why sexual reproduction produces variation in the offspring, but asexual reproduction does not.</p> <p>Describe sexual reproduction in animals.</p> <p>Describe the structure of chromosomes, DNA and genes.</p> <p>Explain that a gene is a small section of DNA that codes for a particular sequence of amino acids to make a specific protein.</p>	1	<p>Recap of reproduction through group work to discuss and share answers to questions:</p> <ul style="list-style-type: none"> • Do we really need males? • Is sex necessary? • Can scientists solve the world food shortage? • Do hermaphrodites lead a solitary existence? <p>Watch BBC video clips of fertilisation in humans (see resources).</p> <p>Recap key ideas by asking students to reorder by size: cell, nucleus, DNA, chromosome, gene, nucleotide.</p> <p>Debate: research and discuss 'DNA profiling' for health.</p> <p>Research roles of Franklin, Watson and Crick in the discovery of the structure of DNA.</p>	<p>Extract DNA from fruits such as onions or kiwi fruit. Observe the long strands which are the polymer</p>	<p>BBC Bitesize – Human fertilisation</p> <p>BBC Bitesize – What is DNA?</p> <p>Ethical issues: ABPI – Genetics and the pharmaceutical industry</p> <p>Nuffield Foundation Extracting DNA from living things</p>

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	all the genes in the DNA of its body cells. This topic has links with 4.1.3 (Cells in animals and plants).			Demo or practical to extract DNA.		
4.4.3.2	In human cells, one of the 23 pairs of chromosomes carries the genes that determine sex. In females the sex chromosomes are the same (XX); in males the chromosomes are different (XY). All eggs contain an X chromosome. Sperm cells contain either an X or a Y chromosome.	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.	1	Look at male and female karyotypes and identify the number of pairs of chromosomes and each pair of sex chromosomes. Use 'Making Reebops' game to demonstrate variation (see resources). Watch BBC video clip about Sex chromosomes (see resources). Use a Punnett square and a genetic cross diagram to illustrate the inheritance of sex; evaluate the chance of producing a male or female.	'Making Reebops' practical.	Video clip: BBC Bitesize – Sex chromosomes Nuffield Foundation Making Reebops: a model for meiosis
4.4.3.3	Some characteristics are controlled by a single gene. Examples are fur colour in mice and red-green colour blindness in humans.	Give examples of characteristics controlled by a single gene and describe their alleles.	1	Discuss variation in families and why offspring have some characteristics of their mother and some of their father and	Complete Punnett squares and genetic crosses. Interpret the results and describe the offspring.	BBC Bitesize – Inheritance activity Teachit Science resource (20142)

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	<p>Each gene may have different forms called alleles.</p> <p>A dominant allele is always expressed, even if only one copy is present. A recessive allele is only expressed if two copies are present (therefore no dominant allele present).</p> <p>If the two alleles present are the same the person is homozygous for that trait, but if the alleles are different they are heterozygous.</p>	<p>Give examples of characteristics controlled by multiple genes.</p> <p>Define and use the terms: gametes, genotype, phenotype, dominant recessive, homozygous and heterozygous.</p> <p>Complete a Punnett square to show the outcomes of genetic crosses.</p> <p>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.</p>		<p>often strongly resemble their grandparents.</p> <p>Complete Punnett squares.</p> <p>BBC activity Inheritance showing genetic crosses (see resources).</p> <p>MS 2e</p> <p>(HT only)Construct a Punnett square diagram and use it to make predictions based on simple probability.</p> <p>WS 1.2</p> <p>Interpret the results of a genetic cross diagram, for a single gene, and understand family trees.</p> <p>MS 1c</p> <p>Use direct proportion and simple ratios to express the outcome of a genetic cross.</p>		<p>‘Inheritance matching’</p> <p>Teachit Science genetics resources</p>
4.4.3.4	All the genes present in an individual organism interact with the environment in which the organism grows and	<p>Define the term phenotype.</p> <p>Give examples of characteristics</p>	1	<p>WS 1.2</p> <p>Explain why studies involving identical twins help to separate the contribution of genes and</p>	Use head size and height data for infants, children, adults as an opportunity to discuss	

