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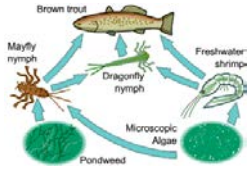
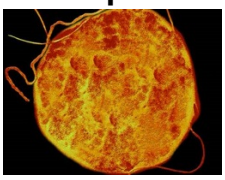
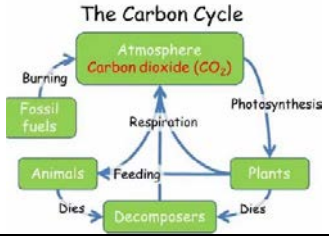
4.7.1	Adaptations, interdependence and competition
4.7.1.1 Communities 	An **ecosystem** is the interaction of a community of living organisms **(biotic)** with the non-living **(abiotic)** parts of their environment. To **survive** and **reproduce** in a community, <u>plants</u> compete with each other for **light and space**, and **water and mineral ions from the soil**. <u>Animals</u> compete with each other for **food, mates and territory**. Each species in a community depends on other species for **food, shelter, pollination and seed dispersal**, etc. If one species is removed it can affect the whole community. This is called **interdependence**. A **stable community** is where all the species and environmental factors are in balance for a constant population sizes.
4.7.1.2 Abiotic factors 	A change in an abiotic (non-living) factor would affect a given community. This includes **light intensity**, **temperature**, **moisture levels**, **soil pH and mineral content**, **wind intensity and direction**, **carbon dioxide levels for plants, oxygen levels** for aquatic animals.
4.7.1.3 Biotic factors	Biotic (living) factors which can affect a community are: **availability of food**, **new predators** arriving, **new pathogens** or one **species outcompeting another**.
4.7.1.4 Adaptations 	Organisms have **features** (**adaptations**) that enable them to survive in conditions in which they normally live. These adaptations may be structural, behavioural or functional. Organisms called **extremophiles live in environments that are very extreme**, such as at high temperature, pressure, or salt concentration. Bacteria living in deep sea vents are extremophiles.

4.7.2	Organisation of an ecosystem
4.7.2.1 Levels of organisation 	Feeding relationships in a community is represented by **food chains**. It begins with a **producer (green plant or alga)** which **synthesises molecules such as glucose** for photosynthesis. Producers **are eaten by primary consumers**, which may be eaten by **secondary consumers** and then **tertiary consumers.** Consumers that kill and eat other animals are **predators**, and those eaten are **prey**. In a stable community the numbers of predators and prey rise and fall in cycles. Methods such as **transects and quadrats** are used by ecologists to determine the **distribution and abundance** of species in an ecosystem.
4.7.2.2 How materials are cycled 	All materials in the living world are **recycled** to <u>provide the building blocks for future organisms.</u> **CARBON CYCLE** returns carbon from organisms to the atmosphere in the form of carbon dioxide. It involves four main processes: – **Photosynthesis:** removes carbon (dioxide) from the air, by green plants, used to make carbohydrates, fats and proteins. – **Respiration:**

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	chemical reaction in all living cells, which releases carbon dioxide back into the air. – **Decay (or decomposition):** Dead organic material is **broken down** (digested) by microorganisms. This releases nutrients back into the soil needed for plants to grow. – **Combustion** burning or (fossil) fuels, which is releases more carbon dioxide into the atmosphere • **<u>WATER CYCLE</u>** provides fresh water for plants and animals on land before draining into the seas. Water is continuously evaporated and precipitated.
4.7.2.3 Decomposition (BIOLOGY only)	Gardeners and farmers try to provide **optimum (best) conditions** for **rapid decay** of **waste biological material (compost)**. The rate of decay can be affected by **temperature**, **water** and the **availability of oxygen**. The compost produced is used as a natural fertiliser for growing garden plants or crops. **Anaerobic** (no oxygen) decay produces methane gas. **Biogas generators** can be used to produce methane gas as a fuel.
4.7.2.4 Impact of environmental change (biology only) (HT only)	The distribution of species in an ecosystem can be affected by environmental changes (**temperature, availability of water and composition of atmospheric gases.** The changes may be seasonal, geographic or caused by human interaction.

4.7.3	Biodiversity and the effect of human interaction on ecosystems
4.7.3.1 Biodiversity 	Biodiversity is the **variety of all the different species** of organisms on earth, or within an ecosystem. Greater biodiversity ensures the stability of ecosystems by reducing the dependence of one species on another.
4.7.3.2 Waste management 	Rapid growth in the human population and an increase in the standard of living means **<u>more resources are used and more waste is produced</u>**. Waste and chemical materials need to be properly handled to reduce pollution. Pollution can occur in **water** (from sewage, fertilisers or toxic chemicals), in **air** (from smoke and acidic gases), on **land** (from landfill and chemicals) and can **kill plants and animals**.
4.7.3.3 Land use 	Humans reduce the amount of land available for other animals and plants by **building, quarrying, farming and dumping waste**. **Peat bogs**, <u>formed in waterlogged bogs</u> over thousands of years by the growth of mosses and other plants, **absorb and 'lock away' carbon**. They are being destroyed to produce garden compost, **reducing the area of this habitat and the variety of different plant, animal and microorganism species** that live there. The decay or burning of the peat releases carbon dioxide into the atmosphere.
4.7.3.4 Deforestation	<u>Large-scale</u> deforestation in <u>tropical</u> areas has occurred to **provide land for cattle and rice fields** and **grow crops for biofuels**.

