

Geography – Ecosystems

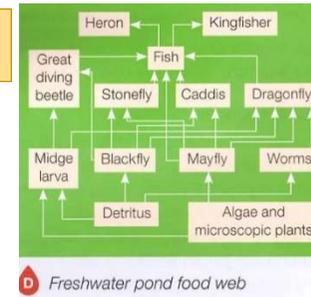
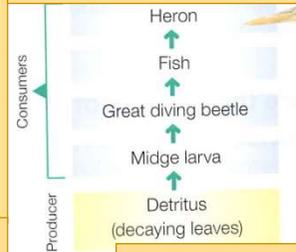
Ecosystem

- An **ecosystem** is a complex natural system made up of plants, animals and the environment.
- They occur at different scales from small (pond, woodland) to global (tropical rainforest).
- Global-scale ecosystems are called **biomes**.
- Within an ecosystem there are **interrelationships** between biotic (plants, animals) and abiotic (climate, soil, light) factors.

Producer	(e.g. plants) They convert energy from the Sun by photosynthesis into carbohydrates (e.g. sugars) for growth.
Consumer	(e.g. cow) They get their energy from eating producers, creating direct links within ecosystems and more complex food webs.
Decomposer	(e.g. bacteria and fungi) Dead plant and animal material is broken down by decomposers to add to nutrients within the soil
Food chain	Connections between producers and consumers in a simple line.
Food web	A complex hierarchy of plants and animals relying on each other for food. When all the food chains in an ecosystem are joined up together, they form a food web.

These nutrients are then used by plants in a process called **nutrient cycling**.
Sources of nutrients: rainwater washes chemicals out of the atmosphere, weathered rock releases nutrients into the soil.

Small scale UK ecosystem A freshwater pond ecosystem



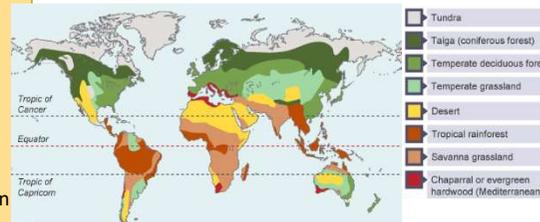
Species	Energy source
Frog tadpole	Microscopic plants, algae, midge larvae
Algae	Sunlight
Sticklebacks	Tadpoles, young fish, water fleas, beetles
Heron	Fish, frogs and tadpoles, larger insects
Perch	Small fish (e.g. sticklebacks), beetles, water fleas

The distribution of global ecosystems

Biomes are defined by the main type of vegetation that grows in the region. They form **broad belts** from west to east, parallel to lines of latitude. This is because the climate and characteristics of ecosystems are determined by global circulation. Variations in these belts of vegetation are due to:

- Ocean currents, winds, the distribution of land and sea**

These factors produce small variations in temperature and moisture which in turn affect the ecosystems.



How does change affect ecosystems?

Causes

Can take place on global-scales, e.g. climate change and local-scales, e.g. changes to a habitat.

Natural changes: Extreme weather events light droughts can be devastating to ponds and lakes.

Changes due to human activities:

- Agricultural fertilisers can lead to eutrophication (nitrates increase growth of algae, deplete oxygen and fish die)
- Ponds may be drained to use for farming
- Woods cut down affecting nutrient cycling

Wolves in Yellowstone National Park

Wolves absent (70 y) then **reintroduced in 1995**
Number of packs increased 3-16 (1995-2004)

Short term impacts

- Elk and coyote population declined because elk are the prey of wolves

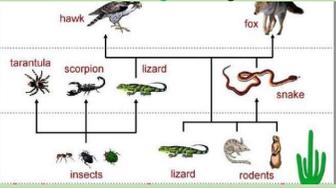
Long term impacts

- Encouraged elk to search for food widely, less pressure on willow trees by river
- Beavers have more willow to create dams
- Increased beaver numbers and creation of new marsh habitats, attracting new wildlife such as fish and wading birds

