Geography Department

Living World

Ecosystems exist at a range of scales & involve the interaction between **<u>biotic</u>** (living) & **<u>abiotic</u>** (non-living) components

What is an ecosystem?

An ecosystem is a natural system that is made up of........

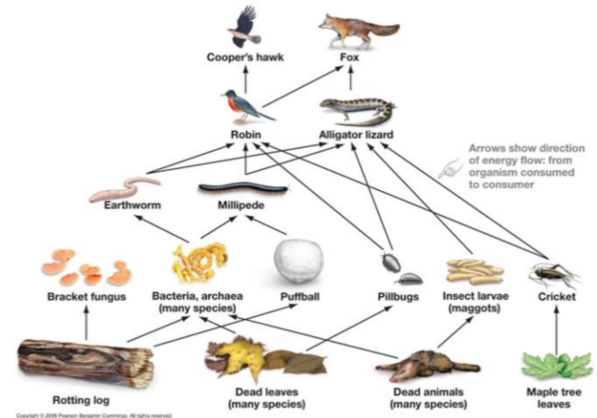
Living things (**biotic**) (plants, animals)

Non-living things (**abiotic**) (climate, soil, water)

What type of ecosystem is this?

Examples of ecosystems

- ✓ A hedgerow
- ✓ A pond
- ✓ A desert
- ✓ Tropical rainforests
- ✓ Polar areas



Changing one component in an ecosystem impacts on another.

What would happen if all the Robins died out or the crickets were wiped out by disease?

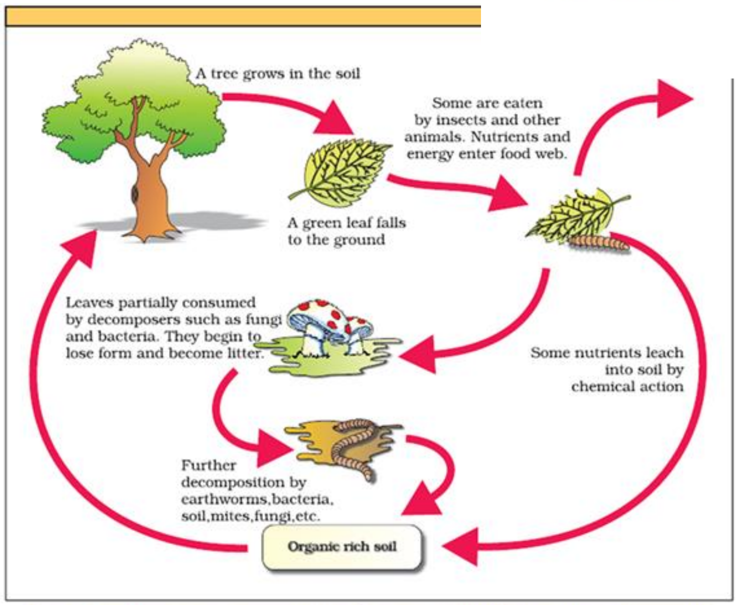


Figure 14.1 Diagrammatic representation of decomposition cycle in a terrestrial ecosystem

Sample Food Chains

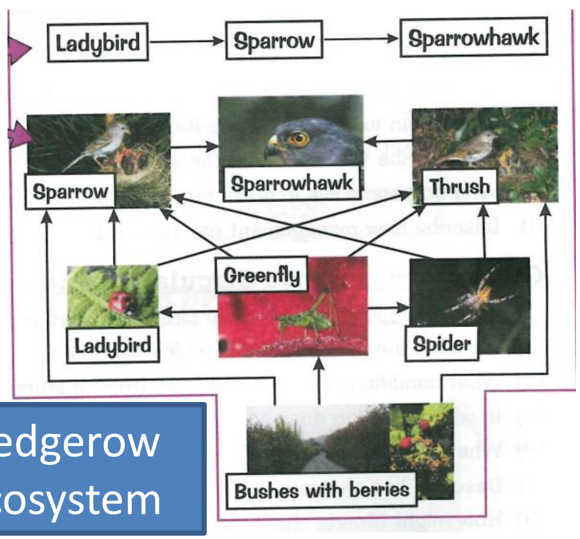
Trophic Level	Grassland Biome	Pond Biome	Ocean Biome
Primary Producer	grass	algae	phytoplankton
Primary Consumer	grasshopper	mosquito larva	zooplankton
Secondary Consumer	rat	dragonfly larva	fish
Tertiary Consumer	snake	fish	seal
Quaternary Consumer	hawk	raccoon	white shark

An example of a small scale ecosystem

A hedgerow ecosystem includes all the plants that make up the hedgerow and the organisms that live within it (***biotic elements***) It also includes the soil, the rainfall and the sunshine (***abiotic elements***).

