

After recent consultations with Ofqual, we have been asked to make some adjustments to the Biology specification. As this may affect any centres who have already started teaching, we have produced this quick guide to compare and contrast old with new, so you can see any areas you may need to re-visit with your students.

Initial version	Accredited version	Explanation of level of change
<p>1.1 Describe the characteristics that are used to classify organisms in the plant or animal kingdoms: a most plants have chloroplasts and the ability to make their own food b most animals are complex organisms that have nervous systems</p> <p>1.2 Demonstrate an understanding of the issues surrounding the classification of fungi, bacteria, algae and viruses: a fungi are not classified as plants because they lack chloroplasts and a cellulose cell wall and are placed in their own kingdom b bacteria lack nuclei and are placed in the prokaryote kingdom c algae have features of both plants and animals (as illustrated by <i>Euglena</i>) and are placed in the protocist kingdom d viruses are regarded by most scientists as non-living and therefore are not placed in any kingdom</p>	<p>1.1 Demonstrate an understanding of how biologists classify organisms according to how closely they are related to one another including a Species – groups of organisms that have many features in common b Genus – contains several species with similar characteristics c Family – comprising of several genera d Order – comprising of several families e Class – comprising of several orders f Phylum – comprising of several classes g The Five Kingdoms – animalia, plantae, fungi, protoctista and prokaryotes</p> <p>1.2 Describe the main characteristics of the five kingdoms including a Animalia – multicellular, do not have cell walls, do not have chlorophyll, feed heterotrophically b Plantae – multicellular, have cell walls, have chlorophyll, feed autotrophically c Fungi – multicellular, have cell walls, do not have chlorophyll, feed saprophytically d Protoctista – unicellular, have a nucleus e Prokaryotes – unicellular, have no nucleus</p> <p>1.3 Explain why scientists do not classify viruses in any of the five kingdoms and regard them as non-living</p>	<p>1.1 and 1.2 have been modified in order to emphasise that students need to have a basic understanding of the classification system from Kingdom down to Species. We had initially focussed on the issues surrounding organisms that didn't fit into the current system. However we have now re-focussed it onto emphasising that students should know the characteristics of the kingdoms. In an assessment, they may be asked to apply this knowledge to explain why an organism may or may not fit into any one kingdom. All students, not just Higher tier students, should now understand that there is an issue of some organisms not fitting into this model and this is exemplified by the viruses (1.3).</p> <p>In the course of your teaching, unless you've missed out H tier material, it's likely that you will have covered the characteristics of the five kingdoms anyway as a precursor to discussing the organisms which scientists have difficulty classifying. The examples you will have covered, including <i>Euglena</i>, will stand students in good stead if they are asked to apply their knowledge of the classification system in an examination.</p>
<p>1.3 Describe the main characteristics of vertebrates and invertebrates</p>	<p>1.4 Describe the main characteristics of the phylum Chordata as animals with a supporting rod running the</p>	<p>Rather than just being able to distinguish between vertebrates and invertebrates, candidates are</p>

<p>1.4 Explain how vertebrate animals are classified into five groups: a most fish have wet scales and gills b most amphibians have smooth, moist, permeable skin c most reptiles have dry, scaly skin d most birds have feathers and a beak e most mammals have hair and produce milk</p>	<p>length of the body, an example of this being the backbone in vertebrates</p> <p>1.5 Explain how scientists place vertebrates into groups based on a Oxygen absorption methods – lungs, gills and skin b Reproduction – internal or external fertilisation, oviparous or viviparous c Thermoregulation – homeotherms and poikilotherms</p> <p>1.6 Demonstrate an understanding of the problems associated with assigning vertebrates to a specific group based on their anatomy and reproduction methods and why many vertebrates are difficult to classify</p>	<p>now required to know the defining characteristics of the Phylum Chordata. You may have to re-visit this with your students if you have been teaching from the second submission version.