

AQA Geography GCSE

3.1.2.1: Ecosystems

Detailed Notes

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Ecosystems

What is an Ecosystem?

An ecosystem is a **natural system** in which a **community of plants and animals interact** with **each other** and their **physical environment**.

Within ecosystems, there are interactions between **biotic components** and **abiotic components**.

Biotic components refer to **living organisms**, such as plants and animals. **Abiotic components** refer to the non-living **environmental factors** which have influence over the ecosystem such as climate (temperature, humidity and precipitation), light exposure, soil type etc.

Ecosystems are present on **different scales**: small-scale and global-scale ecosystems.

- **Small-scale ecosystems** are local ecosystems, such as in a **freshwater pond** or on the **seashore**.
- **Global-scale ecosystems** are **large regions of the world** with **similar environmental conditions** (especially climate, vegetation and soil type). Global-scale ecosystems are referred to as **biomes**.

Ecosystems consist of different **organisms** that produce and transfer **energy** through the system.

Producers

Producers are organisms that **convert energy** from the **environment** (mainly sunlight) **into sugars** (glucose).



Plants are producers as they **convert energy from the sun into glucose** via **photosynthesis**.

Consumers



Consumers are organisms that receive energy from **consuming** (i.e. eating) **living organisms**.

Consumers may **eat producers**, and receive energy from the **sugars** made by producers (e.g. rabbits are consumers as they eat grass - a producer).



However, some consumers receive energy by eating **other consumers** (e.g. a fox would eat a rabbit - another consumer).

Primary consumers (rabbit) are organisms that eat **producers**. **Secondary consumers** (fox) are organisms that eat **primary consumers**.

Decomposers



Decomposers **break down organic material** (e.g. dead plants and animals or faeces) and release the **nutrients** from this organic material into the **soil**. These nutrients are **absorbed by plants** when they grow.

Fungi and bacteria are examples of decomposers.



Interactions within Ecosystems

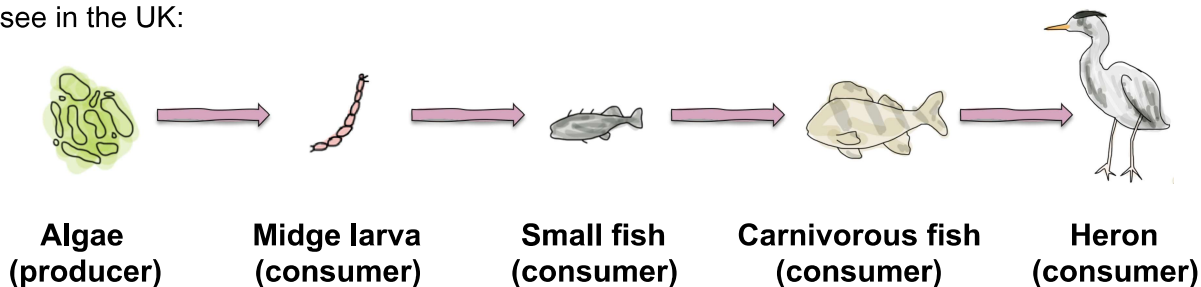
Within ecosystems, producers, consumers and decomposers interact with each other. These interactions can be demonstrated with **food chains** or **food webs**.

Food Chains

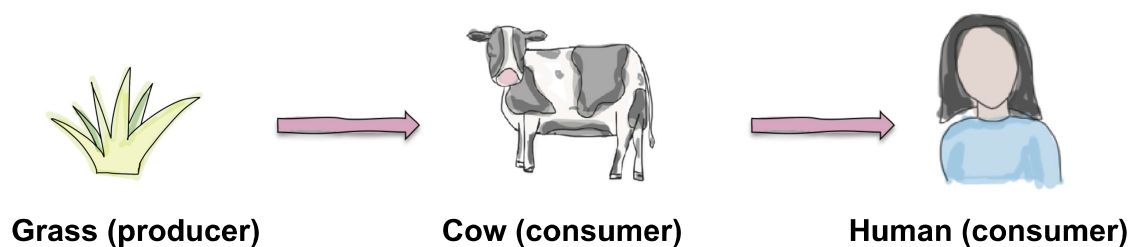
A food chain shows how **producers and consumers** interact within the ecosystem. Food chains are usually depicted in a **straight line**, starting with the producer and ending with the last consumer in the chain. Food chains can also include **decomposers**, which recycle energy back into the producers.