The characteristics of global ecosystems

Biome	Location	Climate	Vegetation	Soil
Tropical rainforest	23.5° N'S	<ul style="list-style-type: none"> Hot and wet all year Around 12 hours of sunshine all year round 	<ul style="list-style-type: none"> Almost all plants are evergreen Plants grow quickly and are adapted to maximum light. Dense vegetation provides food and habitats for many animals. 	Poor soils as nutrients are rapidly recycled as leaves decompose quickly, providing a constant supply of nutrients to the soil
Desert	15-30° N'S Belt of high pressure	<ul style="list-style-type: none"> Low rainfall (only rain once every 2 years) Very cold night temperatures and hot daytime temperatures Hot deserts get more daylight during the summer than the winter. Little cloud cover because they get lots of sunshine during the day. 	<ul style="list-style-type: none"> Plant growth is sparse due to limited rainfall e.g. cacti and thornbushes. Many plants have a short life-cycle and appear only when it rains. Relatively few animals species, those that do exist have adapted to the harsh climate including scorpions, lizards, snakes and insects. 	Sparse vegetation means there is little leaf litter and high temperatures mean it is slow to decompose, leading to soils being thin and nutrient-poor.
Temperate forests (D & C)	40-60° N'S	<ul style="list-style-type: none"> High rainfall and mild-temperatures. 4 distinct seasons Warm summers, cool winters. Days shorter in winter, longer in summer Rain throughout the year 	<ul style="list-style-type: none"> Fewer plant species than tropical rainforests. Made up of broad-leaved trees that drop their leaves in autumn e.g. oak, shrubs Mammals such as foxes, squirrels and mice, birds and insects. 	Plants lose their leaves in autumn, and leaf litter decomposes quickly, so soils are nutrient-rich and relatively thick.
Temperate grassland	40-60° N'S	<ul style="list-style-type: none"> Hot summers and very cold winters, light varies throughout the year. Quite low rainfall. 	<ul style="list-style-type: none"> Mainly grassland vegetation. Rainfall is too low to support large plants, so few trees. Home to fewer species than tropical grasslands. Mammals include bison and wild horses and rodents such as mole rats. 	Decomposition happens quickly in summer due to high temperatures. So soils are relatively thick and nutrient-rich.
Mediterranean	30-40° N'S (WC)	Hot, dry summers and warm, wet winters	Mainly scrub vegetation – plants adapted to summer drought.	
Savanna	Within tropics. Mainly between 5° and 15° N'S	<ul style="list-style-type: none"> Lots of sunshine, relatively low rainfall Hot with a wet and dry season. Fires in dry season. Temperatures are highest before wet season and lowest just after it. 	<ul style="list-style-type: none"> Mainly grass, scrub, small plants and a few specially adapted trees e.g. acacia. These plants are adapted to recover quickly after a fire. Many species of insects. Large mammals e.g. lions, elephants, zebras. 	Thin, nutrient-rich soil formed as the grass dies back or burned during the dry season. Nutrients washed out (leached) during wet season.
Tundra	Above 60°N in N Europe, Alaska, Russia.	<ul style="list-style-type: none"> Below freezing for most of the year. Summer 5-10°C, winter -30°C. Low precipitation, light snow Continuous sunlight in summer, and little or no sunlight in winter. 	<ul style="list-style-type: none"> Vegetation includes mosses, grasses and low shrubs. Few species of animals. E.g. Arctic hares, Arctic foxes and birds. Some animals migrate south during the winter. 	Soil is thin and nutrient-poor. Below the soil surface, there is a layer of permanently frozen land (permafrost).
Polar	Arctic, Antarctic	Very cold all year round.		A permanent or semi-permanent layer of ice.