The **producers** include hawthorn and blackberry bushes.

The **consumers** include thrushes, ladybirds, spiders, greenfly, sparrows and sparrow hawks.



Hedgerow ecosystem

A change in the ecosystem impacts on other components

Hot, dry summer

Reduced plant growth

Fewer berries for birds to eat

A fall in the number of sparrows and thrushes

Fewer birds for sparrow hawks to hunt so sparrow hawk numbers start to drop or they move elsewhere

<u>Producers</u> – organisms that get their energy from CO2 & water. Plants are producers
<u>Consumers</u> – they feed on other living things in an ecosystem
<u>Food chain</u> – A food chain shows the link between **producers** & **consumers.** It shows a **simple linear** series of connections.
<u>Food web</u> – A food web shows the connections between **producers** & **consumers** in a more detailed way. A food web is made up of lots of food chains and is more complex.
<u>Nutrient cycling</u> – nutrients are leached back into the soil from decaying plant & animal matter. These nutrients are then taken up by the producers & recycled into the food chain. Consumers can also eat detritus (decaying plants) and recycle nutrients that way.
<u>Decomposers</u> – organisms that break down plant & animal material; bacteria & fungi are examples of decomposers.

The distribution & characteristics of large scale global ecosystems

Tundra

Found at high latitudes (above 60 ^{o}N) winters are very cold, summers are brief and there is little rain. There are hardly any trees. Vegetation is mainly moss and grass. There is a layer of permanently frozen ground known as permafrost

Hot Desert

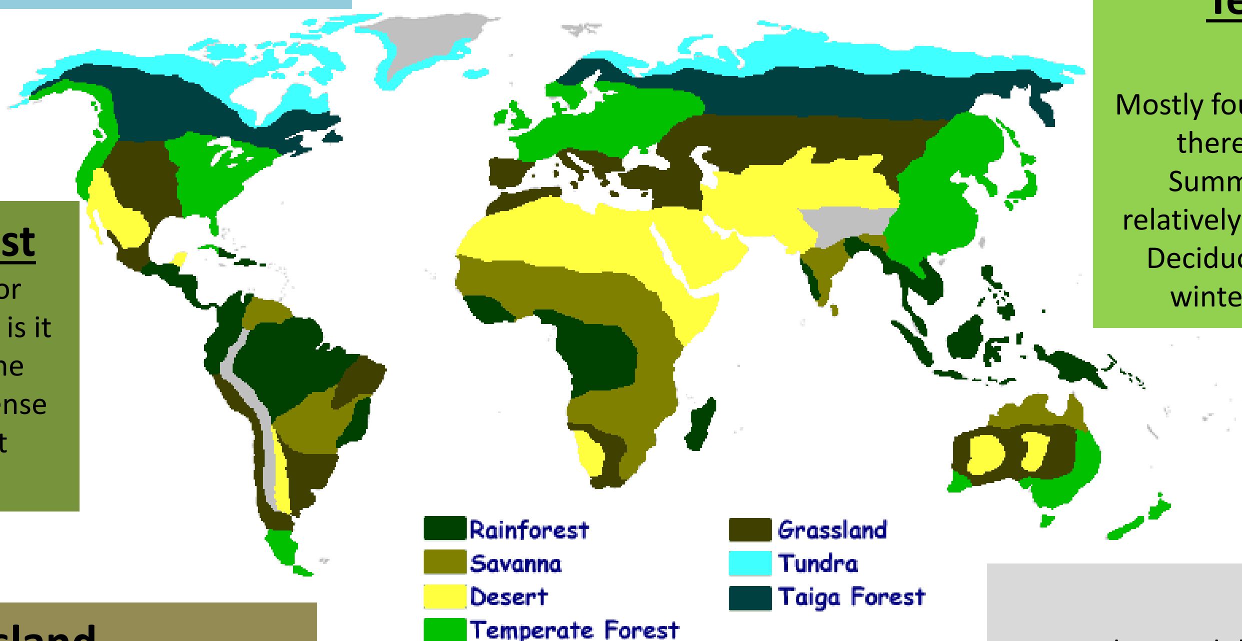
Found between 15 and 35 N and S of the equator. There is little rain. It is very hot in the day and cool at night. Vegetation is sparse due to the lack of rainfall and lack of organic matter in the soil