Food chains are present in every ecosystem, for example the **freshwater pond ecosystem** which we see in the UK:



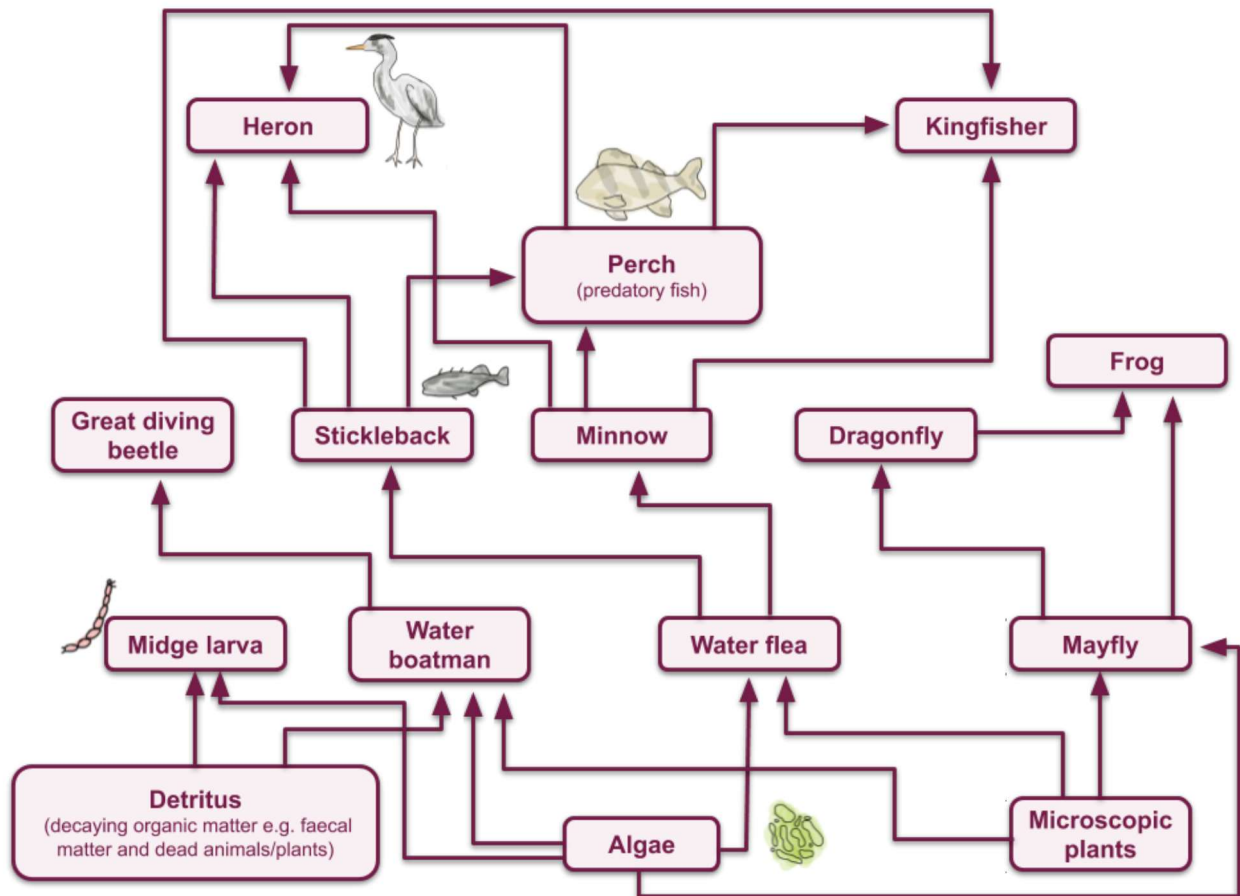
Humans also rely on **food chains** for our sources of food:



