BIG IDEA:	**Organisms are interdependent**
Prior Learning:	**B1.3 Intedependence** An ecosystem is the interaction of a community of organisms with the non-living parts of their habitat A population is a group of the same organism A community is made of several different populations living in the same area that depend on each other for survival If there is a change in one population then this affects other population in the community Sampling techniques are used to measure the size of a population in a habitat - Transects and quadrats are used to count the number of individuals in a specific location and area Feeding relationships within a community can be represented by food chains and webs Producers are plants that can make their own food (glucose) using sunlight Primary consumers eat producers, secondary consumers eat primary consumers and tertiary consumers eat secondary consumers Predators are consumers that eat other animals, called prey Trophic levels can be represented by numbers, starting at level 1 with plants and algae. Further trophic levels are numbered subsequently according to how far the organism is along the food chain. •Level 1: Plants and algae make their own food and are called producers. •Level 2: Herbivores eat plants/algae and are called primary consumers. •Level 3: Carnivores that eat herbivores are called secondary consumers. •Level 4: Carnivores that eat other carnivores are called tertiary consumers. Apex predators are carnivores with no predators In a stable community the numbers or predators and prey increase and decrease in cycles Food chains sometimes accumulate of toxic materials Animals often compete with each other for space, mates and food Plants often compete with each other for space, water, minerals and light Biotic factors are living things that can affect a community, examples of biotic factors are: food, predators Abiotic factors are non-living things that can affect a community, examples of abiotic factors are: temperature, light, wind, amount of water **B2.2 Photosynthesis and Respiration** The reactants of photosynthesis are carbon dioxide and water, and products are glucose and oxygen. Almost all life on Earth depends on the ability of photosynthetic organisms, such as plants and algae, to use sunlight in photosynthesis to build organic molecules. **B2.3 Life Diversity** Crops and domesticated animals are the result of selective breeding Selective breeding is when humans choose plants or animals with particular characteristics to breed
Future Learning:	This unit is the basis of understanding the importance of sustainability to help pupils make responsible lifestyle choices. Pupils will go on to learn more about conservation and relationships in ecosystems.
Key misconceptions:	One of the biggest misconceptions in this topic is that pupils struggle to think of themselves and humans generally as being part of ecosystems and food chains, or that they personally contribute to global warming and associated environmental impacts. Pupils also often struggle to understand why conservation is important in terms of food security and human survival, rather than it just being the right thing to do to protect animals. Many pupils also assume that biodiversity also only refers to animals or plants separately and struggle to link the idea of ecosystems and biodiversity with food chains and feeding relationships.
Unit sequencing	From KS2, pupils should recognise that environments can change and that this can sometimes pose dangers to living things. Many pupils will have watched wildlife documentaries such as Planet Earth that highlight the importance of biodiversity and how humans can reduce the negative impact we have on biodiversity. Global warming also is a regular feature in the media, and pupils may already be informed about the issues surrounding this, and how human activity contributes. Prior to this unit pupils will have studied the Y7 unit B1.3 Interdependence. Pupils will have studied ecosystems, feeding relationships, competition in animals and plants, and abiotic and biotic factors that affect communities of organisms. Pupils will have also learnt about sampling techniques that are used to measure the distribution of species in an area. Pupils will have an understanding of the different trophic levels in food chains from unit B1.3 Interdependence and this knowledge will be applied and deepened in this unit where pyramids of biomass will be constructed and analysed. This unit prepares pupils to consider atmospheric gases and global warming in more depth when they study the Earth's atmosphere in chemistry. Here, pupils will learn about ways that carbon dioxide is released into the atmosphere and how this is causing global warming, then in Y11 they will extend this by understanding how amounts of atmospheric gases have varied over time and other atmospheric pollutants. This unit is the basis of understanding the importance of sustainability to help pupils make responsible and informed lifestyle choices. At A-level, pupils will take this learning further to consider how environmental factors affect the productivity of the land, and learn how different farming techniques can be used to increase productivity. Pupils will also develop their understanding of the evolutionary relationships between species and discover how new genetic technologies are allowing us to protect the endangered species of our planet.

Unit title	Lesson code	Lesson title	What do my students need to know by the end of the lesson?	Specificaton references	What could help my students to understand this knowledge?	What do my students need to be able to do by the end of the lesson?	What prior knowledge do I expect my students to have? Where is this likely to have come from?	What are the core practical, enquiry and maths skills that students will learn and practise? Key: Skills in bold are taught for the first time here	What practical activities are planned? What apparatus and chemicals are required?	What misconceptions may students arrive at the lesson with? What could they leave the lesson thinking if we are not careful? How can I address this directly? NOTE: More misconceptions are discussed in the 'notes' section of the powerpoints	What exit ticket questions will the students be required to answer by the end of the lesson?	What alternative activities could I do in this lesson?	What keywords am I introducting in this lesson that students may find difficult?
