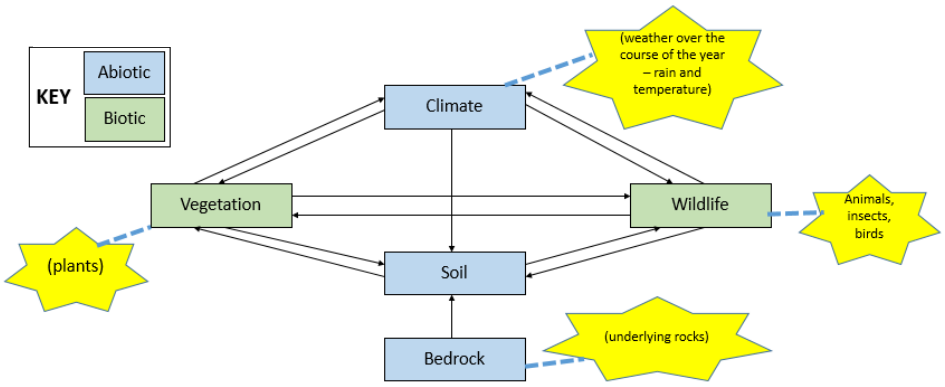
Geography Revision Guide: The Living World (Ecosystems)

1. What is an ecosystem?

An ecosystem is community of plants and animals living together in a habitat. The lives of the plants and animals are closely linked to each other and the climate and soil of the area that they live in.



2. What are the components of an ecosystem?

See the diagram top right. Biotic means living; abiotic means non-living. There are interrelationships between the different components.

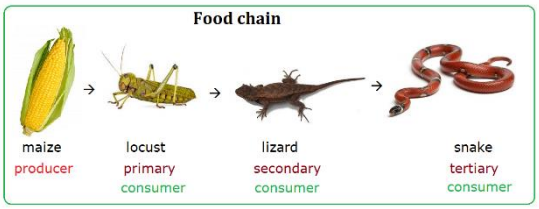
3. What ecosystem key terminology do I need to know?

See the table on the right.

Food web	A complex hierarchy of plants and animals relying on each other for food.
Food chain	The connections between different organisms (plants and animals) that rely upon one another as their source of food.
Producers	An organism or plant that is able to absorb energy from the sun through photosynthesis (making sugars). It also needs water, carbon dioxide and nutrients from soil/rock to produce what it needs for itself.
Ecosystem	A community of plants (flora) and animals (fauna) that interact with each other (living components/biotic) and their physical environment (non-living components/abiotic, e.g. temperature, rainfall, soil, water, and light).
Consumer	Creature that eats herbivores and/or plant matter. They obtain the energy from what they eat, e.g. if they eat a producer they will get the sugars they made.
Decomposer	An organism such as a bacterium or fungus, that breaks down dead tissue, which effectively recycles their nutrients back to the environment.
Nutrient Cycling	A set of processes whereby organisms extract nutrients (e.g. nitrogen, potash, and potassium) necessary for growth from soil or water, before passing them on through the food chain – and ultimately back to the soil and water when they die.

4. How do food chain work?

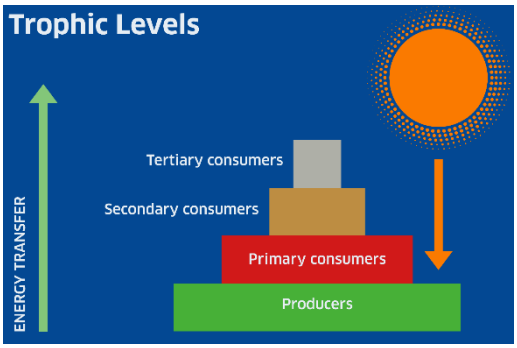
As suggested in the table, plants are 'producers'. These are eaten by 'consumers', specifically, herbivores (plant eaters – e.g. cows). Herbivores are eaten by carnivores (meat-eaters). Some animals are omnivores (eat plants and animals – like a fox).



5. What are the interrelationships between the feeding groups in the food chain?

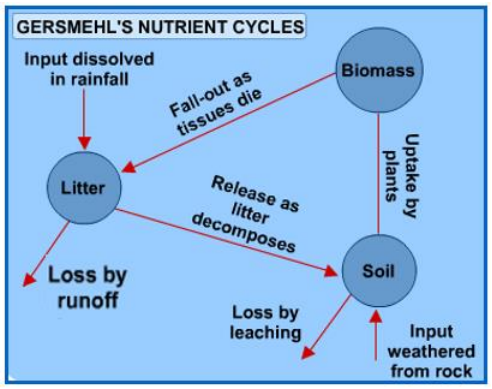
If you look at the diagram on the right, the biomass (weight of living material) decreases at each stage of the food chain. Why?

- Respiration (energy used just to stay alive, rather than add biomass - energy expended hunting/ searching for food
- Animals don't eat 100% of their prey – bones etc.
- Excretion



6. What is the function of decomposers?

You can see the definition in the table above. Decomposers (such as scavengers like vultures or detritivores, such as bacteria) operate at all stages of the food chain when animals die. They are important as they recycle nutrients and put them back into the soil.