Temperate forest (Deciduous)

Mostly found in the mid latitudes where there are four seasons e.g. UK. Summers are warm, winters are relatively mild and there is rain all year. Deciduous trees lose their leaves in winter in response to the cold. .

Tropical Rainforest

Found around the equator between the tropics where is it warm and wet all year. The forest is lush, green and dense because of the excellent growing conditions



Grassland

Savannah grassland is found between the tropics . There is a wet and dry season although overall rain is low. Most of the vegetation is grass with a few scattered trees.

Polar

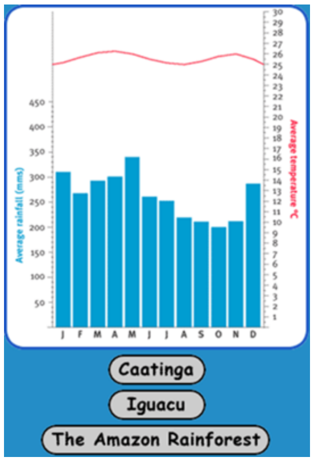
Found around the north and south poles. Conditions are very icy and dry. Not much grows here and it is dark for several months each year so the growing season is limited to about two months

Tropical rainforests have a range of distinctive characteristics

Climate

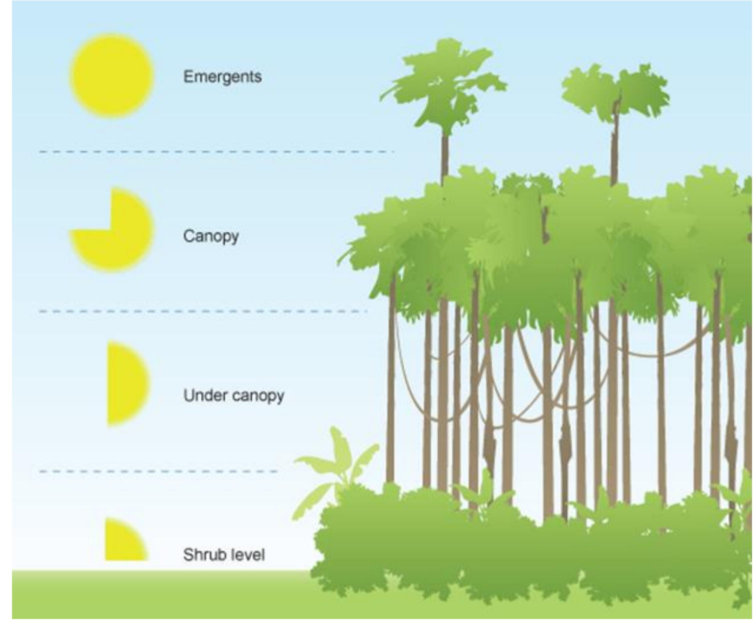
The same all year – **no seasonal variation** due to equatorial location & Hadley cell

- **Very warm** (27-29 ^oC)
- **Very wet** 2000mm+ annually
- Rains daily, usually in the afternoon



Plants

- Most trees are **evergreen**
- **Dense** vegetation
- **Layered** structure (see diagram)
- Lots of **epiphytes**. Plants that use other plants as hosts to gain nutrients e.g. orchids and ferns



Soil

- **Not very fertile**
- Nutrients are found on the surface in the **leaf litter.** Plants and animals decay quickly in the moist heat so nutrients are taken up by **shallow roots**.
- **Leaching** from heavy rain washes nutrients away