The characteristics of Tropical rainforest

Location	Climate	Vegetation	Animals	Soil
A broad belt through the Tropics, between the latitudes of 23.5°N (Tropic of Cancer) and 23.5°S (Tropic of Capricorn). They are found in continents such as South America, Asia, Africa and Australia, specifically countries such as Brazil, Congo, Indonesia, Peru and Columbia.	<ul style="list-style-type: none"> Temperature: It is high and constant throughout the year, averaging about 27°C. This is because the powerful Sun is overhead for most of the time, so it receives a lot of insolation. Precipitation: The rainfall is high with over 2000mm per year. This is because global circulation causes an area of low pressure to form at the Equator. The rising air creates clouds and triggers heavy rain. This rainfall varies throughout the year, with a distinct wet season lasting about six months. This is due to a period of intense rainfall when the equatorial low-pressure area is directly overhead. Humidity: The humidity level is very high, averaging around 80%. This is because of evapotranspiration, which is the combined evaporation of water to gas and transpiration, which is the release of water out of the leaves of plants that occurs during photosynthesis. 	<ul style="list-style-type: none"> Emergent layer: the tops of the highest trees Canopy layer: the branches and leaves of most of the rainforest's trees. This is the layer in which the largest number of rainforest species are found Understory layer: small trees and shrubs that are able to live in low-light conditions Forest Floor layer: the dark, damp ground layer, where the rainforest's largest animals are found <p>ADAPTATIONS:</p> <ul style="list-style-type: none"> Buttress roots – big ridges at base of trunks to help support the tall trees allowing them to grow taller, and increased gas exchange (SA). Smooth bark – water can flow down easily Flexible leaves – turn to face sun, maximise photosynthesis Fast growing trees – compete for sunlight Drip tip leaves – heavy rainfall doesn't damage leaves Lianas – woody creeper plants grow up other trees and carried to canopy Epiphytes – live on branches and receive their nutrients from the air 	<p>ADAPTATIONS</p> <ul style="list-style-type: none"> Sloth – camouflage and moves very slowly to make it difficult for predators to spot Spider monkey – long strong limbs help climb through forest Flying frog – webbed feet and hands allowing it to glide between the plants Toucan – long large bill allows it to reach and cut fruit from branches that are too weak to support its weight Poison dart frog – toxic glands and warning colouration 	<ul style="list-style-type: none"> Heavy rainfall can quickly dissolve and carry away nutrients. This is called leaching. It leaves behind an infertile red, iron-rich soil called latosol. It is a huge system of nutrient cycling that allows the vegetation to grow. As vegetation dies it is quickly decomposed by insects, bacteria and fungi. This releases nutrients into the surface of the soil which is taken up quickly by the plants.

MALAYSIA

Basic info: Southeast Asia, Peninsular Malaysia and East Malaysia (part of island of Borneo), 67% land tropical rainforest

Logging	Road building	Energy development	Mineral extraction	Population pressure	Commercial farming	Subsistence farming
1980s – became worlds largest exporter of topical wood. This has led to total destruction and clear felling.	Roads are constructed to provide access to mining areas, new settlements and energy projects. Logging also requires road construction to bring in machinery and take away the timber.	The Bakun Dam: the reservoir flooded over 700km ² of forests and farmland, several more dams are planned to boost electricity supplies.	Very common in Peninsular Malaysia, rainforest cleared for mining and road construction. Drilling for oil and gas has recently started on Borneo.	Poor urban people were encouraged by government to move to countryside – transmigration. Between 1956-80 15000 hectares rainforest felled for settlers.	Malaysia is world's largest exporter of palm oil in the world. 1970: large areas of land converted to plantations, and owners receive 10-year tax incentives, so increasing amounts of land have been converted.	Tribal people use method of 'slash and burn' to clear land for agricultural purposes. These fires can grow out of control, destroying large areas of forest