Food Webs

Within **ecosystems**, interactions between organisms are **complex**. These complex relationships can be demonstrated by **food webs**, which illustrate how multiple producers and consumers interact within ecosystems through several different food chains. On the following page is a food web illustrating the relationships within a freshwater pond:



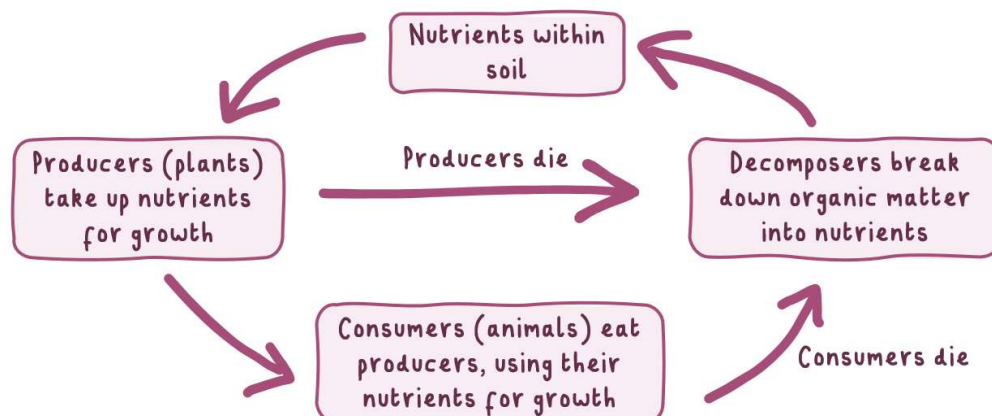


Nutrient Cycling

Nutrients are substances that fuel **plant and animal growth**, such as **nitrates** and **phosphates**. Nutrients come from different sources:

- Rocks and minerals (e.g. phosphorus containing rocks) **break down** by **weathering**, which releases nutrients into the **soils**.
- Chemicals in the **atmosphere** can be **washed out** within **precipitation**.
- Special bacteria can **absorb chemicals from the air** and store them in soil.

Nutrients are **transferred throughout the ecosystem** in different ways. Animals and plants die, and decomposers **break up their organic matter** into nutrients, which are put **back into the soil**.



The Impact of Change Within Ecosystems

Abiotic (non-living) and **biotic** (living) components are **delicately balanced within ecosystems**. Changing just one abiotic or biotic factor can have **knock-on effects** on other factors, as the components of an ecosystem are all **interrelated**.

If the changes are **slow**, the ecosystem can adapt over time. (e.g. slow climate change taking place over tens of thousands of years). However, **abrupt** changes can throw off the ecosystem's balance, and can potentially **completely alter** an ecosystem.

Changes within ecosystems can be **natural** or **human-induced**, and may be on a **global-scale** (e.g. climate change) or a **local scale** (e.g. a change to a habitat). For example:

- The introduction of **disease**, which can devastate both **plant** and **animal populations**. Changes in **population size** can affect food chains and have knock-on effects on other species numbers.

- **Extreme weather, climate change** and **natural disasters** (droughts, flooding, forest fires, volcanoes etc.) can radically change an ecosystem. For example, **ponds and lakes** can **dry up** after long periods of drought, devastating the freshwater ecosystem that exists within them.

For example, following a drought in Australia, many duck ponds completely dried up, destroying the ducks' habitat.



(Source: www.smh.com.au/environment/weather)

- **The introduction** of a **new species** can **alter food chains**, as well as create **competition** for space and food. A new **predator** could dramatically decrease populations **lower down the food chain**. Alternatively, a new species may act as a new **food source** for animals **higher up the food chain**, increasing their population size.