</p> <p>We then move on to discuss how vertebrates are grouped. Instead of asking students to define the features of the major groups, we now require them to understand that the major groups can be identified through three sets of characteristics.</p> <p>The new 1.6 is entirely new material and centres on the idea that you can place organisms within the construct of a classification system, but there will always be exceptions, e.g axolotl, duck-billed platypus. This gives us scope to examine how students apply their knowledge of the classification system, and is good HSW. If you have already taught this section, it would be wise to re-visit to make sure you've fully covered this aspect.</p>
<p>1.5 Define the term species as organisms that are capable of interbreeding to produce fertile offspring</p> <p>1.6 Demonstrate an understanding of why scientists around the world use the binomial system as a basis for naming species</p> <p>1.7 Demonstrate an understanding of why accurate classification is needed to identify, study and conserve species, and recognise areas of greater</p>	<p>1.7 Discuss why the definition of a species as organisms that produce fertile offspring may have limitations: some organisms do not always reproduce sexually and some hybrids are fertile</p> <p>1.8 Explain why binomial classification is needed to identify, study and conserve species, and can be used to target conservation efforts</p>	<p>We've redefined the section on species again with a more HSW focus. Rather than just understand what a species is, students must now understand the problems scientists have with exceptions to the rule. Again, if you've already taught this section, it would be wise to re-visit.</p>

<p>biodiversity</p> <p>1.8 Demonstrate an understanding of how variations within a species make accurate classification complicated, including: a hybridisation in ducks b ring species</p> <p>1.9 Construct and use keys to show how species can be identified</p>	<p>1.9 Explain how accurate classification may be complicated by: a variation within a species b hybridisation in ducks c ring species</p> <p>1.10 Construct and use keys to show how species can be identified</p>	<p>A clarification on wording in the new 1.9 completes the changes. Clarification was required because ring species are actually a set of separate species and so do not undergo variation within a species</p>
<p>1.10 <i>Investigate the variations within a species to illustrate continuous variation and discontinuous variation</i></p> <p>1.11 Explain that organisms are adapted to their environment and that some organisms are adapted to survive in extreme environments, including deep-sea hydrothermal vents and polar regions</p> <p>1.12 Demonstrate an understanding of the process of evolution by means of Darwin's theory of natural selection, including that: a there is variation within and between species b organisms compete for resources that are limited c organisms best suited to the environment survive and reproduce d organisms less well suited are unable to compete and this may lead to the extinction of the species</p>	<p>1.11 Explain how organisms are adapted to their environment and how some organisms have characteristics that enable them to survive in extreme environments, including deep-sea hydrothermal vents and polar regions</p> <p>1.12 Demonstrate an understanding of Darwin's theory of evolution by natural selection including a variation – most populations of organisms contain individuals which vary slightly from one to another b over-production – most organisms produce more young than will survive to adulthood c struggle for existence – because populations do not generally increase rapidly in size there must therefore be considerable competition for survival between the organisms d survival- those with advantageous characteristics are more likely to survive this struggle. e advantageous characteristics inherited – better adapted organisms are more likely to reproduce successfully passing on the advantageous characteristics to their offspring f gradual change – over a period of time the proportion of</p>	<p>Work has been done on the clarity of the specification with respect to Darwin's theory of natural selection. We now require an understanding of the mechanism by which natural selection occurs (1.12). This is linked into an understanding of how variation occurs. It is likely that this will have little impact on how you would teach the subject, however you may have to return and ensure that students can interpret distribution curves. We have been required to add this in to ensure there is a standard of mathematical demand within GCSE science qualifications.</p> <p>Once students understand natural selection as a distinct process, we then require them to learn about one of the consequences of natural</p>