7. In Q6, I mentioned recycling – how can this cycle be shown as a diagram?

The diagram on the right shows the nutrient cycle. It shows the three components of the nutrient cycle: soil, biomass and litter (dead leaves). This shows how ecosystems have interrelationships – the links show how they are

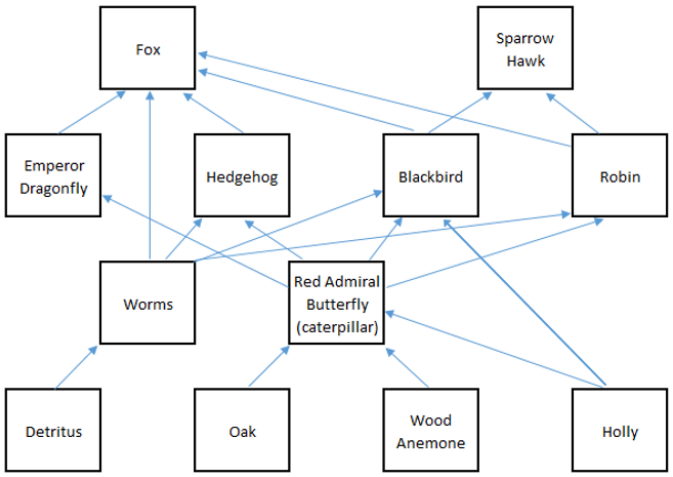
reliant on each other. Changes to one component can cause significant problems to the cycle. For example, in a rainforest – cut down the biomass, which then means the litter is exposed to the rain. The litter is then washed away before being decomposed, so the nutrients are not returned to the soil. The cycle can therefore break down.

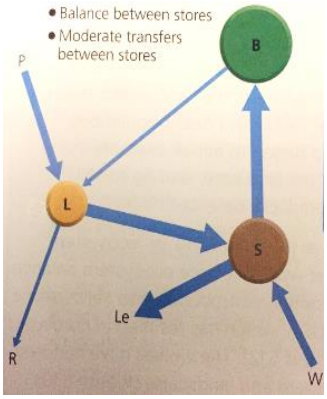
8. An example of a small-scale UK ecosystem: Frendstaple Wood

Frendstaple Wood is located in Waterlooville in Hampshire. In fact, it is just outside of the perimeter of our school fence. It is a temperate deciduous woodland, with some coniferous trees. The woods have a distinct structure to them:

- Large trees – Oak, Ash
- Shrub layer (about 5 metres high or lower) – Holly, Hazel
- Field layer – grasses, Bracken, Wood Anemone
- Wood floor – mosses, lichens

The food web (complex interactions of food chains) is shown on the right.





Frendstaple Woods are managed by 'The Woodsedge Waders'. They meet at 10am on the second Sunday of every month. The perform tasks such as clearing vegetation from the paths, removing litter and clearing the ponds that are present in the woods.

The interrelationships in the woodland really comes from the annual cycle of the seasons. Most of the trees are deciduous, so lose their leaves in winter to conserve their energy. In the spring, new broad leaves grow to maximise the food production from photosynthesis during the summer months. By autumn, the woodland floor is covered by a thick layer of leaves. However, this will have disappeared by spring due to the decomposers and detritivores. Nutrients will then be stored in the soil as humus ready to support the new season's plant growth. Crucially, the new season's growth will include leaves and things like berries, which in turn will provide food for the primary consumers. These will then provide food for the secondary and tertiary consumers.

9. Changes in ecosystems – impacts and how to deal with it.

Ecosystems can change due to the following:

- Drought
- Huge storms (e.g. UK 1987)
- Natural fires
- Disease killing some animals
- Also, human changes can exert an influence too – deforestation, climate change.

These can cause significant problems for ecosystems as flora and fauna struggle to adapt.

Changes suggested above can mean that certain species die out. For example, look at the species for Frendstaple Wood – what would happen is foxes were removed? What would happen if the caterpillars were removed?