In some sub-Antarctic islands, the accidental introduction of **mice** has caused **reductions in seabird numbers** because the mice eat eggs and small birds. Mice are also thought to be **disrupting seabird breeding behaviour**.



(Source: [Mark Fraser](#))

- Human activities (e.g. construction, agriculture, deforestation) can disrupt ecosystems and make the conditions **unsuitable** for plants and animals as they are not **adapted**. Simple changes like **removing a hedge** or **building a road** can alter the nutrient cycle, disrupt animal behaviour and alter many components within the ecosystem.
- **Removing a top predator**, e.g. by hunting, has knock-on effects lower down the food chain. For example, in a woodland ecosystem, removing **wolves** would cause higher levels of **deer**, reducing **vegetation levels**. This concept is referred to as a **trophic cascade**.



EXAMPLE 1: EUTROPHICATION

Changes to **nutrient levels** in **freshwater ecosystems**.

Agricultural **fertilisers** wash into ponds and freshwater ecosystems when it rains.



Algae grows rapidly due to the **nutrients** in the fertilisers, which **stops light** from penetrating lower down.



Plants in the system cannot **photosynthesise** as they receive no light, so they don't produce **oxygen**.



Oxygen-depleted waters cannot support aquatic life as there is no oxygen for **respiration**, causing animals to die.



(Image source: [Alexandr Trubetskoy](#))

EXAMPLE 2: FOOD CHAIN DISRUPTION

Changes to ecosystems by the introduction of **species** that alter the food chain.

Zebra mussels are native to **Russia** and **Ukraine**, but were accidentally introduced to North American waters in the 1980s.



The mussels have **no natural predators** in the USA freshwater ecosystem, meaning – without predation – their populations have grown **very rapidly**.



Native mussel populations have declined due to **competition for food and space**, removing an important **food source** for animals higher up in the food chain.



Zebra mussels feed on **small organisms like plankton**, which native **fish** in the ecosystem also eat. Fish populations have declined due to the reduced **food source**.



(Image source: www.duluthnewstribune.com)