	<p>individuals with the advantageous characteristics in the population will increase compared with the proportion of individuals with poorly adapted characteristics, and the poorly adapted characteristics may eventually be lost</p> <p>1.13 Describe variation as continuous or discontinuous</p> <p>1.14 <i>Investigate the variations within a species to illustrate continuous variation and discontinuous variation</i></p> <p>1.15 Interpret information on variation using normal distribution curves</p> <p>1.16 Demonstrate an understanding of the causes of variation, including: a genetic variation – different characteristics as a result of mutation or reproduction b environmental variation – different characteristics caused by an organism’s environment (acquired characteristics)</p> <p>1.17 Demonstrate an understanding of how speciation occurs as a result of geographic isolation</p> <p>1.18 Explain how new evidence from DNA research and the emergence of resistant organisms support Darwin’s theory</p>	<p>selection; speciation through geographic isolation. Again, this is an area that may be worth going back and seeing if you’ve covered fully.</p> <p>1.18 is entirely new and it is likely that you will have to re-visit with students. No specific detail of DNA research is required; students should just understand that molecular evidence now helps scientist better understand relatedness, e.g. between chimpanzees and humans. Resistant organisms, such as warfarin-resistant rats brings a real-life, observable context, to natural selection.</p> <p>You may have taken the opportunity to bring some HSW into this section through discussion of the scientific community’s reaction to Darwin’s theory.</p>
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<p>1.13 Describe the structure of the nucleus of the cell as containing chromosomes, on which genes are located</p> <p>1.14 Demonstrate an understanding that genes exist in alternative forms called alleles which give rise to differences in inherited characteristics</p> <p>1.15 Recall the meaning of, and use appropriately, the terms: dominant, recessive, homozygous, heterozygous, phenotype and genotype</p> <p>1.16 Analyse and interpret patterns of monohybrid inheritance using a genetic diagram, Punnett squares and family pedigrees</p> <p>1.17 Calculate and analyse outcomes (using probabilities, ratios and percentages) from monohybrid crosses</p> <p>1.18 Describe the symptoms of the genetic disorders:</p> <ul style="list-style-type: none"> a sickle cell disease b cystic fibrosis <p>1.19 Demonstrate an understanding of the inheritance of the genetic disorders:</p> <ul style="list-style-type: none"> a sickle cell disease b cystic fibrosis 	<p>1.20 Describe the structure of the nucleus of the cell as containing chromosomes, on which genes are located</p> <p>1.21 Demonstrate an understanding that genes exist in alternative forms called alleles which give rise to differences in inherited characteristics</p> <p>1.22 Recall the meaning of, and use appropriately, the terms: dominant, recessive, homozygous, heterozygous, phenotype and genotype</p> <p>1.23 Analyse and interpret patterns of monohybrid inheritance using a genetic diagram, Punnett squares and family pedigrees</p> <p>1.24 Calculate and analyse outcomes (using probabilities, ratios and percentages) from monohybrid crosses</p> <p>1.25 Describe the symptoms of the genetic disorders:</p> <ul style="list-style-type: none"> a sickle cell disease b cystic fibrosis <p>1.26 Evaluate the outcomes of pedigree analysis when screening for genetic disorders:</p> <ul style="list-style-type: none"> a sickle cell disease b cystic fibrosis 	<p>For the most part, the only changes here are re-numbering of specification points. However, all students, not just Higher tier students should be able to perform mathematical manipulations to calculate outcomes from monohybrid crosses. (1.24)</p> <p>In addition, higher tier students are required to demonstrate higher order thinking skills in this section, they should now be able to evaluate the outcomes of pedigree analysis, specifically related to sickle cell and cystic fibrosis, rather than just understand the inheritance of these disorders.</p>
<p>2.1 Define homeostasis as the maintenance of a stable internal environment</p>	<p>2.1 Define homeostasis as the maintenance of a stable internal environment</p>	<p>The most change in the specification is to be found in Topic 2. We have changed the flow of the</p>