Animals

- **More animal species** than any other ecosystem due to abundance of vegetation
- Gorillas, jaguars, tree frogs and sloths are all found in the TRF
- Lots of birds and insects

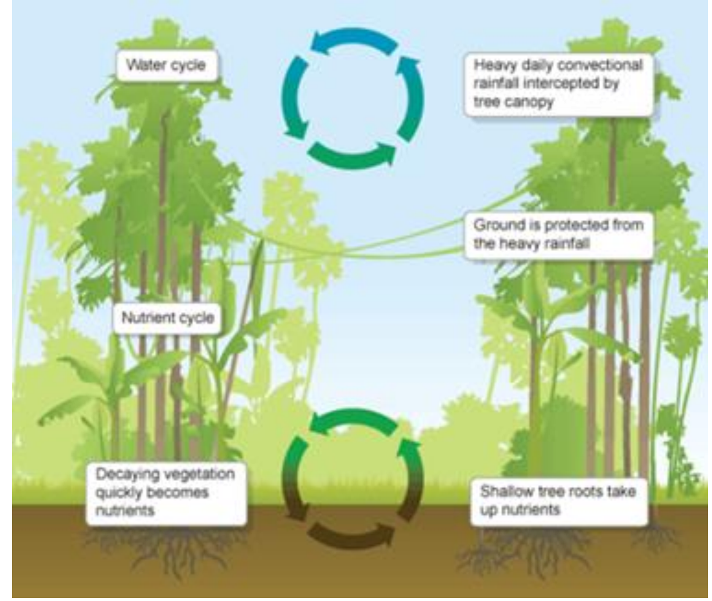
People

- People have **adapted** to life in the TRF
- They survive through **hunting** and **fishing, gathering nuts** and **berries** and **growing vegetables** in small garden plots

Rainforests are interdependent ecosystems

If the climate, soil, plants, animals or people change it has a **knock on effect** on everything in the ecosystem

- The warm wet climate **decomposes** dead plant and animals quickly and the vegetation takes up the **nutrients** in the surface of the soil layer
- Plants pass on their nutrients when eaten by the animals. The dense vegetation provides lots of food so animals populations are high
- **Reducing tree cover** through deforestation will affect the structure of the rainforest and the soil layer will lose protection from the heavy rain creating more **leaching** and possible floods



Plant adaptations

Rainforests have a **shallow layer of fertile soil**, so trees only need shallow roots to reach the nutrients. However, shallow roots can't support huge rainforest trees, so many tropical trees have developed huge **buttress roots**. These stretch from the ground to two metres or more up the trunk and help to anchor the tree to the ground.

Fan palms have large, fan-shaped leaves that are good for catching sunshine and water. The leaves are segmented, so excess water can drain away.

The **Agouti** (*a rodent*)buries **Brazil nuts** to eat later. These sprout and produce new seedlings. If the Agouti became extinct Brazil nut trees would decline as would all animals who depend on this tree for food and habitats. People who sell Brazil nuts would also be affected

Rainforests have very high biodiversity

Biodiversity is the variety of organisms living in a particular area – *both plants and animals*

- ✓ The TRF has a VERY high biodiversity. They contain over **50% of the worlds plant, animal and insect species**
- ✓ Deforestation of the TRF is likely to lead to the **extinction** of many species and therefore a loss of biodiversity.
- ✓ The number of endangered species in Brazil has risen from 218 in 1989 to 628 in 2008

Deforestation

Deforestation is the removal of trees from the forest. Usually by burning or cutting down

The **rate of deforestation is very high** (approx. 130 000km^2 annually)
Globally the rate is beginning to slow but there are **hotspots** where it is increasing e.g. **Nigeria & Borneo** who need to use the forest for development opportunities
Brazil and Indonesia account for almost **50%** of all deforestation but the rate has slowed since 1990

Causes of deforestation

Subsistence farming
forest is cleared by locals to grow food for themselves

Logging
trees are cut down to sell wood to make furniture, homes etc

Road building
forest is cleared for roads to access mines, dams etc

Energy development
Building dams to generate HEP floods large areas of forest

Population growth and settlement
trees are cleared to make way for new settlements as the population increases

