

Biology Knowledge Organiser

B18 - Biodiversity and ecosystems

Biodiversity

Biodiversity, the variety of all the species of organisms, can be measured at the level of a community, ecosystem or the whole earth (biosphere). A large biodiversity increases the stability of ecosystems, because it reduces the dependence of one species on another, for instance for food. So, for example, if a species has only one food source (think: pandas and bamboo shoots), it may be easily threatened by environmental changes.

In spite of our future as a species on Earth depends totally on maintenance of biodiversity, many human activities threaten biodiversity. Indeed, in many ecosystems, we have already significantly reduced biodiversity. For instance, deforestation had damaged biodiversity in all kinds of forest. Our waste, polluting land, air and sea, has negatively affected biodiversity in many areas. And the big one: global warming is already having measurable effects on global biodiversity. It is only recently that humans have taken any measures to try to prevent our damage to biodiversity going too much further – obviously, we don't yet know if these measures will be enough.

Land use

Humans reduce the amount of land available for other organisms by: building, quarrying, farming and dumping waste (landfill). This in turn can reduce biodiversity.

Peat bogs are made of peat, a type of fossil fuel formed from dead plants. Peat bogs are destroyed as peat can be used as a fuel and is a very good fertiliser if you're growing plants. This has seriously reduced the area of this habitat and reduced biodiversity as a result. Furthermore, using peat as a fuel produces CO₂ (contributing to global warming) and using it as a fertiliser (in compost) allows it to decay, which also produces CO₂.

Key Terms	Definitions
Evaporated	Water changing state from liquid to vapour.
Precipitated	Water changing from vapour to liquid/solid form – i.e. rain, hail, snow.
Biodiversity	The variety of all the different species of organisms.

Waste management

Since the human population is growing at an incredible rate, and in general people's living standard is going up globally, we (the human population) is using more and more resources and producing more and more waste. Our waste causes pollution, which can occur:

- In water, thanks to sewage, fertilisers running off farmland, or toxic chemicals used in industry;
- In the air, from smoke, waste gases and acidic gases (e.g. sulphur dioxide)
- On land, from landfill (rubbish dumps) and from toxic chemicals.

Pollution kills organisms; therefore it can reduce biodiversity.

Deforestation

Deforestation on a large scale happens to provide land, with the largest areas cleared for raising cattle, to plant rice fields and to grow crops that can be made into biofuels. Our food and fuel needs conflict with the need to preserve forests and rainforests so biodiversity is maintained.

Global warming

As you'll know, since the industrial revolution, human activities have dramatically increased the levels of greenhouse gases in the atmosphere. The main gases involved are carbon dioxide and methane. The molecules of these gases absorb infrared (heat) radiation and re-radiate it, causing gradual but measurable increases the atmosphere's, and therefore Earth's, temperature. Global warming as caused by humans used to be controversial; now, thousands of peer-reviewed publications later, the global scientific consensus is that humans are definitely causing climate change through global warming.

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The impact of environmental change

Environmental changes affect the **distribution** of species in an ecosystem. Environmental changes can be seasonal (summer vs. winter), geographic (e.g. flooding, volcanic activity and so on) or caused by human interaction with the environment (e.g. anthropogenic climate change). Changes that affect organisms include temperature, availability of water and the composition of gases in the atmosphere. Be ready to evaluate the impact of examples of environmental changes on distribution of species.