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	<p>develops its observable appearance and character. These characteristics are its phenotype.</p> <p>The variation in the characteristics of individuals of the same kind may be due to differences in:</p> <ul style="list-style-type: none"> • the genes they have inherited (genetic causes) • the conditions in which they have developed (environmental causes) • a combination of genes and the environment. <p>Human height is an example of a characteristic determined by many genes, each with different alleles. The set of alleles that determine the height of a person is the genotype for that characteristic. Height is also affected by diet and exercise which are part of the</p>	<p>controlled by multiple genes.</p>		<p>the environment to the development of their phenotypes.</p> <p>WS 1.1</p> <p>Given a context and related information, discuss the potential importance for medicine of our increasing understanding of the human genome.</p>	<p>the merits of using of ratio and proportion in science.</p> <p>Demonstrate the function and use of height percentile graphs. Students use the information to explain to an audience, eg parents of young children, how 'normal' growth is gauged.</p>	

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	environment in which an individual grows up					

4.4.4 Variation and evolution

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4.4.4.1	<p>Mutations are changes in DNA molecules that may affect genes. Mutation of a gene can alter the proteins that it contains the code for, or even prevent the protein being produced in cells.</p> <p>Mutations can happen when DNA is copied during cell division or when cells are affected by environmental factors such as ionising radiation. Many mutations have no effect, but some can lead to significant variation.</p>	<p>Define the term mutation.</p> <p>Describe how mutations can be caused.</p> <p>Explain that some mutations have no effect, but some can lead to significant variation.</p>	1			RIGB Christmas lectures; Clip 2 - Mutation

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4.4.4.2	<p>The theory of evolution by natural selection explains the evolution of all species of living things from simple life forms that first developed more than three billion years ago.</p> <p>If two populations of one species become isolated geographically or environmentally they may evolve in different ways to suit different conditions. If they become so different that they can no longer interbreed to produce fertile offspring they have formed two new species.</p>	<p>Describe Darwin's theory of evolution by natural selection.</p> <p>Describe the main stages of natural selection.</p>	1	<p>Look at exhibition to show the wide variety of organisms that live, or have lived, on Earth.</p> <p>Discuss how they were all formed.</p> <p>BBC activity about Evolution.</p> <p>Watch BBC video clip illustrating survival of the fittest (see resources).</p> <p>Watch video clip about ancestor of horses from BBC <i>Walking with Beasts</i>.</p> <p>Draw a flow diagram to explain natural selection.</p> <p>Natural selection role play activities.</p> <p>Peppered moth game; explain in terms of natural selection.</p> <p>Look at pictures of Darwin's finches and match up with the Galapagos Island they lived on based on food available there.</p>	<p>Students design an activity to demonstrate the evolution of camouflage using coloured sweets/markers against different coloured backgrounds. The activity can be extended to collect data. Graph the data and use in comparisons with other group results</p> <p>Natural selection – beak shapes investigation.</p> <p>Discussion questions:</p> <ul style="list-style-type: none"> • Why do giraffes have long necks? • Why would it be unfair to ignore Alfred Russel Wallace when discussing Darwin's theory of evolution by natural selection? • What is meant by a 'scientific theory'? 	<p>BBC Bitesize – Evolution activity</p> <p>Video clip</p> <p>BBC Bitesize - Natural selection and survival of the fittest</p> <p>Horse ancestor: BBC Nature – Propalaeotherium videos, news and facts</p> <p>BBC Bitesize – Evolution, extinction and biodiversity</p> <p>Darwin and evidence for evolution; extinction: BBC Bitesize – Charles Darwin</p> <p>BBC Nature – Species</p> <p>Peer assessment of camouflage activity. Can valid</p>

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				<p>Discuss how you could show that a donkey and a horse are different species.</p> <p>Interpret evolutionary trees.</p> <p>WS 1.2</p> <p>Use the model in an explanation, or match features of a model to the data from experiments or observations that the model describes or explains.</p>	<ul style="list-style-type: none"> • Are humans evolving? • Do breeds of dog provide evidence for evolution? • Is evolution caused by the environment? • How does natural selection affect variation within species? 	<p>comparisons be drawn?</p> <p>Teachit Science resource (20717) 'Natural selection – beak shapes investigation'</p>
4.4.4.3	<p>Evidence for evolution comes from the study of fossils that show how much or how little different organisms have changed as life developed on Earth.</p> <p>Evolution of bacteria can be observed happening in a much shorter time because they reproduce so fast. Bacteria that cause disease evolve by natural selection when exposed to antibiotics; this gives rise to a resistant strain.</p>	<p>Describe the evidence for the theory of evolution by natural selection.</p> <p>Define the term 'fossil'.</p> <p>Explain what we should do to slow down the rate of development of resistant strains of bacteria.</p> <p>Describe the impact of antibiotic resistance</p>	1	<p>Discuss the evidence we have to support Darwin's theory and present in a suitable format.</p> <p>Observe fossils or pictures of fossils eg images of a range of trilobites. What factors may have caused the changes visible in the form of the fossils? How much do these observations contribute to the theory of evolution?</p> <p>Discuss how fossils provide evidence for evolution.</p>	<p>Students produce tables of results from graphs which show antibiotic resistance in bacteria and the impact of antibiotic restriction on resistance.</p> <p>Why did Fleming, Forey and Chain share the 1945 Nobel Prize for Medicine?</p> <p>Use data from antibiotic timeline to plot a graph of year of introduction vs year resistance</p>	<p>BBC News – Q&A: Antibiotic resistance</p> <p>Timeline of the discovery of antibiotics nature.com/nrd/journal/v12/n5/fig_tab/nrd3975_T1.html</p> <p>CDDEP interactive antibiotic timeline cddep.org/tool/antibiotic_timeline</p>