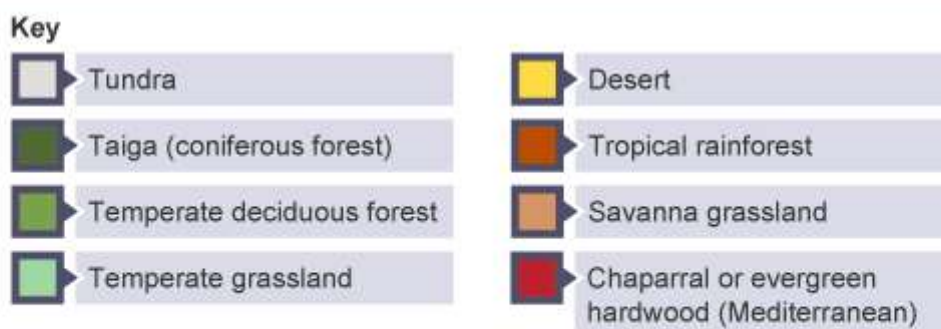
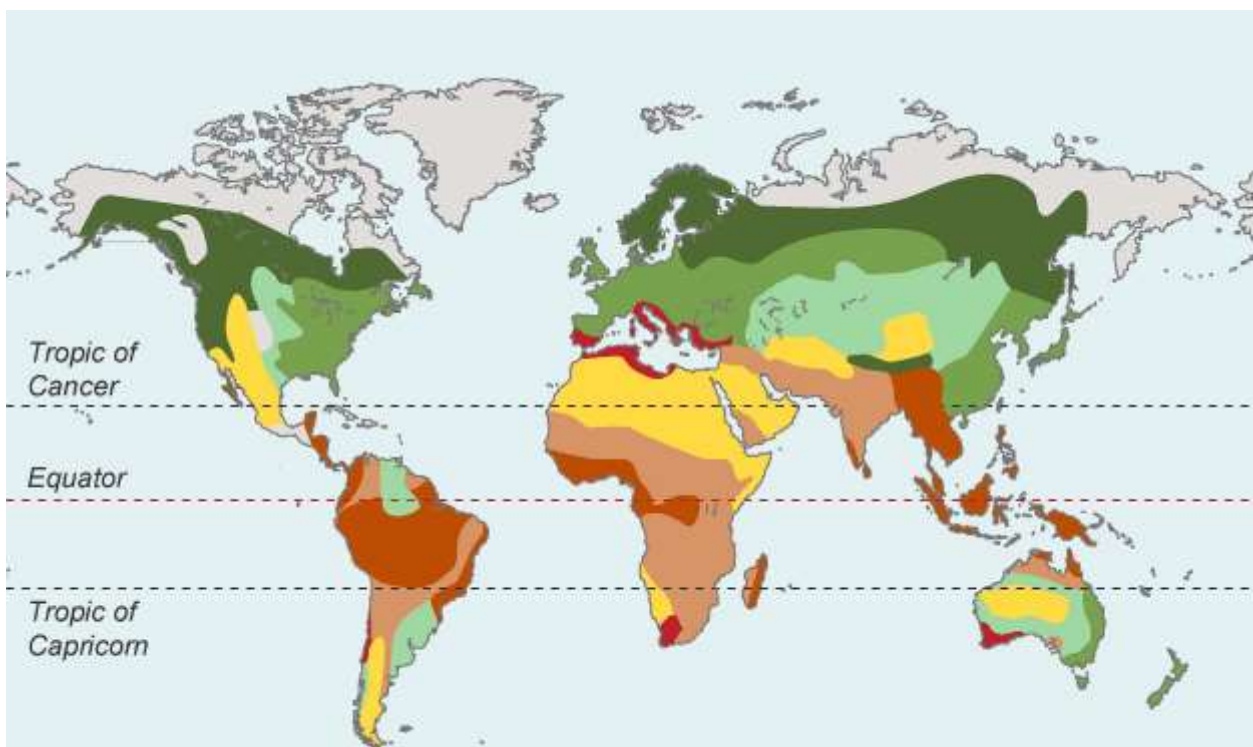
Global Ecosystems

Global ecosystems (also known as **biomes**) are large-scale ecosystems that exist throughout the world, categorised by **similar environmental characteristics** such as **climate, vegetation type and soil**.

Biomes usually occur in **latitudinal belts**, meaning they are present across the world at **similar latitudes** (horizontally on a typical map).

These **latitudinal patterns** occur because the climate in these regions is similar due to **atmospheric circulation**. However, there are **some variations** in biome distribution due to other influences, like **ocean currents, winds** and **land-sea temperature differences**.

Distribution of Global Biomes

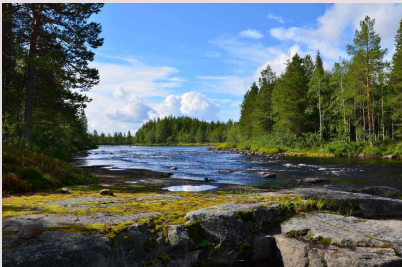
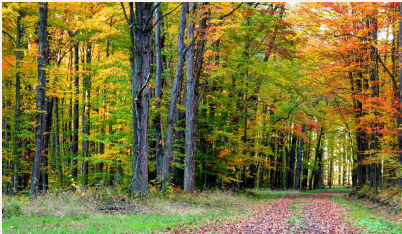


Some of the biomes (polar, monsoon etc.) are not included in this map because they are small, and the **definition of biomes varies**.

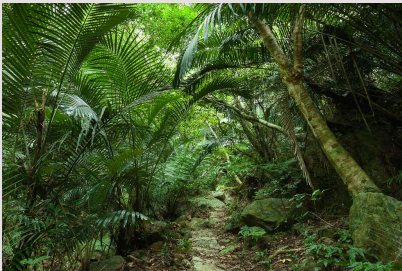


Characteristics

Global ecosystems have different defining **characteristics**. These are outlined in the table below.