	B3.2.1	Prior Knowledge Review		AQA: 4.7.1.1, 4.7.1.2, 4.7.1.3, 4.7.2.1			B1.3 Interdependence - pupils should be confident with constructing and interpreting food chains and food webs. They should know definitions of: producer, primary consumer, secondary consumer, predator, prey, herbivore, carnivore, omnivore, ecosystem, community, population, habitat				1. Which best describes what the arrows on a food chain or web represent? A. Which animals are being eaten B. The direction of energy transfer C. Producers, primary consumers and secondary consumers 2. A primary consumer is … A. a carnivore that only eats plants B. a herbivore that eats other animals C. a herbivore that eats plants or algae 3. What piece of equipment would be used to count the number of organisms present in a certain place? A. A quadrat B. A transect C. A sample	Pre-unit quiz	Producer, consumer, predator, prey, energy transfer, herbivore, carnivore
	B3.2.2	Biodiversity	•Biodiversity is the variety of all the different species in an ecosystem •The biodiversity of a habitat can be measured by using sampling techniques to count the abundance of different species •High biodiversity in an ecosystem makes it stable because one species will not depend on another species alone	AQA: 4.7.3.1	Although pupils are not expected to perform calculations on percentage coverage or statistical analysis of distribution of organisms, it may be worth showing higher ability classes these skills as they can further understanding of when different sampling methods should be used.	Define biodiversity Explain why it is important to maintain biodiversity Write a method for estimating the size of a population in a given area Use sampling data to calculate the estimated size of a population in a given area Interpret date from systematic sampling and identify trends Identify variables and suggest why results from sampling may not be accurate Suggest improvements to a given sampling method	Pupils should have carried out a simple version of this investigation in B1.3 to count the abundance of organisms in a particular location.		Required practical activity 9: measure the population size of a common species in a habitat. Use sampling techniques to investigate the effect of a factor on the distribution of this species.	Menzel & Bogeholz (2009) found that students are aware of biodiversity being a measure of variety but did not understand that this includes genetic diversity.	1. Biodiversity is… A. How many plants and animals live in a particular habitat B. The number of plants and animals within an ecosystem C. The variety of different species in an ecosystem 2. Which type of sampling would be used to investigate the effect of shade on abundance of flowers in a field. A. Systematic sampling using a transect and quadrats at regular intervals B. Random sampling using a quadrats at random coordinates C. Using quadrats randomly placed in a sunny area and a shaded area 3. Why is high biodiversity useful for an ecosystem? A. So that plants and animals have lots of food B. It allows animals to have lots of choice when choosing their food C. It means that a species is not dependent on one other species		Biodiversity, habitat, ecosystem, abundance, quadrat, transect, species

B3.2 Human interaction	B3.2.3	How Humans affect Biodiversity	•Many human activities are reducing biodiversity on Earth •Humans reduce the amount of land available for biodiversity by building, deforestation, quarrying, farming and waste disposal •Deforestation happens in tropical areas to provide land for cattle, rice fields and to grow crops for biofuels •Introducing non-indigenous species can reduce biodiversity if the species out-competes or kills indigenous species •Peat bogs are a habitat that is being destroyed because peat is taken for garden and farming compost. Although we need peat compost for farming, this is also reducing biodiversity •Peat is a fossil fuel. Decay or the burning of peat releases carbon dioxide into the atmosphere	**AQA:** 4.7.3.3, 4.7.3.4	Often pupils can be unaware that indiviuals contribute to emissions/pollution - you may want to use a carbon footprint app/quiz to show pupils the effects of all their actions, and how each individual person then adds up to a huge impact.	Identify the ways humans can impact biodiversity Explain why deforestation can lead to increased carbon dioxide levels Suggest uses for the land after deforestation Interpret graphs around deforestation and peat useage Identify the negative impacts of deforestation on an ecosystem/the atmosphere Identiy the effects that destroying peat bos can have on an ecosystem/the atmosphere		**5. Explain why data is needed to answer scientific questions, and why it may be uncertain, incomplete or not available.** **B5. Understand the principles of sampling as applied to scientific data**		Torkar (2016) found students showed more positive attitudes towards maintaining biodiversity if they had higher subject knowledge of it, and that female students showed more positive attitudes than males. Morris & Schagen (1997) found that only a third of teenagers thought of species loss as a serious issue and most ranked it less important than global warming or the reduction in the ozone layer. Stanisstreet et al. (1993) found that less than half of children thought all animals should be conserved (perhaps from a survival instinct of wanting to get rid of predators) and most did not rank conservation as a high priority. Ballouard et al. (2011) also found that children identify more with protecting exotic species rather than local species, not understanding the local threats to biodiversity.	Which statement is correct? A. It is fine to destroy peat bogs as long as peat is not burnt B. Peat bogs are a very large carbon store C. No species can live in a peat bog as it is acidic 2. Which best explains an effect of a growing population? A. Humans need more food than animals so more crops have to be grown B. More humans are growing bigger so need more food C. Humans are destroying habitats to be able to grow more crops 3. Which of these actions would not decrease biodiversity? A. Maintaining natural land B. Introducing a new species into an ecosystem C. Clearing forests to grow one single crop		Pollution, resources, deforestation