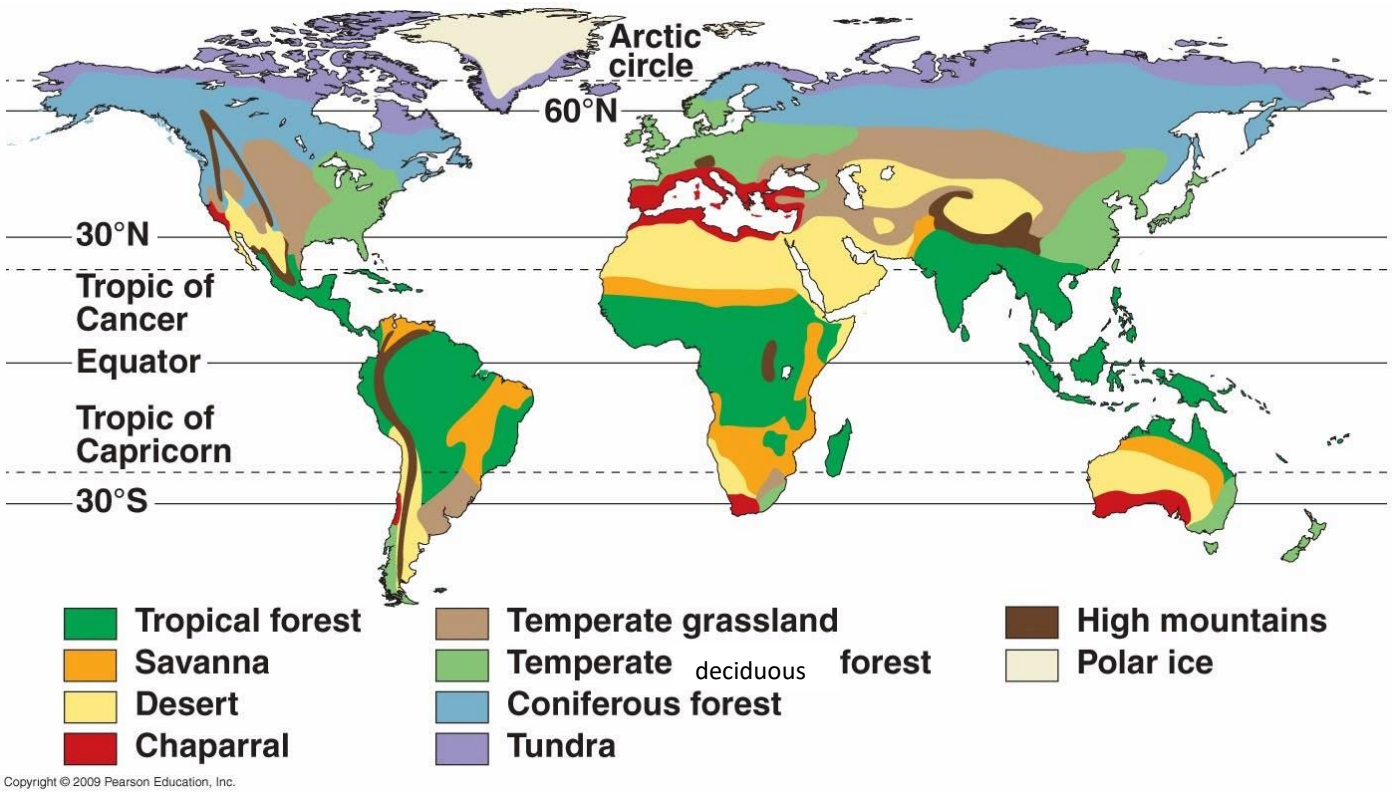
In some ecosystems, humans have introduced predators to try to encourage balance – e.g. Wolves in Yellowstone, USA. Elk have been killed by the Wolves which has reduced grazing and other species have also prospered.

10. What are the large-scale ecosystems called?

Biomes

We live in the Temperate Deciduous Woodland biomes (e.g. like Frendstaple Wood)

11. What are the biomes like?



Tropical Rainforests – near the equator. High temp and rainfall. 50% of the World plants and animals come from the rainforest. Large, tall trees.

Temperate deciduous woodland – 50-60° N/S of the equator. Shed leaves in winter. Large, broad leaves to maximise photosynthesis in summer.

Temperate grassland – 30-40° N/S of the equator. Warm, dry summers and cold winters. 'Prairies' in USA and 'Steppes' in Eastern Europe.

Tundra – From Arctic circle to about 65°C N of the equator. Low growing plants that can tolerate cold. Very fragile ecosystem – found in mountain areas too.

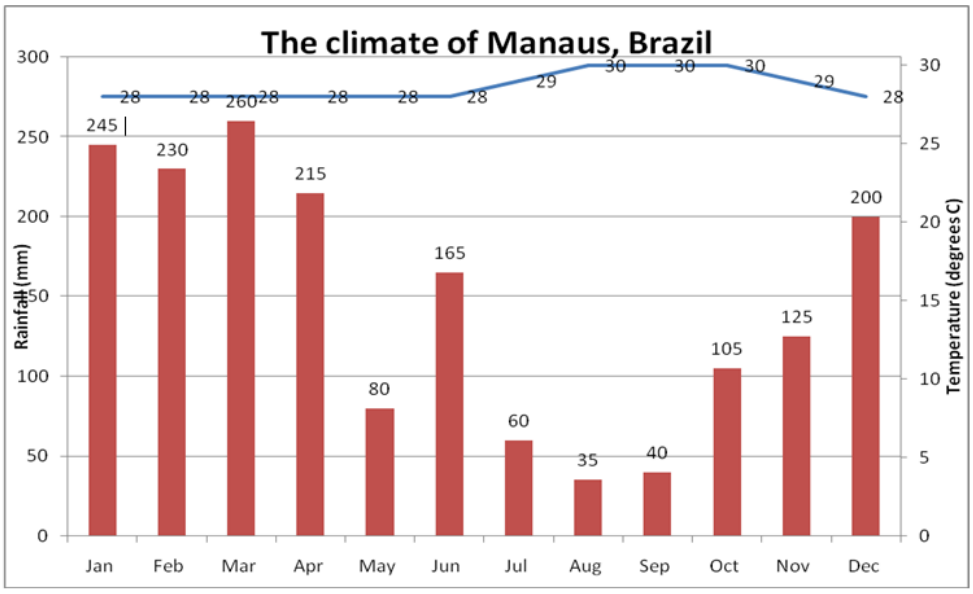
Desert - 30°N & S of the equator. Covers 20% of land surface along the sub-tropical high pressure belts. High temperatures during the day and cold at night. . Low rainfall. Plants have to adapt.