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				<p>Students design a presentation for primary schools to show why it is important not to use antibiotics routinely and how they can prevent the spread of infection.</p> <p>Explain how bacteria can become resistant to antibiotics.</p> <p>Explain how antibiotic resistance has impacted on cleaning practices in Britain's hospitals.</p> <p>Interpret data about antibiotic resistance.</p> <p>Role play: life without antibiotics.</p> <p>Research MRSA and C. difficile infections and treatment.</p> <p>Discuss how the rate of development of resistant bacteria could be slowed down.</p> <p>Discuss why there are few new antibiotics being developed,</p>	<p>developed. Calculate the average time between introduction and resistance developing.</p> <p>Students research Teixobactin and provide recommendations to government about its use in the future.</p>	

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				and suggest how drug companies might be encouraged to develop some. MS 2c, 4a Extract and interpret information from charts, graphs and tables.		
4.4.4.4	<p>In studies of evolution it is essential to be able to identify and classify living things. Traditionally living things have been classified into groups depending on their structure and characteristics.</p> <p>Organisms are named by the binomial system of genus and species.</p> <p>As evidence of internal structures became more developed due to improvements in microscopes and progress with the understanding of biochemical processes, new models of classification have been proposed. Modern</p>	<p>Classify organisms based on their similarities.</p> <p>Describe classification using:</p> <ul style="list-style-type: none"> • Kingdom • Phylum • Class • Order • Family • Genus • Species. <p>Explain the importance of the binomial system to name organisms.</p> <p>Explain how modern technologies have affected how</p>	1	<p>Discuss classifying; anything from cars to cosmetics. Why do we do it?</p> <p>Do we only classify physical objects?</p> <p>Exhibition of organisms to classify, use post-it notes to explain groupings – observe and discuss choices made by other groups.</p> <p>Watch BBC video clips about Linnaeus and classification (see resources).</p> <p>Compare the classification of related and unrelated organisms using the Linnaeus system.</p>	<p>Exhibition of organisms to classify into groups (this could be the first lesson on evolution).</p> <p>Compare classification information on related and unrelated organisms.</p> <p>Pictures and names of different plants to discuss.</p> <p>Why is there disagreement about the total number of Kingdoms?</p> <p>Students research figures for the total number of species.</p>	<p>Exhibition of pictures and specimens of plants and animals.</p> <p>Video clips</p> <p>BBC Bitesize – Linnaeus and the first system of classification of plants</p> <p>BBC Bitesize – Classification</p> <p>BBC Four – Botany: A Blooming System</p> <p>BBC Bitesize – Classification techniques and the</p>

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	classifications systems are based on theories about evolution developed from analysis of differences in DNA molecules.	organisms are classified today.		<p>Match images of animals to binomial names e.g. <i>Giraffa camelopardalis</i>.</p> <p>Look at the variety of names given to the same plant and discuss why the binomial system is more useful.</p> <p>Watch BBC video clip about chemical analysis and its use in classifying organisms (see resources).</p> <p>WS 1.1</p> <p>Show how new methods of investigation and new discoveries led to new scientific ideas</p>	<p>What is the range? Why is there uncertainty about a total for the number of species?</p> <p>Why are Euglena, slow worms, echidna difficult to classify?</p> <p>How are species and biodiversity connected?</p> <p>Students show similarities and differences between whales and sharks, snakes and worms, in diagrammatic form.</p>	search for useful plants
4.4.4.5	<p>Selective breeding (artificial selection) is the process by which humans breed plants and animals for particular genetic traits.</p> <p>Selective breeding involves choosing parents from a mixed population with the desired characteristic. They are bred together. From the</p>	<p>Explain why humans selectively breed plants and animals.</p> <p>Describe selective breeding as a type of sexual reproduction.</p> <p>Describe the process of selective breeding and give examples.</p>	1	<p>Images of different dogs. Students 'breed' and name a new dog from selecting any two – draw a picture of their new breed.</p> <p>Draw a flow diagram to explain the steps involved in selective breeding.</p>	<p>Produce a model to describe selective breeding.</p> <p>What was special about the race horse Frankel?</p> <p>Why is artificial insemination not used in the horse racing industry?</p>	<p>Video clips:</p> <p>BBC Bitesize – Selective breeding in dogs</p> <p>BBC Bitesize – Natural and artificial selection in racehorses</p>