<p>2.2 Recall that regulating body water content and body temperature are both examples of homeostasis</p> <p>2.3 Demonstrate an understanding of how organisms are able to respond to changes in their surroundings in order to maintain their internal environment, with reference to the function of the skin in the control of body temperature, including:</p> <ul style="list-style-type: none"> a sweat glands release sweat that contains water and salts b the evaporation of water in sweat transfers heat from the skin c shivering involves the movement of muscles which releases heat <p>2.4 Demonstrate an understanding of the process of vasoconstriction and vasodilation in relation to the control of body temperature</p>	<p>2.2 Demonstrate an understanding of the homeostatic mechanisms of:</p> <ul style="list-style-type: none"> a thermoregulation and the effect of temperature on enzymes b osmoregulation c blood glucose regulation <p>2.3 Explain how thermoregulation takes place, with reference to the function of the skin, including</p> <ul style="list-style-type: none"> a the role of the dermis – sweat glands, blood vessels, nerve endings, hair, erector muscles and sebaceous glands b the role of the hypothalamus – regulating body temperature <p>2.4 Explain how thermoregulation takes place, with reference to:</p> <ul style="list-style-type: none"> a vasoconstriction b vasodilation c negative feedback 	<p>specification so that thermoregulation and blood glucose regulation are together, linked through the idea of homeostasis, and that blood glucose and plant hormones are together, linking ideas of hormonal control. Note that the nervous system has been moved to the end of the section.</p> <p>We were required to increase the demand in this section, and did so by requiring students to understand the function of the skin in thermoregulation. They should understand the physiological mechanisms at work. In addition, higher tier candidates should understand not only the concepts of vasoconstriction and vasodilation but also the role of negative feedback. This is all new content and therefore if you have taught it already, you will have to revisit with more of a physiological emphasis.</p>
<p>2.11 Recall that hormones are produced in endocrine glands and are transported by the blood to their target organs</p> <p>2.12 Explain how blood glucose levels are regulated by insulin and excess blood glucose is converted to glycogen in the liver</p> <p>2.13 Explain how blood glucose levels are regulated by glucagon and glycogen is converted to glucose</p> <p>2.14 Explain that Type 1 diabetes is caused by a lack of insulin</p> <p>2.15 Explain that Type 1 diabetes can be controlled by</p>	<p>2.5 Recall that hormones are produced in endocrine glands and are transported by the blood to their target organs</p> <p>2.6 Explain how blood glucose levels are regulated by insulin and excess blood glucose is converted to glycogen in the liver</p> <p>2.7 Explain how blood glucose levels are regulated by glucagon causing the conversion of glycogen to glucose</p> <p>2.8 Recall that Type 1 diabetes is caused by a lack of insulin</p> <p>2.9 Explain how Type 1 diabetes can be controlled,</p>	<p>There is very little change in this section, mostly just clarifications of command words. This should not affect how you teach the topic.</p>

<p>injection of insulin usually into the subcutaneous fat</p> <p>2.16 Explain that the dosage of insulin depends upon the balance between activity and diet</p> <p>2.17 Explain that Type 2 diabetes is caused by a person becoming resistant to insulin</p> <p>2.18 Explain that Type 2 diabetes can be controlled by diet and physical activity</p> <p>2.19 Demonstrate an understanding of the correlation between obesity (including calculations of BMI) and Type 2 diabetes</p> <p>2.20 Explain that plants use hormones to respond to stimuli, including: a shoots are positively phototropic b roots are positively geotropic (gravitropic)</p> <p>2.21 Demonstrate an understanding of how auxin brings about shoot curvature involving cell elongation</p> <p>2.22 <i>Investigate tropic responses</i></p> <p>2.23 Analyse, interpret and evaluate data from plant hormone experiments, including the action of auxins and gibberellins</p> <p>2.24 Demonstrate an understanding of the uses of plant hormones, including: a selective weedkillers b rooting powder c seedless fruit d fruit ripening</p>	<p>including the roles of diet and injection of insulin usually into the subcutaneous fat</p> <p>2.10 Explain how, in Type 1 diabetes, the level of physical activity and diet affect the amount of insulin