Tropical grassland (Savanna) – 15-30° N & S of the equator. Tropical climate with wet & dry seasons. Very dry + fires, but violent thunderstorms at other times. Lions, Zebra etc.

Coniferous forests - 50-60° N/S of the equator. Trees are cone-bearing and retain their leaves all year. Conifers, with their needles, are better suited to colder conditions than deciduous trees.

Mediterranean/ Chaparral – 40-45°N of the equator. Also found in some parts of Australia. Hot, sunny, dry summers. Trees such as olives, lemons and oranges.

Section B – Tropical Rainforests



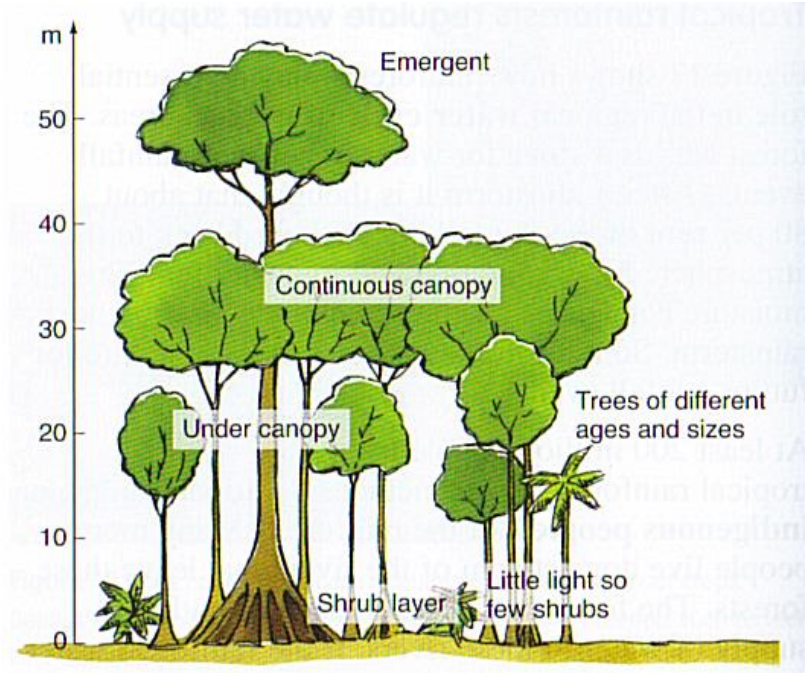
12. What are the physical characteristics of the rainforest?

A). **Climate** – look at the graph on the right. Hot all year (average 27°C) & over 2000mm of rain per year. There are wetter periods and drier periods. It is wet when the equatorial low pressure is directly overhead; it is dry when the equatorial low pressure migrates north.

LOOK AT THE BIOME MAP TO SEE WHERE THEY ARE LOCATED.

B). **Soils** - Deep 20-30 metres, red/brown in colour due to the presence of iron oxide (rust if you like). Soils are actually very poor. Soils in rainforest are called LATOSOLS. Leaching is why the soils are poor: heavy rain means that nutrients are washed away from the soil.

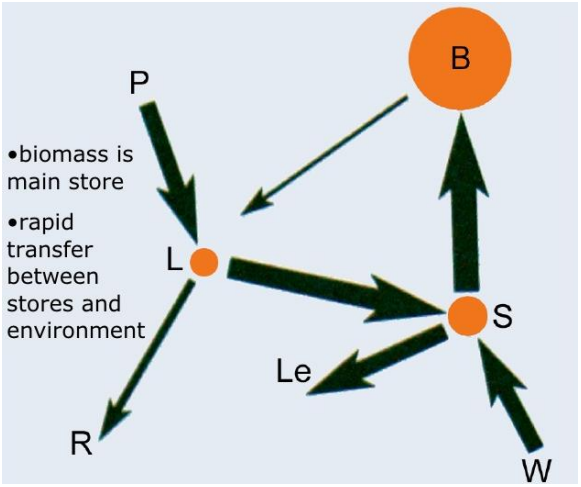
C). Vegetation – There is an incredible amount of biodiversity in the rainforest. There are distinct layers in the rainforest. See diagram below:



What sort of adaptations have plants made in rainforests?:

- Fast growing to get to light – tall
- Drip tip leaves to get rid of water
- Buttress roots – help support tall trees
- Thin, smooth bark – allows water to soak down
- Epiphytes – live high on branches to allow them to get to sunlight
- Lianas – creepers rooted in the ground, but cling to trees
- Leaves are broad on floor to maximise capture of sunlight

Nutrient cycling is rapid, so roots are dense and often above ground to take nutrients directly from decomposing litter.