	B3.2.4	How Humans can Preserve Biodiverity	•Many human activities are reducing biodiversity on Earth •Scientists and citizens are using various programmes to reduce the negative impact humans have on biodiversity, including: breeding programmes for endangered species, protecting rare habitats, reducing how many forests are cut down, reforestation, recycling resources to reduce landfill waste and growing hedgerows on farms where previously there was only one crop growing	**AQA:** 4.7.3.6		Explain why it is important to maintain biodiversity Explain methods humans can use to maintain biodiversity	Many pupils will be aware of endangered species and also species that have already gone extinct (e.g. dodos) and different breeding programmes.				Which of the following is not a way to maintain biodiversity? A. Protecting rare habitats B. Selective breeding programmes C. Reducing deforestation 2. Which best explains what growing hedgerows on farms means?? A. Growing hedges and wildflower on the borders of fields to decrease biodiversity B. Removing hedges between fields to increase crop yield C. Growing hedges and wildflower on the borders of fields to increase biodiversity 3. Which of these actions would increase biodiversity? A. Maintaining nature reserves B. Introducing a new species into an ecosystem C. Using a selective breeding programme to produce more individuals with a desired characteristic		Biodiversity, Population, Resources
	B3.2.5	The Effect of Pollution on Biodiversity	•Rapid growth in the human population and an increase in the standard of living mean that increasingly more resources are used and more waste is produced. Unless waste and chemical materials are properly handled, more pollution will be caused. •Pollution can occur in water, from sewage, fertiliser or toxic chemicals, in air, from smoke and acidic gases, on land, from landfill and from toxic chemicals •Pollution is caused when human waste isn't properly handled, for example: air pollution from smoke, land pollution from landfill rubbish and water pollution from sewage and fertilisers •Pollution kills animals and plants which reduces biodiversity •Indicator species can be used to monitor the level of pollution in a habitat	**AQA:** 4.7.3.2		Identify reasons why human pollution (air/water/landfill) is increasing Suggest ways increasing waste can affect the environment Identify ways in which human activities can affect other living organisms Identify the effects that a quarry can have on wildlife nearby Explain how waste from farms can get into surrounding bodies of water aand the effects they can have Interpret data about indicator species	Pupils should be aware of the term pollution and know that it is 'a bad thing', although they may not be able to scientifically explain why. They will be aware of various recycling schemes (reduce, reuse, recycle) and know that this is to try to reduce pollution.			Brody (1994) found that many students had the misconception that pollutions always kills plants and animals, rather than harming them, although they were able to recognise the effect of increasing concentrations of pollutants. Hogan (2000) also found that children only noted pollutant effects when they came into direct contact with organisms and did not appreciate that different species are affected to varying degrees. Many pupils assume that water waste is only sewage (toilet waste), when it can refer to any water that is used for household activities (showering, washing machines, sinks etc).	Which correctly explains why humans are now producing more waste? A. Humans now have a worse quality of life, fewer resources are used B. The human population has increased hugely over the last century C. Many resources can now be recycled so we can throw away non-recyclable items 2. Which is a consequence of not treating waste water? A. Contamination of water sources, leading to severe illnesses B. Factories illegally leaking toxic chemicals into streams and rivers C. Run off of fertilisers from farms after heavy rain 3. Why is pollution bad for many plants and animals? A. Pollution kills all plants and animals B. Pollution is harmful for many habitats and can spread toxic substances through food chains C. Pollution increases biodiversity	Natural History Museum pollution resources: https://www.nhm.ac.uk/schools/teaching-resources/urban-nature-teaching-resources.html https://www.nhm.ac.uk/content/dam/nhmwww/schools/teaching-resources/urban-nature-project/particulate-matter-testing.pdf	Sewage, fertilisers, leaching, contamination, indicator species