required</p> <p>2.11 Recall that Type 2 diabetes is caused by a person becoming resistant to insulin</p> <p>2.12 Explain how Type 2 diabetes can be controlled by diet and physical activity</p> <p>2.13 Evaluate the correlation between obesity (including calculations of BMI) and Type 2 diabetes</p> <p>2.14 Explain how plant growth substances (hormones) bring about: a positive phototropism in shoots b positive gravitropism (geotropism) in roots</p> <p>2.15 Explain how auxins bring about shoot curvature using cell elongation</p> <p>2.16 <i>Investigate tropic responses</i></p> <p>2.17 Analyse, interpret and evaluate data from plant hormone experiments, including the action of auxins and gibberellins</p> <p>2.18 Demonstrate an understanding of the uses of plant hormones, including: a selective weedkillers b rooting powder c seedless fruit d fruit ripening</p>	
<p>2.6 Describe how stimulation of receptors in the sense</p>	<p>2.19 Recall that the central nervous system consists of the</p>	<p>Note that the section on the nervous system has</p>

<p>organs sends electrical impulses along neurones</p> <p><i>2.7 Investigate human responses to external stimuli</i></p> <p>2.8 Explain that a coordinated response requires a stimulus, a receptor, a sensory neurone, the central nervous system, a motor neurone, an effector and a response</p> <p>2.9 Demonstrate an understanding of a simple reflex arc that bypasses the brain to create a faster response that is essential for protecting the body</p> <p>2.10 Explain that transmission between neurones is at a synapse through the release of chemical messengers called neurotransmitters</p>	<p>brain and spinal cord and is linked to sense organs by nerves</p> <p>2.20 Explain the structure and function of dendrons and axons in the nervous system</p> <p>2.21 Describe how stimulation of receptors in the sense organs sends electrical impulses along neurones</p> <p><i>2.22 Investigate human responses to external stimuli</i></p> <p>2.23 Describe the structure and function of sensory, relay and motor neurones and synapses including: a the role of the myelin sheath b the role of neurotransmitters c the reflex arc</p>	<p>been moved within the specification (but only within the topic).</p> <p>The section on the nervous system looks different now but in reality, a few statements have been condensed into one over-arching statement. If you need to re-visit this topic, it will be probably only be to clarify the anatomy of nerves and the nervous system, including myelination and the structure and function of dendrons and axons.</p>
<p>3.1 Define a drug as a substance that changes the way in which the body works</p> <p>3.2 Describe the general effects of: a painkillers that block nerve impulses, including morphine b hallucinogens that distort sense perception, including LSD c stimulants that increase the speed of reactions and neurotransmission at the synapse, including caffeine d depressants that slow down the activity of the brain, including alcohol</p> <p><i>3.3 Investigate reaction times</i></p> <p>3.4 Explain the effects of some chemicals in cigarette smoke, including: a nicotine as an addictive drug</p>	<p>3.1 Define a drug as a chemical substance, such as a narcotic or hallucinogen, that affects the central nervous system, causing changes in psychological behaviour and possible addiction</p> <p>3.2 Describe the general effects of: a painkillers that block nerve impulses, including morphine b hallucinogens that distort sense perception, including LSD c stimulants that increase the speed of reactions and neurotransmission at the synapse, including caffeine d depressants that slow down the activity of the brain, including alcohol</p> <p><i>3.3 Investigate reaction times</i></p> <p>3.4 Explain the effects of some chemicals in cigarette smoke, including: a nicotine as an addictive drug</p>	<p>There is very little change in this topic. Any changes tend to be clarifications (e.g. 3.10 now explains exactly what barriers of defence the examiners would like students to know about). However, please note that some statements have been expanded to ensure we can ask questions which require use of mathematics in the examination, so your students need to be prepared for this, e.g. 3.6 now requires students to be able to evaluate evidence. This can include mathematical handling of data.</p>