Mineral extraction
Minerals such as gold and iron ore are mined so trees are cleared to give access to the ground underneath

Commercial farming
forest cleared for cattle ranching or for huge crop plantations e.g. palm oil

Effects of deforestation

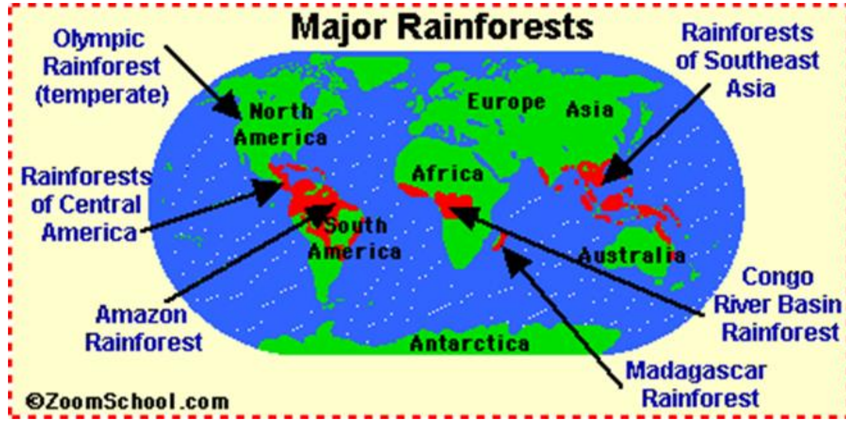
Economic development – logging, mining and farming create **jobs** and a lot of money is made from selling timber, food, gold and aluminium. However once the resource has gone it is harder for people to make money and the area becomes less attractive to **develop tourism**

Soil erosion – with no trees to bind the soil heavy rain can wash the top soil away creating **landslides** and **flooding**,

Loss of biodiversity – more water reaches the soil as the canopy is removed which causes **leaching.** The soil becomes less fertile and it is hard for the ecosystem to recover. As plants are removed or can't grow back **animals lose their habitats**

Contribution to climate change – removing trees creates more CO2 in the atmosphere as trees absorb CO2. Burning trees creates additional CO2 into the atmosphere. Deforestation is responsible for at least 15% of global CO2 emissions (*more than all transport emissions combined!!!)*

Tropical rainforests need to be managed sustainably



It is important to protect the TRF because……..

- ✓ **Protecting biodiversity** is valuable to people and the environment
- ✓ Many **products** such as ***coffee, chocolate*** *and* ***medicines*** are sourced from the TRF. If species become extinct we may lose cures for some diseases
- ✓ Trees absorb CO2, by **reducing the greenhouse effect** we can slow down the effects of **climate change** which affects all countries
- ✓ Trees prevent **local flooding**

Selective logging

Only some trees are felled. Using **horse** or **helicopter logging** is less damaging than big trucks.

This is sustainable because…..by taking only a few trees the **structure of the forest** is left intact protecting the soil from erosion and helping the forest to regenerate

Replanting

New trees are planted to replace those cut down. In some countries this is the law. The same types of trees should be replanted

This is sustainable because….. it **maintains biodiversity** in the forest and there are trees left for **people to use** in the **future**

Ecotourism

Tourism that minimises damage to the environment and benefits local people by providing jobs. Only a few people can visit an area at one time to minimise the impact of waste and litter contamination. Ecotourism is the largest source of income in Costa Rica (21%)

This is sustainable because**…..** local people are employed as guides or looking after tourists they don't have to cut down the forest in order to make money. There is an incentive to protect the environment in order to make more money from tourism.

Education

Educating people about the need to protect the forest e.g. encouraging people to buying wood from sustainably managed forests.

This is sustainable because**…..** educating local people about the damaging environmental effects of deforestation will make them keener on finding alternative ways to make money e.g. ecotourism

International hardwood agreement

Dense hard wood such as **mahogany** and **teak** is considered very desirable and therefore valuable. They are becoming **rare** so international agreements are in place to promote only buying hardwood from **sustainably managed forests**

This is sustainable because**.....** Less hardwood is lost and hardwoods are replanted

Reducing debt

A lot of rainforest are in LICs. These countries can sometimes allow logging, mining and farming in order to **make money and pay back expensive loans**. If debt is reduced or cancelled then rainforest doesn't have t be destroyed to make money. In 2008 the **USA reduced Peru's debt by £25bn** in exchange for rainforest conservation

This is sustainable because**.....** Countries can protect their economic interests and the rainforests.