	B3.2.6	Global Warming	•Levels of carbon dioxide and methane in the atmosphere are increasing and contributing to global warming •The biological consequences of global warming include loss of habitats, changing breeding patterns and changing migratory patterns which all affect biodiversity	**AQA:** 4.7.3.2, 4.7.3.5	Greenhouse effect is covered in more detail in Physics (as part of black body radiation) so at this point they do not need to be able to explain the physics behind it, but it may be useful for them to understand how greenhouse gases prevent reflected radiation escaping the atmosphere.	Identify greenhouse gases Identiy the effects of global warming and the greenohuse effect Describe, as fully as you can, major effects of global warming and how these may affect the human population. Explain how increases in the proportion of greenhouse gases in the atmosphere lead to global warming. Evaluate evidence for and against the theory that an increase in the concentration of carbon dioxide in the atmosphere causes an increase in air temperature. Interpret graphs around greenhouse gases and global warming	Most pupils should have at least a basic awareness of global warming through various media sources and be able to explain simply how human activities are contributing.	1. Recognise that scientific methods and theories change over time		Many pupils tend to confuse the terms global warming and climate change, as they will likely have heard about both in the media. Human activities are contributing to global warming (the increasing temperature of the atmosphere), which in turn is causing climate change.	Which is the best definition of global warming? A. Changing weather patterns B. The Earth getting hotter C. The increase in the overall temperature of the Earth's atmosphere 2. Which is not a consequence of global warming? A. Rising sea levels and flooding B. Fossil fuels being burned C. Extreme weather patterns 3. Which would be an action to reduce greenhouse gas emissions? A. Cutting down trees B. Using renewable energy sources	This is a good opportunity for pupils to work on debate skills, e.g. a model UN activity with different pupils representing the interests of different countries (e.g. USA withdrawing from the Paris agreement) https://www.nhm.ac.uk/content/dam/nhmwww/schools/teaching-resources/urban-nature-project/climate-change-species-trumps.pdf	Global warming, climate change, emissions, greenhouse gas
	B3.2.7	Taking it Further: Pyramids of Biomass (Biology only)	*• Biomass is lost at each stage of a food chain* *• Producers are mostly plants and algae which transfer about 1% of the energy from light into new plant biomass during photosynthesis* *• Only approximately 10% of the biomass from each trophic level is transferred to the next trophic level* *• Biomass is lost from a food chain when it is excreted as waste. This includes the egestion of undigested material in faeces, the loss of water and urea in urine, and the loss of carbon dioxide and water in respiration* *• Life processes, including movement and regulation of temperature, require energy from glucose. Energy released during respiration, used to sustain these processes, is not transferred to the next trophic level* *• Percentage efficiency transfer can be calculated using the following equation: Percentage efficiency transfer=(biomass in higher trophic level)/(biomass in lower trophic level) x 100* *• The number of organisms at higher trophic levels is often lower because the efficiency of biomass transfer decreases*	**AQA:** *(Biology only) 4.7.4.1, 4.7.4.2, 4.7.4.3*	Lessons from this point are Biology single science content but are extremely useful for all pupils to learn in terms of sustainability and helping them to understand the impact of humans on the environment and helping them to make responsible choices.	Identify trophic levels in a food chain Label trohpic levels on a pyramid of biomass Draw and interpret a pyramid of biomass to scale Calculate the efficiency of biomass transfers between trophic levels Explain why biomass is lost between trophic levels	Pupils should be secure in their knowledge of food chains and the order/direction of energy transfer. They should have seen pyramids of numbers in B1.3 Interdependence but may need a refresher. Pupils should also be aware of the life processes from KS2 (MRS GREN).			Some pupils may struggle with the concept of such a low transfer efficiency so it may be worth showing an example (such as a pig) to highlight the areas of biomass/energy loss - i.e. not the whole animal is eaten, the animal uses energy from respiration to move and to keep itself warm and some biomass is lost through its waste processes.	Which is the best description of a pyramid of biomass? A. A representation of the number of organisms in each trophic level B. A diagram to show how big each organism is compared to others C. A representation of the amount of organic material in each trophic level 2. Which best explains why only approximately 10 % of biomass is passed on to the next trophic level? A. The rest of the biomass is released as waste urine and faeces B. Biomass is lost at each trophic level through waste and life processes C. Each trophic level needs to keep the rest of the biomass for themselves 3. Which best explains why food chains rarely have more than 5 levels? A. The apex predators cannot get any bigger B. Only approximately 10 % of biomass is passed on to the next trophic level C. Only half the biomass is passed on so it will eventually run out		biomass, trophic level, efficiency, thermoregulation