<p>b tar as a carcinogen c carbon monoxide reducing the oxygen-carrying ability of the blood</p> <p>3.5 Evaluate data relating to the correlation between smoking and its negative effects on health</p> <p>3.6 Describe some harmful effects of alcohol abuse: a in the short term – blurred vision, lowering of inhibitions, slowing of reactions b in the long term – liver cirrhosis, brain damage</p> <p>3.7 Demonstrate an understanding of the ethics of organ transplants, including: a liver transplants for alcoholics b heart transplants for the clinically obese c the supply of organs</p> <p>3.8 Recall that infectious diseases are caused by pathogens</p> <p>3.9 Describe how pathogens are spread, including: a in water, including cholera bacterium b by food, including <i>Salmonella</i> bacterium c airborne (eg sneezing), including influenza virus d by contact, including athlete's foot fungus e by body fluids, including HIV f by animal vectors, including: i housefly: dysentery bacterium ii <i>Anopheles</i> mosquito: malarial protozoan</p> <p>3.10 Demonstrate an understanding of how animals defend themselves against attack from pathogens by the use of chemical and physical barriers</p>	<p>b tar as a carcinogen c carbon monoxide reducing the oxygen-carrying ability of the blood</p> <p>3.5 Evaluate data relating to the correlation between smoking and its negative effects on health</p> <p>3.6 Evaluate evidence of some harmful effects of alcohol abuse: a in the short term – blurred vision, lowering of inhibitions, slowing of reactions b in the long term – liver cirrhosis, brain damage</p> <p>3.7 Discuss the ethics of organ transplants, including: a liver transplants for alcoholics b heart transplants for the clinically obese c the supply of organs</p> <p>3.8 Recall that infectious diseases are caused by pathogens</p> <p>3.9 Describe how pathogens are spread, including: a in water, including cholera bacterium b by food, including <i>Salmonella</i> bacterium c airborne (eg sneezing), including influenza virus d by contact, including athlete's foot fungus e by body fluids, including HIV f by animal vectors, including: i housefly: dysentery bacterium ii <i>Anopheles</i> mosquito: malarial protozoan</p> <p>3.10 Explain how the human body can be effective against attack from pathogens, including: a physical barriers – skin, cilia, mucus b chemical defence – hydrochloric acid in the stomach, lysozymes in tears</p>	
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<p>3.11 Demonstrate an understanding that plants produce chemicals that have antibacterial effects in order to defend themselves, some of which are used by humans</p> <p>3.12 Describe how antiseptics can be used to prevent the spread of infection</p> <p>3.13 Demonstrate an understanding of the use of antibiotics to control infection, including: a antibacterials to treat bacterial infections b antifungals to treat fungal infections</p> <p>3.14 Demonstrate an understanding of how resistant strains of bacteria, including MRSA, can arise from the misuse of antibiotics</p> <p>3.15 <i>Investigate the effects of antiseptics or antibiotics on microbial cultures</i></p> <p>3.16 Explain how all living things are interdependent</p> <p>3.17 Demonstrate an understanding of how some energy is transferred to less useful forms at each trophic level and this limits the length of a food chain</p> <p>3.18 Explain how the shape of a pyramid of biomass is related to the energy transferred at each trophic level</p> <p>3.19 Explain how the survival of some organisms may depend on the presence of another species: a parasitism, including: i fleas ii headlice</p>	<p>3.11 Demonstrate an understanding that plants produce chemicals that have antibacterial effects in order to defend themselves, some of which are used by humans</p> <p>3.12 Describe how antiseptics can be used to prevent the spread of infection</p> <p>3.13 Explain the use of antibiotics to control infection, including: a antibacterials to treat bacterial infections b antifungals to treat fungal infections</p> <p>3.14 Evaluate evidence that resistant strains of bacteria, including MRSA, can arise from the misuse of antibiotics</p> <p>3.15 <i>Investigate the effects of antiseptics or antibiotics on microbial cultures</i></p> <p>3.16 Recall that interdependence is the dynamic relationship between all living things</p> <p>3.17 Demonstrate an understanding of how some energy is transferred to less useful forms at each trophic level and this limits the length of a food chain</p> <p>3.18 Demonstrate an understanding that the shape of a pyramid of biomass is determined by energy transferred at each trophic level</p> <p>3.19 Explain how the survival of some organisms may depend on the presence of another species: a parasitism, including: i fleas ii head lice iii tapeworms</p>	