Ecosystem	Location	Characteristics
Tundra 	Located in the far north. Arctic circle to 60-70°N (e.g. Canada, Northern Russia, coastal Greenland). Not as prevalent in the southern hemisphere as there aren't as many land masses far south.	• Harsh, cold winters and extremely short summers. • Treeless ecosystem as it is too cold and not wet enough for trees. • Precipitation is extremely low (10-25cm/yr) • Short growing season, nutrient poor soils and lack of biodiversity. • Animals are usually migratory (i.e. they move further south in winter) • Soils are permanently frozen (permafrost).
Taiga (coniferous forest/boreal) 	Located at latitudes below the tundra biome, anywhere from 50-70°N (e.g. North America, Russia, Scandinavia).	• Coniferous forest (conifers) which are drought resistant, cone-bearing trees. • They retain their leaves all year round to maximise photosynthesis, especially during short summers. • Around 50cm/yr of rainfall and a longer growing season, meaning there are more plants. • Small animals and migrating birds are present. Coniferous forests may also contain wolves, bears and moose.
Temperate deciduous forest 	Around 40-50°N and S of the equator, although this varies. Located in Eastern USA, Europe - including the UK - Eastern Australia.	• Deciduous vegetation (broad-leaf trees that shed their leaves in winter to retain moisture) • Oak, maple, beech trees common. • Highly seasonal temperatures: hot summers and cold winters. • Moderate precipitation - 75-150cm/yr. • Animals include deer, bear and small animals.



Temperate grassland (prairie, steppe, pampas) 	Located roughly 30–40°N and S of the equator, away from coastal areas. E.g. Central Europe and Asia, Central USA, Central Australia, some parts of South America. Prairie = USA Steppe = Europe/Siberia Pampas = South America	• Dominant vegetation is grasses due to periodic fires and precipitation being too low to support trees. • Low precipitation (25–75cm/yr). • Animals include prairie dogs and originally bison, although these were overhunted in the past. • Hot summers, cold winters.
Desert 	Around 30°N and S of the equator. E.g. Northern Africa, Australia, Eastern USA, Middle-East, southern South America.	• Precipitation is extremely low - under 25cm/yr. • Temperature fluctuates from well above 20°C in the day to below 0°C at night. • Precipitation greatly limits plant growth, soil is very low in nutrients and high in salts. Mainly cacti and sagebrushes. • Small animals live in deserts, often nocturnal to regulate body temperature. • Deserts cover one fifth of the world's land surface.
Tropical rainforest 	Close to the equator. E.g. equatorial South America, South-East Asia.	• Species rich ecosystem, with over half of the world's species of plants and animals. • Warm, moist climate throughout the year with little variation, perfect for plant growth. Temperatures stay around 26°C. • Precipitation is extremely high (200–450cm/yr). • Very quick nutrient cycle, soils are nutrient poor but there is a thin layer of organic matter on the top of soils that makes plants very productive. • Animals include many insects, reptiles and amphibians.



Savanna (tropical grassland)



Located between 15-30° N and S of the equator.

India, Central Africa, Central South America.

- Temperature varies **little throughout the year**, staying in the **high 20°Cs**.
- **Precipitation is very seasonal**, with distinct **wet and dry seasons**. Yearly precipitation is around 76-150cm/yr, though most of this falls in winter.
- Tropical grassland dry seasons are characterised by **wildfires**, and the vegetation is **adapted to this**.
- Wide expanses of grass means this ecosystem is often used for **animal grazing**.
- Hoofed animals and **herds** are common in this ecosystem, as well as **large predators** like lions and leopards.

Mediterranean (chaparral)



Around 40-45°N of the equator.

South of the equator, the Mediterranean biome exists in some areas of **South Africa** and **Western Australia**.

- Mild, moist winters. Hot, dry summers (precipitation around 50cm/yr).
- Frequent **wildfires**, with vegetation adapted to this.
- Dense growth of **shrubs**, as well as fruit trees.
- Diverse **wildlife** - animals include foxes, pumas, tortoises, lizards.