	B3.2.8	**Talking it Further: Farming and Biotechnology** **(Biology only)**	*•The efficiency of food production can be improved by restricting energy transfer from livestock (animals bred for food) to the environment. This can be done by limiting their movement and by controlling the temperature of their surroundings. There are ethical implications to these farming methods* *•Livestock can be fed high protein foods to increase growth, and given antibiotics to prevent disease* *•Fish stocks in the oceans are declining. It is important to maintain fish stocks at a level where breeding continues or certain species may disappear altogether in some areas* *•Fish stocks can be controlled by using nets with larger holes. This prevents smaller fish from being caught so they can continue breeding* *•Fishing quotas limit the number of fish that can be caught by each country. The fishing of some endangered species of fish is banned* *•Alternative food sources have been developed to enhance food security. Modern biotechnology techniques enable large quantities of microorganisms to be cultured for food* *•The fungus Fusarium is useful for producing mycoprotein, a protein-rich food suitable for vegetarians. The fungus is grown on glucose syrup, in aerobic conditions, and the biomass is harvested and purified*	**AQA**: *(Biology only) 4.7.5.2, 4.7.5.3, 4.7.5.4*	Pupils need to know the methods used for intensive farming methods, rather than how organic farming works. It can be useful to use this as a comparison/discussion point.	Interpret data about crop yield Identify that mycoprotein is prduced by fungus Calculate efficiency of rearing animals Explain how intensive farming of animals increases the efficiency of food production Evaluate the pros and cons of intensive farming methods Describe how different ypes of nets help conserve fish stocks Evaluate the use of mycoprotein as an alternative to meat Suggest ways to reduce overfishing		7. a. Describe and explain specified examples of the technological applications of science. b. Describe and evaluate, with the help of data, methods that can be used to tackle problems caused by human impacts on the environment.		Hungerford & Volk (1990) - students must be informed about advantages and disadvantages of methods to help them make choices. Attitudes alone will not lead to sustainable actions.	Which is an advantage of using intensive farming methods? A. Less energy is lost through movement and thermoregulation B. Populations of animals must be kept very low C. Animals can be treated with antibiotics 2. Which best explains why fishing quotas are used? A. So that each country gets the same amount of fish B. To make sure that not all fish are caught in each trawl C. To maintain fish populations at a stable breeding level 3. Which is the correct description of mycoprotein? A. Genetically modified crops with added nutritional value B. A protein-rich food made from fusarium C. Bacteria that are used to produce insulin		Intensive farming, quota, biotechnology, efficiency
	B3.2.9	**Taking it Further: Food Security** **(Biology only)**	*•Food security means that all people on Earth have access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life* *•Food security is being threatened due to a range of different biological factors in different countries. These include increasing birth rates leading to a rise in populations, changing diets in developed countries, new pests and pathogens that affect farming, increased costs of farming, conflict over resources and environmental changes that affect biodiversity* *•Food security can be increased by making food production more efficient* *•Individuals can contribute to improving food security. This can be done by reducing meat intake, increasingly eating food products from producers and eating local, seasonal produce where possible*	**AQA:** *(Biology only) 4.7.5.1*		Suggest reasons that eating meat contributes to global warming Use data to ake judgements about food security Compare the arguents for/against buying local UK produce rather than imported produce	Many pupils will be aware of food shortages and famines in various parts of the world but be unable to explain this scientifically or the causes.	6. Outline a simple ethical argument about the rights and wrongs of a new development, discovery or technology.		Skamp et al. (2004) - majority of students agreed to environmental taxation and legislation when aimed at other individuals or companies but not when they were directly affected - they may not feel a lot of personal responsibility (perhaps because they do not understand how they contribute to the problems). Jenkins & Pell (2006) found that most students do not think they are personally able to have an impact on environmental issues. Carvalho (2001) - children are able to internalise environmental awareness more than adults, so if they are educated and informed properly there is likely to be a change in behaviour. McNeill & Vaughan (2012) - climate change curriculum results in pupils changing their beliefs in their own impact (and often their behaviours).	Which is the best definition of food security? A. Every person having the same amount of food B. Having a sufficient amount of food for a population C. Making sure that crops are protected against droughts or floods 2. Which is least likely to be a threat to food security? A. A decreasing birth rate B. A new resistant pathogen (disease-causing microorganism) C. An ongoing political conflict 3. Which is the best definition of sustainability? A. Ensuring that food supplies never run out B. Supporting long-term ecological balance by not depleting natural resources C. Using farming and agricultural methods that are environmentally friendly and considerate of animals		food security, famine
	B3.2.10	**Feedback Lesson**												