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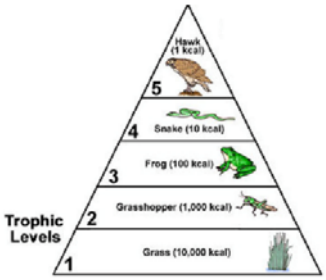
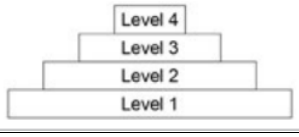
4.7.3.5 Global warming 	**Carbon dioxide and methane levels** in the atmosphere are **increasing,** and contribute to 'global warming'.
4.7.3.6 Maintaining biodiversity	Scientists and citizens have recommended programmes to maintain biodiversity. These include **breeding programmes** for endangered species, **protect and regenerate rare habitats, reintroduce field margins and hedgerows** in agricultural areas where farmers grow only one type of crop, **reduce deforestation** and **carbon dioxide emissions**, **recycle** rather than dump in landfills.

4.7.4	4.7.4 Trophic levels in an ecosystem (biology only)
4.7.4.1 Trophic levels 	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. **Decomposers** break down dead plant and animal matter by **secreting enzymes** into the environment. **Small soluble food molecules** then diffuse into the microorganism.
4.7.4.2 Pyramids of biomass	Pyramids of biomass can be constructed to represent the amount of biomass in each level of a food chain. Trophic level 1 is at the bottom of. 
4.7.4.3 Transfer of biomass	Producers (plants and algae) transfer about 1% of the incident energy from light for photosynthesis. Only around 10% of the biomass from each trophic level is transferred to the level above it. **Loss of biomass** is because: **not all the ingested material is absorbed**, **only some is egested as faeces**, some **lost as waste** (such as carbon dioxide and water in respiration and water and urea in urine). Large **amounts of glucose** are used in **respiration.** **Equation:** The percentage efficiency of energy transfer between trophic levels = energy transferred to next level ÷ total energy in × 100

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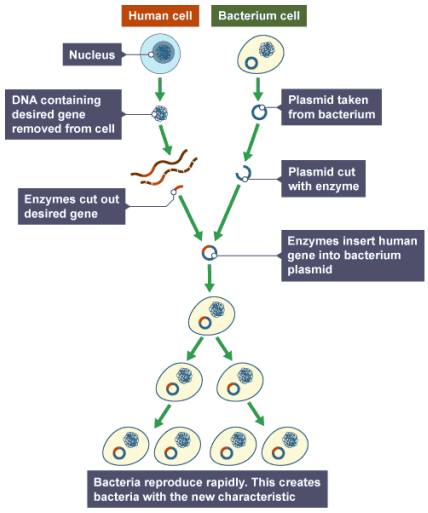
4.7.5	4.7.5 Food production (biology only)
4.7.5.1 Factors affecting food security 	Food security is having enough food to feed a population. Biological factors threatening food security include: • **increasing birth rate**, **changing diets in developed countries** means **scarce food** resources are **transported** around the world, **new pests and pathogens that affect farming**, **environmental changes** (widespread famine in countries if rains fail), the **cost** of agricultural inputs, **conflicts** in some parts of the world.
4.7.5.2 Farming techniques 	Food production can be improved by **limiting energy transfer** from food to animals to the environment. Examples include, **restricting animal movement and keeping them close together (so less energy is wasted)**, **controlling the temperature of their surroundings** or **high protein diets** to increase growth.
4.7.5.3 Sustainable fisheries	Fish stocks in the oceans are declining (going down). Certain **species of fish may disappear** if fish stocks levels are not maintained. Control of net size and the introduction of fishing quotas can help in conserving fish stocks at a sustainable level.
4.7.5.4 Role of biotechnology 	Modern biotechnology techniques enable large quantities of microorganisms to be cultured for food. The **fungus Fusarium, for example, is useful for producing mycoprotein**, a protein-rich food suitable for vegetarians. The fungus is **grown on glucose syrup in aerobic (oxygen) conditions** and the biomass is **harvested and purified**. **Genetic engineering: Genes** from the chromosomes of humans and other organisms can be 'cut out' using **enzymes** and transferred to cells of other organisms. • **GM crops** that have been given beneficial traits (eg. resistant to insect attack or to herbicides or improved nutritional value such as golden rice) • **Bacteria** that are genetically modified to produce human insulin (for diabetics) <u>(HT): Steps involved in genetic engineering</u> **Enzymes** are used to <u>isolate and cut out</u> the desired gene; this **gene is inserted into a vector**, usually a <u>bacterial plasmid</u> or a virus. The plasmid or vector **reproduces quickly** with the desired characteristics.