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<p>iii tapeworms iv mistletoe</p> <p>b mutualism, including: i oxpeckers that clean other species ii cleaner fish iii nitrogen-fixing bacteria in legumes iv chemosynthetic bacteria in tube worms in deep-sea vents</p> <p>3.20 Analyse, interpret and evaluate data on global population change</p> <p>3.21 Explain how the increase in human population contributes to an increase in the production of pollutants, including phosphates, nitrates and sulfur dioxide</p> <p>3.22 Demonstrate an understanding of the problems caused by eutrophication when excessive nitrate levels build up in lakes, seas and rivers</p> <p>3.23 <i>Investigate the effect of pollutants on plant germination and growth</i></p> <p>3.24 Demonstrate an understanding of how the presence or absence of indicator species can be used to assess the level of pollution: a polluted water indicator – bloodworm, sludgeworm b clean water indicator – stonefly, freshwater shrimps c air quality indicator – lichen species, blackspot fungus on roses</p> <p>3.25 Demonstrate an understanding of how recycling can reduce the demand for resources and the problem of waste disposal, including paper, plastics and metals</p>	<p>iv mistletoe b mutualism, including: i oxpeckers that clean other species ii cleaner fish iii nitrogen-fixing bacteria in legumes iv chemosynthetic bacteria in tube worms in deep-sea vents</p> <p>3.20 Analyse, interpret and evaluate data on global population change</p> <p>3.21 Explain how the increase in human population contributes to an increase in the production of pollutants, including phosphates, nitrates and sulfur dioxide</p> <p>3.22 Explain how eutrophication occurs and the problems associated with eutrophication in an aquatic environment</p> <p>3.23 <i>Investigate the effect of pollutants on plant germination and plant growth</i></p> <p>3.24 Demonstrate an understanding of how scientists can use the presence or absence of indicator species as evidence to assess the level of pollution: a polluted water indicator – bloodworm, sludgeworm b clean water indicator – stonefly, freshwater shrimps c air quality indicator – lichen species, blackspot fungus on roses</p> <p>3.25 Demonstrate an understanding of how recycling can reduce the demand for resources and the problem of waste disposal, including paper, plastics and metals</p> <p>3.26 Demonstrate an understanding of how carbon is</p>	
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<p>3.26 Demonstrate an understanding of how carbon is recycled:</p> <p>a during photosynthesis plants remove carbon dioxide from the atmosphere</p> <p>b carbon compounds pass along a food chain</p> <p>c during respiration organisms release carbon dioxide into the atmosphere</p> <p>d decomposers release carbon dioxide into the atmosphere</p> <p>e combustion of fossil fuels releases carbon dioxide into the atmosphere</p> <p>3.27 Demonstrate an understanding of how nitrogen is recycled:</p> <p>a nitrogen gas in the air cannot be used directly by plants and animals</p> <p>b nitrogen-fixing bacteria living in root nodules or the soil can fix nitrogen gas</p> <p>c the action of lightning can convert nitrogen gas into nitrates</p> <p>d decomposers break down dead animals and plants</p> <p>e soil bacteria convert proteins and urea into ammonia</p> <p>f nitrifying bacteria convert this ammonia to nitrates</p> <p>g plants absorb nitrates from the soil</p> <p>h nitrates are needed by plants to make proteins for growth</p> <p>i nitrogen compounds pass along a food chain or web</p> <p>j denitrifying bacteria convert nitrates to nitrogen gas</p>	<p>recycled:</p> <p>a during photosynthesis plants remove carbon dioxide from the atmosphere</p> <p>b carbon compounds pass along a food chain</p> <p>c during respiration organisms release carbon dioxide into the atmosphere</p> <p>d decomposers release carbon dioxide into the atmosphere</p> <p>e combustion of fossil fuels releases carbon dioxide into the atmosphere</p> <p>3.27 Demonstrate an understanding of how nitrogen is recycled:</p> <p>a nitrogen gas in the air cannot be used directly by plants and animals</p> <p>b nitrogen-fixing bacteria living in root nodules or the soil can fix nitrogen gas</p> <p>c the action of lightning can convert nitrogen gas into nitrates</p> <p>d decomposers break down dead animals and plants</p> <p>e soil bacteria convert proteins and urea into ammonia</p> <p>f nitrifying bacteria convert this ammonia to nitrates</p> <p>g plants absorb nitrates from the soil</p> <p>h nitrates are needed by plants to make proteins for growth</p> <p>i nitrogen compounds pass along a food chain or web</p> <p>j denitrifying bacteria convert nitrates to nitrogen gas</p>	
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