Conservation

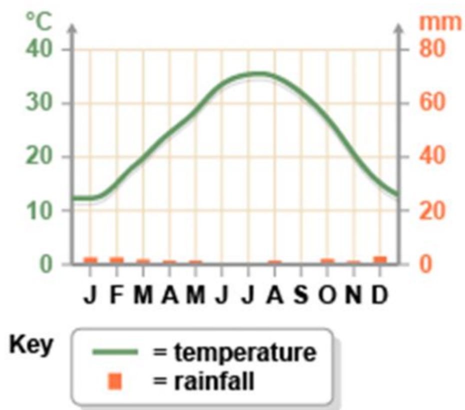
Many countries have set up **national parks** and **nature reserves** within rainforest s to protect against **illegal logging**. Lack of funding can make this difficult to police but foreign governments and businesses and NGOs (WWF) can help with funding. e.g. **Norway** has paid **£1bn** into Brazils **Amazon fund** for conservation.

This is sustainable because**.....** Rainforest is protected from illegal logging

Hot Deserts have a range of distinctive characteristics

Climate

- **Very little rainfall –** less than **250mm** annually
- **Rainfall varies**, it might rain only once every three years or a little over a few months
- **Temperatures** are **extreme.** They can be **very hot** in the **day** (45^{o}C) to very cold at night (5^{o}C)



Plants

- Plant growth is **sparse**
- Many plants have a **short life cycle** only appearing after it rains
- **Cacti** and **thornbushes** are typical desert plants – they tend to be short and low shrubs due to the lack of rain

Soil

- **Dry soil** with little **organic matter**
- **Not very fertile**
- **Coarse** and **gravelly** in texture

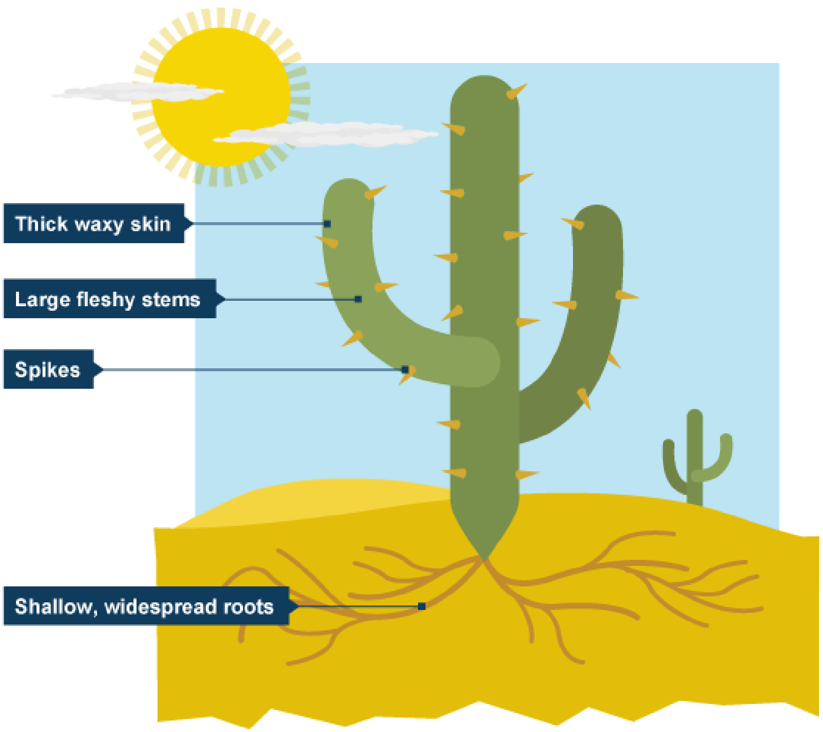
Animals

- Animals have **adapted** to the **harsh environment**
- Lots of snakes, lizards and insects
- **Mammals** tend to be small and **nocturnal** e.g. fennec fox