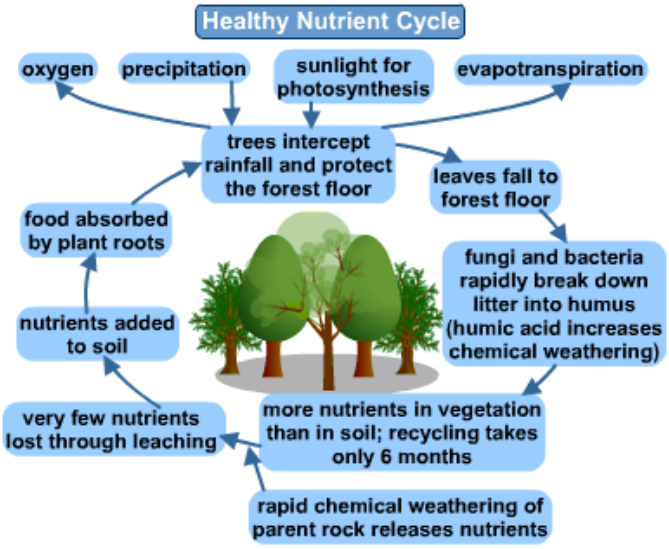


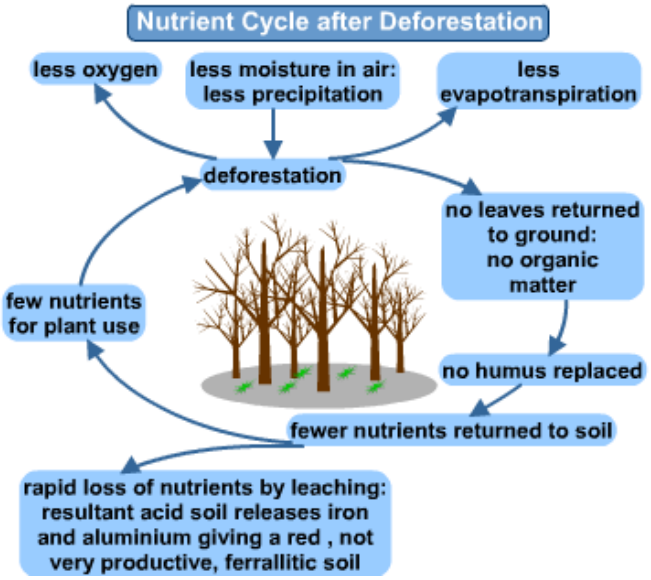
13. How is the climate, water, soils, plants, animals and people interdependent in the rainforest?

In Q7, I showed you a nutrient cycle diagram. It has three components: biomass, soil and litter. In a rainforest, the components are not equal – see diagram on the right (W=nutrients from weathered rock, Le=leaching, R=runoff, P=precipitation).

Most of the nutrients are stored in biomass. Soils are actually nutrient-poor, hence the small circle. Litter is very small too – this is because the humidity and heat in the rainforest ensures that there is rapid decomposition of the leaf litter.

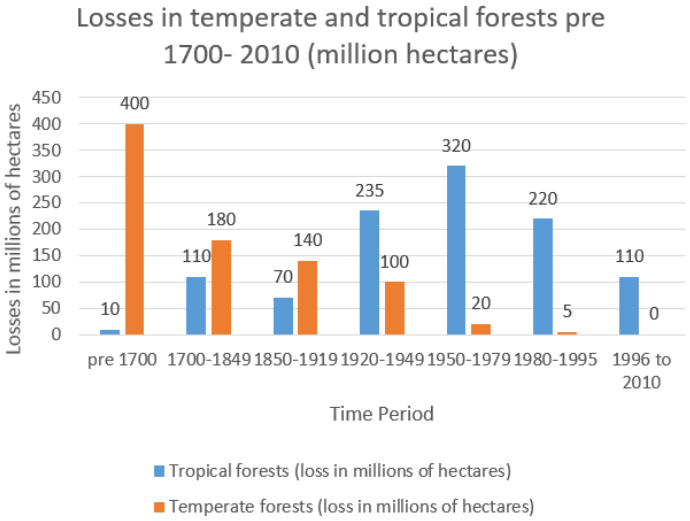
14. How can this cycle be interrupted by humans?





Cut the trees down and the litter and soils and left exposed to the heavy rainfall. The nutrients are therefore lost as runoff/leaching. As the soils are actually nutrient-poor, this means that they forest will not grow back. The damage has been done… Rainforests are actually quite fragile and any changes can cause issues with BIODIVERSITY. This is the measure of the variety of plants and animals in a particular ecosystem. Deforestation destroys habitats and therefore reduces biodiversity.

15. How much deforestation is occurring?



If you look at the graph, deforestation increased during the 2nd half of the 20th century, but it has started to decline, probably due to the raising of awareness of the issues associated with deforestation. However, deforestation is still a problem as countries try to gain income from their natural resources.

16. A case study of a tropical rainforest: Amazon

Causes of deforestation in the Amazon

- Logging – only about 3%, which is very small! Loggers are after Teak and Mahogany (for furniture) – this is called **selective felling**, whereas widespread logging is called **clear felling** (wood for paper, fuel etc.).

- Mineral extraction – mainly gold in the Amazon. 50,000 hectares in the Amazon are used for this. Other minerals such as bauxite (for aluminium) are mined too which creates huge scars on the landscape.
- Energy development – Hydro-electric Power (HEP). Dams flood vast areas of forest. They get clogged up with sediment due to the high rainfall.