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	<p>offspring those with the desired characteristic are bred together. This continues over many generations until all the offspring show the desired characteristic.</p> <p>The trait can be chosen for usefulness or appearance.</p> <p>Selective breeding can lead to 'inbreeding' where some breeds are particularly prone to disease or inherited defects.</p>	<p>Explain the benefits and risks of selective breeding in plants and animals.</p>		<p>Give examples of characteristics that are selectively bred in plants and animals.</p> <p>Discuss the advantages and risks of selective breeding in plants and animals.</p> <p>Debate: Should people be allowed to breed dogs?</p> <p>WS 1.3, 1.4</p> <p>Evaluate the benefits and risks of selective breeding given appropriate information and consider related ethical issues.</p>	<p>Consider the social, economic and ethical implications of selective breeding.</p>	<p>BBC Bitesize – Species and selective breeding</p> <p>BBC Bitesize – The development of artificial selection in farming</p>
4.4.4.6	<p>In genetic engineering, selected genes from one organism are transferred to another organism which may, or may not, belong to the same species. This process for genetic modification uses enzymes and vectors (such as bacterial plasmids or viruses) to transfer genes. It is much faster than selective breeding.</p>	<p>Define the term genetic engineering.</p> <p>Describe the process of genetic engineering and its advantages.</p> <p>(HT only): Describe in detail the process of genetic engineering.</p> <p>Evaluate the use of genetic engineering in medicine, eg in gene</p>	1	<p>Think-pair-share what the terms genetic engineering, genetic modification and gene therapy mean.</p> <p>List examples of genetic engineering.</p> <p>Produce a leaflet for a doctor's surgery to explain how human insulin is produced by bacteria and discuss the advantages of this over porcine insulin.</p>	<p>Use a model to describe genetic engineering techniques.</p> <p>Evaluate the use of genetic engineering in agriculture and medicine.</p> <p>What is 'synthetic biology' and should it be regulated?</p>	<p>UPD8 – GM decisions</p> <p>Information on genetically modified food can be found at curriculumbits.com</p> <p>PPT B1.7 Genetic variation and its control</p>

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	<p>Genes can be transferred to the cells of animals, plants or microorganisms at an early stage in their development so that they develop with the desired characteristics.</p> <p>Crops that have had their genes modified in this way are called genetically modified crops (GM crops). Crops can be genetically modified to give increased yields or to increase the amount of a vitamin in the food from the crop. Genetically modified crops also include ones that are resistant to insect attack or to herbicides. This means that farmers can cut down on the use of pesticides. They can also spray to kill weeds while leaving the crop plant unaffected.</p> <p>Concerns about GM crops include the effect on populations of wild flowers and insects as a result of cross-pollination. Insects may evolve to become resistant</p>	<p>therapy and production of hormones and some vaccines.</p> <p>Interpret information about genetic engineering techniques.</p> <p>Make informed judgements about the economic, social and ethical issues concerning genetic engineering and GM crops.</p> <p>Explain advantages and disadvantages of genetic engineering.</p>		<p>Interpret information about genetic engineering techniques.</p> <p>Research advantages and disadvantages of GM crops. What characteristics may be modified? Produce a web page or a table of benefits versus concerns for homework.</p> <p>Produce short, headline paragraphs to represent the views of organic farmers, Food-Aid organisers, GM Research scientists and students.</p> <p>Research the use of genetic engineering in medicine.</p> <p>WS 1.4</p> <p>Evaluate the advantages and disadvantages of GM technologies based on data or other information.</p> <p>WS 1.3</p>	<p>Provide examples of GM. Students decide criteria and give each example a weighting according to potential risk and benefit. Can a quantitative value be useful in decision making?</p> <p>Should GM products be kept out of the human food chain?</p> <p>In the light of antibiotic resistance what changes might develop over time with regard to specific examples of GM, eg in crops genetically modified to be unaffected by herbicides?</p>	

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	so that the GM crops are no longer protected.			Give a simple ethical argument about the rights and wrongs of a GM technology. WS 1.3 Recognise, in given information, the difference between a practical and an ethical argument		