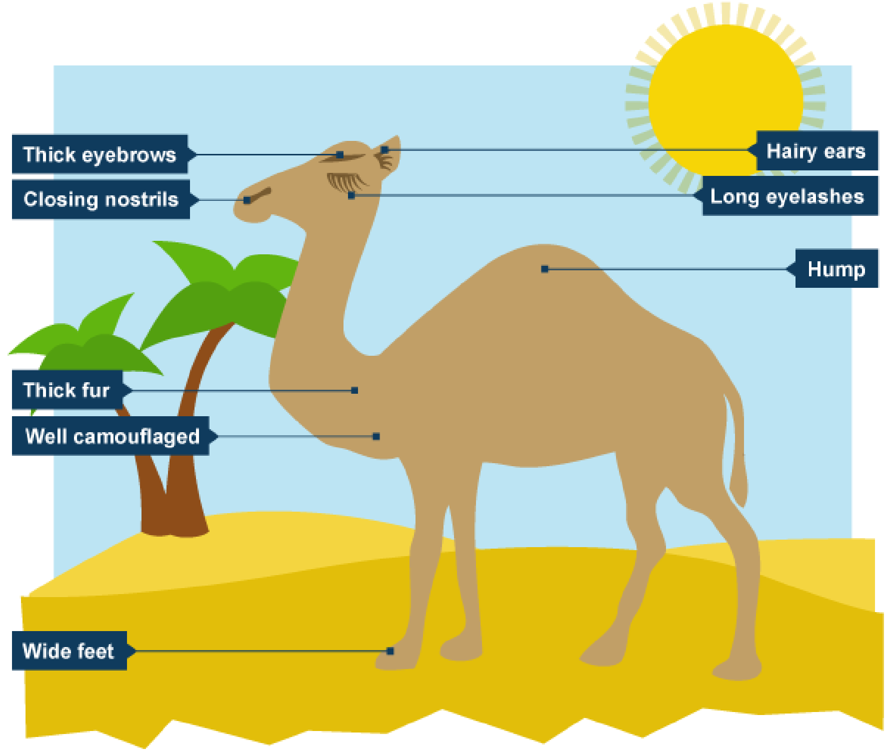
People

- Many people live in the desert despite the lack of rain
- People have **adapted** to life in the desert
- **Indigenous people** are often **nomadic** and travel in search of food and water for their herds, which are mainly goats and sheep

Hot deserts: Plant and animal adaptations



- Thick waxy skin to reduce loss of water and to reflect heat
- large, fleshy stems to store water
- thorns and thin, spiky or glossy leaves to reduce water loss
- spikes protect cacti from animals wishing to use stored water
- deep roots to tap groundwater
- long shallow roots which spread over a wide area
- plants lie dormant for years until rain falls



- long eye lashes, hairy ears and closing nostrils keep out sand
- thick eyebrows which stand out and shade eyes from the sun
- wide feet so they don't sink in the sand
- they can go without water for over a week because they can drink gallons in one go
- they can go months without food - they store fat in their humps
- body temperature can change to avoid losing water through sweating
- thick fur helps to keep them warm at night

Hot Deserts are fragile interdependent ecosystems

If the climate, soil, plants, animals or people change it has a **knock on effect** on everything in the ecosystem

- The hot dry climate makes the **soil salty** due to high evaporation.
- The soils are low in nutrients due to a **lack of organic matter** – dead plants and animals
- The sparse vegetation means animal numbers are low
- Water is scarce and quickly drains away when it rains. Animals and people have to keep moving (nomadic) to find water or dig deep wells.
- Overgrazing and over cultivation can cause soil erosion. Without plants to bind the soil the wind can blow the top soil away. The big dust clouds form reduce the rainfall further making deserts even drier

Biodiversity in the desert

Biodiversity is the variety of organisms living in a particular area – *both plants and animals*

- ✓ Hot deserts have relatively **low biodiversity** (compared with the TRF)
- ✓ The highest range of biodiversity is found in **areas with more water** - along the desert margins or areas or temporary ponds/rivers
- ✓ Biodiversity is threatened by **desertification**
- ✓ some animals are threatened with **extinction** as climate change is making some deserts hotter and drier

Desertification

The degradation of land so that it becomes more desert like, drier and less productive

Overgrazing

Too many sheep and goats will eat plants faster than they can re-grow. This leads to more soil erosion . Trampling by animals also erodes the soil

Over-cultivation

If crops are not rotated all the nutrients in the soil are quickly used up. If plants can no longer grow soil erosion will follow very quickly!