- Farming: cattle – About 80% of deforestation in the Amazon is for this. The land is not good for long, so farmers move on to another area, causing further deforestation.
- Farming: crops – forest is cleared for plantations (bananas, palm oil etc. As above, the soils degrade quickly and more trees are cleared for new farmland.
- Subsistence farming: this is where traditional farming methods are employed (slash and burn to clear a small section of forest and the burning provides nutrients in to the soil). After a while, the farmers move on to another plot – this is called shifting cultivation. This gives the original plot time to recover and the farmers might come back to it in about 20 years. This does damage the forest, but not to the same extent as the other activities described here.

- Road building: these are built to get equipment in for farming, HEP, logging etc. These then allow more people in to the forest to exploit them as there is better access. The Trans-Amazonian Highway is 4,000km long and was started in 1972.
- Settlement/ population growth: The activities described above require workers (and their families), which means forest are cleared for settlements.

Impacts of deforestation in the Amazon

Global	Local
👎 **Global warming – reduced ability to absorb CO2. Fore used for clearing releases carbon stored in trees into the atmosphere too.** 👎 **Loss of biodiversity – some species could become extinct. By 2030, the Amazon could lose about 30-45% of its species.**	Less trees = less evaporation. This reduces rainfall locally. See Q14 on how a deforested area loses its soils etc. Decline of indigenous tribes – they are about 240 Amazonian tribes left. This is reducing due to the activities discussed above. However, about 1 million live in the rainforest still.

It is worth noting that the activities can lead to economic development, so it is not all bad! However, how sustainable is using the Amazon rainforest in the way that they have?

17. Why should rainforests be managed sustainably?

- 👍 Medicine – 25% of medicines come from the rainforest – cures for diseases could still be in there that we haven't found yet.
- 👍 Climate change – discussed in the table above. 28% of oxygen comes from the rainforest
- 👍 Water 0 20% of fresh water comes from the Amazon.
- 👍 Biodiversity – 50% of World plants and animals come from the rainforest
- 👍 Wood, crops, wild meat and fish

18. How can rainforests be managed sustainably?

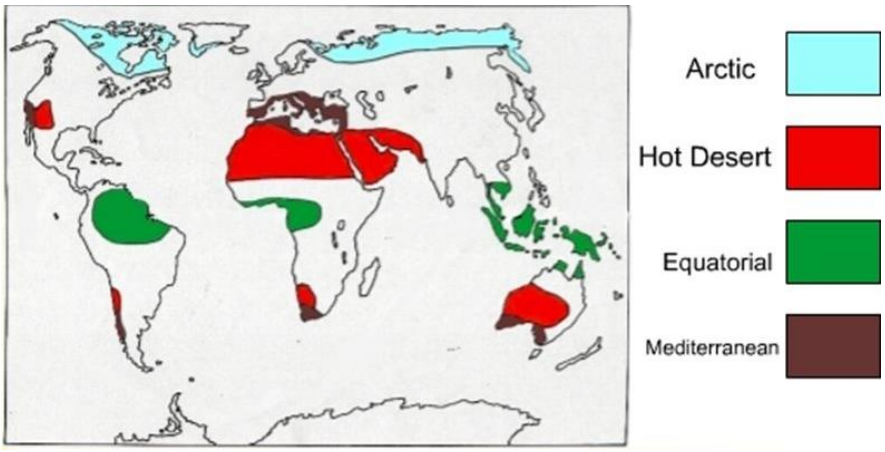
- ❖ **Selective logging** – only cut down the valuable trees that you really want. As vast areas have not been destroyed, tress can be replanted and can be returned to in about 40 years time – i.e. a cycle
- ❖ **Conservation and education** – National Parks and nature reserves used for research, education and scientific research

- **Ecotourism** – Small scale tourism that does little damage. Often expensive. Key is that involves local communities and they receive a share of the profits. People pay to come and see the rainforest, so locals understand the importance of it. As a result, it is preserved and logging doesn't take place.
- **International agreements** – Pressure is put on countries with rainforests to preserve them (biodiversity, climate change etc.).
- **Debt reduction** – many countries got in to debt in the 1970s and can't afford to make the repayments (see Development topic). Often, countries would cut down trees to enable economic activity to take place to repay these debts. The richer countries (who the money is owed to) reduce the amount owed in return for an agreement that guarantees that rainforest is not destroyed. This is called 'debt for conservation swapping'.