Maintaining biodiversity

As you've seen, many human activities have negative effects on biodiversity. However, as the scale of our negative influence has become more and more apparent, scientists and concerned citizens have brought in programmes to try to reduce our negative influences. Here are the key examples you should know:

- **Breeding programmes** for endangered species. For instance, tigers and pandas are bred in captivity to ensure they do not become extinct.
- **Protection and regeneration** of rare habitats. This includes passing laws to ensure people leave certain areas alone (e.g. parts of the Great Barrier Reef). Regeneration means activity trying to bring a habitat back to its former glory.
- Reintroduction of **field margins** and **hedgerows** in agricultural areas where farmers only grow one kind of crop. Growing one sort of crop (called monoculture) is bad for biodiversity because it only provides a habitat for a few species. So, farmers are encouraged to use hedges (not fences) and leave a margin around the edge of their crop fields, so wild plants can grow there, which in turn allows other organisms (e.g. insects) to survive there too. This improves biodiversity on agricultural land.
- Reduction of **deforestation** and carbon dioxide by some governments. There have been numerous attempts, not always totally successful, to get governments of countries around the world to agree to specific targets for how much carbon dioxide they emit, since global warming is, of course, a worldwide problem. As with many things in politics, agreement is very difficult to obtain... but progress has been made in these international agreements.
- **Recycling** resources rather than dumping in landfill. You are used to recycling as much of your household waste as you can. Work continues to increase the range of materials that can be recycled so we can continue to reduce the amount of waste dumped in landfill.

Key Terms	Definitions
Breeding programme	Producing offspring, especially of endangered species to protect their population.
Field margin	The area around the edge of a field between the crop and the fence/hedge/wall.
Hedgerow	The barrier at an edge of a field made of growing plants, as opposed to a fence or wall.



A lovely big field margin, and hedgerow on the left

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Food security

Food security is having enough food to feed a population. Unfortunately, many populations around the world suffer from a lack of food security. Numerous biological factors threaten food security, including:

- Increasing **birth rate** raising the population
- Changing **diets**, which often results in scarce foods being imported to countries where they can't grow them, or results in people eating more meat
- New **pests** (insects that eat plants) or pathogens that affect crops
- **Environmental changes** (including effects of climate change) that affects food production
- The **cost** of doing agriculture – e.g. price of seeds for crops, or farming equipment
- **War** can affect the availability of water for crops/animals, or directly affect the availability of food.

So, a major global challenge is finding sustainable methods to feed everyone on Earth. Whoa.

Farming techniques

Food production efficiency links to the flow of biomass in food chains and pyramids of biomass, so check you know that. The basic idea is that if you reduce energy transfers from food animals (like chickens, pigs and cows) to the environment. This means they don't have to respire so much, meaning that more of the biomass the animal **consumes** is converted to biomass in their bodies.

- Keeping the animals **warm** (indoors) reduces the use of respiration to maintain their body temperature. Therefore more of the biomass they eat is used to build their bodies, rather than being used up in respiration.
- **Limiting their movement** – which yes, does sound rather cruel. Again, this reduces the need for energy from respiration; therefore less of the biomass eaten is used in respiration and more is converted to biomass in the animals' bodies.
- Feeding animals a **high protein** diet to speed up growth.

Key Terms	Definitions
Sustainable	Able to continue/maintain something. For instance, sustainable food production won't use up all of food resource.
Fishery	A farm where fish are bred for food OR a part of the sea/lake where fish are caught for food.
Biotechnology	Technology that involves manipulating living things.

Sustainable fisheries

The amount of fish in the ocean that people eat (**fish stocks**) is dropping. The solution is to restrict fishing so there are enough left to breed and replace those caught. There are two main ways to keep people from catching too many, so **fisheries** stay sustainable:

1. Control **net sizes** so not too many fish are caught
2. **Fishing quotas** – this is a legal limit on how many fish a company can catch. They get fined if they catch more than their quota.

Without methods like this, certain species may die out altogether.

Role of biotechnology

Modern biotechnology can help with food security.

- Genetic modification (genetic engineering) can produce crops with higher **yields** (more food per plant) or better nutritional value. An example is Golden Rice, which provides vitamin A.
- **Mycoprotein** (e.g. Quorn) is grown in tanks. The fungus *Fusarium* grows on glucose syrup in aerobic conditions, then the biomass is harvested. Huge quantities can be cultured at a time, so it's a pretty efficient way of making food.