Climate change

Rainfall - climate change could reduce rainfall in the desert. Less water means that **plants will die**; Less plant roots to hold the soil together will **increase soil erosion**

Temperature - Global temperatures are expected to increase. Higher temperatures in the desert will lead to more evaporation, which will make the soil in deserts drier and saltier

Removal of fuelwood

Many people in dry areas depend on wood for cooking. Removal of the trees means less roots and more soil erosion which leads to desertification

Population growth

A growth in the number of people puts more pressure on the land, leading to more deforestation (for fuelwood), overgrazing and over-cultivation

How to reduce the risk of desertification

Water management – *growing crops that don't need much water (**millet, olives**) using drip rather than surface irrigation reduces salinization and soil erosion*

Soil management – *leaving areas to rest helps to recover **nutrients from the soil**. Rotating crops will also use up different nutrients*

Tree planting – *trees can be planted to act as windbreaks to protect the top soil being blown away in the **wind**. Also growing trees will help to bind the soil and reduce soil erosion and provide **shade** which reduces evaporation rates and reduces the need for irrigation*

Appropriate technology – using **sustainable** materials that are cheap, easy to use and easy to maintain. **Sand fences** can stabilise soil and reduce erosion. '**Magic stones**' can help with irrigation. Use of **solar cookers** to make food and so reduce the need for fuelwood.

CASE STUDIES:

1. Deforestation in the tropical rainforest
2. Opportunities and challenges in the hot desert

Deforestation is a problem in **Malaysia**, Asia and the **Amazon**, South America

Learn **EITHER** the Malaysia or Amazon case study that you completed in class to show the **causes** of **deforestation** and the **impacts of deforestation**

Opportunities for economic development exist in the hot desert but they also present challenges

Learn **EITHER** the

a) **Mojave Desert** or **Thar Desert** case study that you have completed in class **or**

b) The **Sahara** case study from the CGP revision guide

To show the opportunities and challenges of a hot desert.

Key term	Definition	Key term	Definition
Biotic	Living things e.g. plants and animals	Leaching	The draining away of water from the soil
Abiotic	Non living things e.g. soil, water, climate	Canopy	The top layer of the rainforest vegetation structure 25-40m
Producers	organisms that get their energy from CO2 & water. Plants are producers	Under canopy	The layer under the main canopy 15-20m
Consumers	they feed on other living things in an ecosystem	Shrub layer	The lowest layer of the rainforest structure 5-10m
Decomposers	organisms that break down plant & animal material; bacteria & fungi are examples of decomposers.	Climate	The average weather taken over 30 years. Temperature and rainfall
Nutrient cycling	nutrients are leached back into the soil from decaying plant & animal matter. These nutrients are then taken up by the producers & recycled into the food chain. Consumers can also eat detritus (decaying plants) and recycle nutrients that way.	Biodiversity	Biodiversity is the variety of organisms living in a particular area – *both plants and animals*
Food chain	shows the link between **producers** & **consumers.** It shows a **simple linear** series of connections.	Deforestation	Deforestation is the removal of trees from the forest. Usually by burning or cutting down
Food web	shows the connections between **producers** & **consumers** in a more detailed way. A food web is made up of lots of food chains and is more complex.	Indigenous	Local people
Evergreen	A plant/tree that retains its leaves throughout the year	Nomadic	People that move around. Usually to look for food and water
Deciduous	Shedding its leaves in winter	Nocturnal	Sleep in the day. Feed and hunt at night
Emergents	The tallest trees in the rainforest that breakthrough the canopy layer 50m+	Desertification	The degradation of land so that it becomes more desert like, drier and less productive