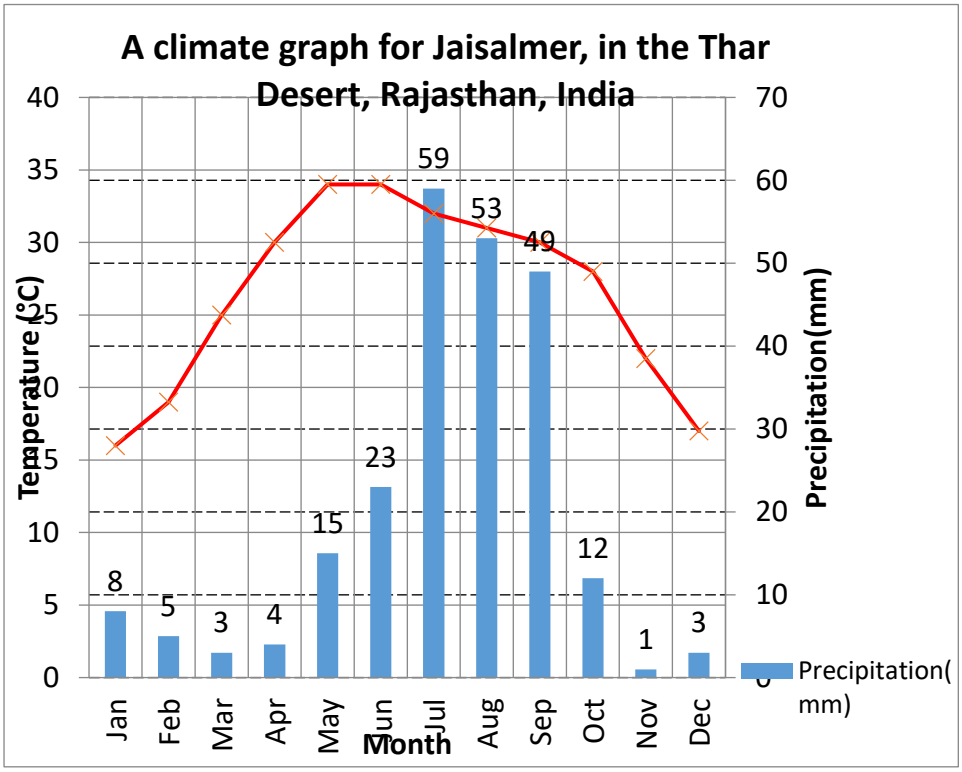
HOT DESERTS

19. What are the physical characteristics of hot deserts?

A desert is an area that receives less than 250mm of rainfall per year. Day to night temperatures can fluctuate dramatically from 50°C in the day to below 0°C at night due to the lack of cloud cover (extension- this is called a high diurnal temperature range). Dryness and aridity is the main factor controlling life in the desert.



See the Hazards revision guide which discusses the global atmospheric circulation model. At 30°N and S of the equator air that rose at the equator descends and therefore creates high pressure. This means that there is a lack of cloud and therefore rainfall. Also, no cloud cover at night explains why deserts can become very cold.



Climate

If you look at the graph, temperatures remain high (red line) for the majority of the year and rainfall is low (blue bars) – 59mm on this graph is not very high!

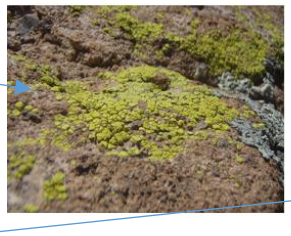
Soils

Soil-forming processes are limited by the shortage of water and vegetation. Over time, weathering creates deep deposits of sand and loose material. There may be little organic content due to lack of vegetation. These sandy, rocky soils are typically around one metre in depth, although in some place, the wind action can make them much deeper

20. How have plants adapted to the desert environment?

Saguaro cactus - Spines to discourage animals from eating plants for water. Plants can store water in their stems or leaves - these are called succulents.

Lichens appear as a flaky crust on the ground. They don't need soil to grow – called pioneer species. They break down rock chemically with their own organic acids to extract nutrients.



Ephemerals - Short life cycles. Some plants germinate in response to rain, grow, flower, and die within one year (ephemerals). These plants can therefore avoid drought.

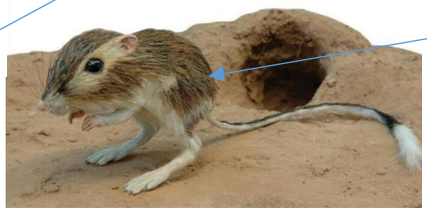
Many plants **have long root systems** spread out wide or go deep into the ground to absorb water (e.g. **Acacia tree** has roots that can penetrate 50m – they are also fire-resistant).

21. How have animals adapted to the desert environment?

Arabian camel - Store water in hump – tolerate body temperatures of 40 degrees C. Large flat feet to walk on sand. Two rows of eyelashes to keep out sand

Peringuey's adder - Slide sideways to minimise the contact with the ground

Kangaroo Rat - Do not drink water – get it from food. Live in burrows – escape heat. Efficient kidneys that don't produce urine. Don't perspire

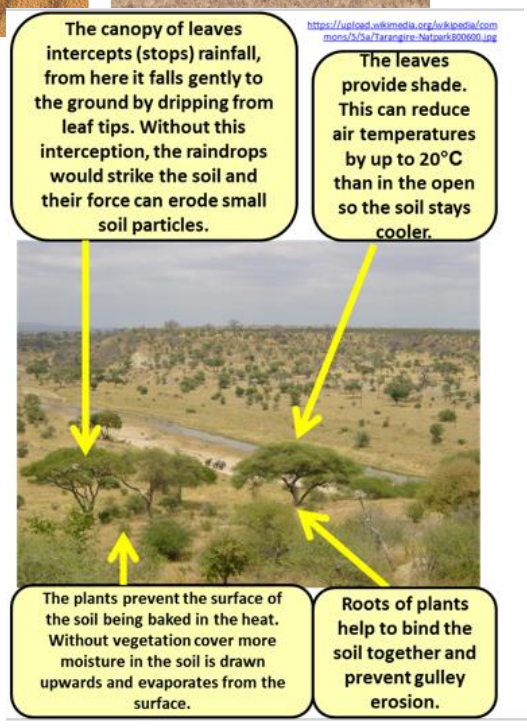


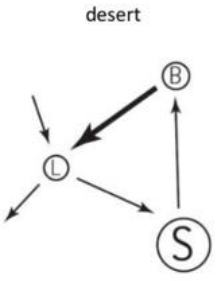
Cottontail rabbit - Nocturnal – sleep underground during the day

Bat-eared Fox - Large ears – maximise heat loss. Large surface area to volume

22. How are the deserts interdependent?

The living things that inhabit hot deserts are linked to each other and their physical environment. Many of the elements of the biome are interdependent upon one another. People are dependent upon their animals in deserts, for food, milk and as use as pack animals. The diagram on the right shows the link between the different stores of nutrients and how the components are connected.

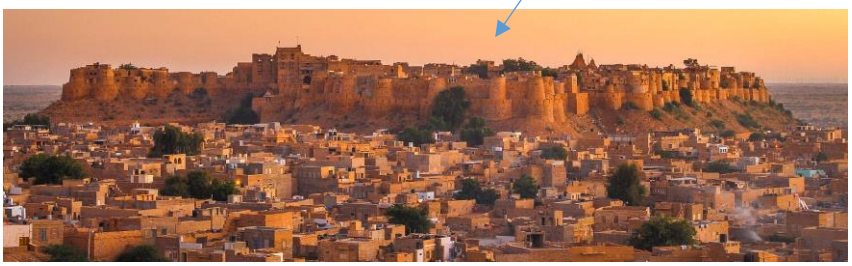




- *Soil is the main store*
- *Slow rate of nutrient transfer between stores (except for the transfer from biomass to litter)*

23. A case study of a desert environment – the Thar Desert

The Thar desert is found in NW India and into Pakistan. It is about 200,000km^2. It is the most densely populated desert in the World. See the climate graph in Q19, which is for Jaisalmer, which is in the Thar Desert.



What are the development opportunities in the Thar Desert?

Land use	Development Opportunities
Tourism	- Attractive landscape - Thousands visit the desert each year (many from Pakistan) - Camel safari - Desert festival is held each year in winter - Local people work as guides and look after the camels. Act as guides
Farming and agriculture	- Subsistence farming - Grazing animals on the grassy areas and cultivating vegetables and fruit trees - Commercial farming has grown in recent decades (due to irrigation – Indira Ghandi canal) - The creation of the Canal in 1958 has revolutionised farming and crops such as wheat and cotton now thrive in an area that used to be poor desert - Other crops grown under irrigation such as maize and mustard
Energy production	- Coal extensive lignite coal deposits and a thermal energy plant has been constructed at Giral - Oil – a large oilfield has been discovered in the Barmer district - Wind – the Jaisalmer wind park was constructed in 2001 (India's largest wind farm) - Solar – the Thar desert offers ideal conditions for solar power
Mineral extraction	- Gypsum (used in making plaster), feldspar (used to make ceramics), phospherite (used for making fertilisers), kaolin (used as a whitener in paper),limestone (used in steel industry), marble (construction industry)

What are the challenges of living in the Thar Desert?

EXTREME TEMPERATURES - See the climate graph! Extreme temperatures! Difficult to work in the heat of the day. High rates of evaporation leads to water shortages. Cattle and goats need protection from the Sun.

WATER SUPPLY – High population and climate has lead to water shortages. Water has been stored in ponds (some man-made). There aren't many rivers, and even those have intermittent flow (not all the time). Some water is stored underground in the rocks, but is not great quality. The INDIRA GHANDI CANAL improved the situation. This was built in 1958 and transported water to the desert. Jaisalmer benefitted greatly. Farmers have used the water for irrigation and has allowed crops such as wheat and cotton to be grown. People obtain drinking water from the canal.

ACCESSIBILITY – Limited road network and tarmac can melt. Sand is blown over the roads. Public transport is not great.

24. What are the causes of desertification?

Desertification – The process by which land becomes drier and degraded, as a result of climate change or human activities, or both.

- Natural: droughts – climate change?
- Human: poor land management – over-grazing/ cultivation. Often due to increasing population (too much farming – crops and livestock). Removal of vegetation leads to soil erosion – often for fuelwood (rising population).

Areas on the fringes of deserts are particularly vulnerable.

25. How can desertification be reduced?

Tree planting – roots bind soil together. In the Thar desert, they plant Prosopis cineraria. Also provide shade, fuel and food.

Appropriate technology – Efficient stoves (instead of burning lots of wood) and things such as solar power for electricity for cooking. Contour stones lines are built that stop water and soil washing down the slope – easy to do and can use local materials.

Water and soil management – see contour stone lines above. The water trapped can then be used for irrigation. Too much underground water contains salts and can cause salinization of soils, so water is stored above ground.

The use of **stone lines** to limit water and soil losses