Economic development

Economic gains	Economic losses
Development of land for mining, farming, energy → direct (construction and farming) and indirect (supply and support industries) employment	Pollution of water sources and increasingly dry climate may result in water shortages
Companies pay taxes → improve public services	Fires cause harmful pollution – burn out of control – destroying vast forest areas
Improved transport infrastructure → new areas for industrial development and tourism	Rising temps could devastate some forms of farming e.g. tea, fruit, flowers
Products such as oil palm provide raw materials for processing industries	Plants that bring huge medical benefits and profits may become extinct
Hydroelectric power → cheap plentiful energy	Climate change may have economic costs as people must adapt to climate
Minerals like gold are very valuable	Number of tourists attracted decrease

Impacts of deforestation

- Soil erosion** – The roots of trees and plants bind the soil together, so deforestation means that soil can easily become loose and erode away by wind and rain
- Loss of biodiversity** – Rainforests are the most biodiverse ecosystems in the world, deforestation destroys ecosystem and habitats, e.g. the Main Range (upland region and largest area of continuous forest left) has over 600 different species
- Contribution to climate change** – Trees give off moisture by the process of transpiration; deforestation reduces the moisture in the air resulting in a drier climate. The process of evaporation uses up heat and cools the air; if trees are cut down, this cooling ceases and temperatures rise. They are also carbon sinks.

Why should tropical rainforests be protected?

- Biodiversity** – They contain half of the world's plants and animals, so are home to thousands of different species.
- Climate change** – They absorb and store CO₂ since they are carbon sink, so reduce CO₂ concentrations in atmosphere
- Climate** – 28% of world's oxygen comes from the rainforests, they prevent the climate from becoming too hot and dry also
- Medicine** – Around 25% of all medicines come from rainforest plants, over 2000 plants have anti-cancer properties
- Resources** – Provide valuable hardwoods as well as nuts, fruit and rubber
- Water** – 20% of worlds fresh water comes from Amazon Basin
- People** – Indigenous tribes live in harmony making use of resources

Achuar people in Peruvian Amazon

This is a primitive tribe of about 11000 people that rely on the resources of the rainforest for buildings, food, and fuel. There are rich oil reserves in region, if this happens the Achuar will lose some of traditional lands. In 2012, oil company stopped their oil exploration in region.

Deforestation in Brazil

- Most deforestation involves large landowners and big companies. Most rainforest cleared for cattle ranching.
- Since 2004, rate of deforestation has fallen by 80%:
 - The Brazilian government has tackled illegal deforestation
 - Brazil is leading the world in conservation – over half of Amazon is protected
 - Committed to reducing carbon emissions
 - Consumer pressure not to use products from deforested areas

How can rainforests be managed sustainably?

Method	How it helps to manage the environment
Selective logging and replanting	<ul style="list-style-type: none"> The most damaging form of deforestation is clear felling, selective logging is more sustainable Low volume of high-quality trees removed whilst maintaining the structure and canopy of the rainforest E.g. Malaysia's Selective Management System means that rainforest is allowed 30-40 years to completely recover before the felling cycle begins again Road building, hard to manage, strenuous labour, other trees can be damaged in the process because a felled tree can damage other trees as it falls, clear some forest to make way for machinery.
Conservation and education	<ul style="list-style-type: none"> Rainforests can be preserved in conservation areas such as national parks or nature reserves, and used for education, scientific research, and tourism Large international business support conservation projects in exchange for carrying out scientific research or the provision of raw materials. E.g. Givaudan is Swiss perfume company that works with Conservation International to protect 148000 hectares.
Ecotourism	<ul style="list-style-type: none"> Countries like Costa Rica, Belize and Malaysia have promoted their forests for ecotourism Through income generated, local people and governments benefit from protecting rainforest trees Tourists get involved in management, it provides employment for locals, people learn more about issues so are more likely to fund, minimises environmental impacts while still providing source of income
International agreements and debt reduction	<ul style="list-style-type: none"> This means that countries reduce deforestation and implement rules to protect rainforests E.g. Debt for nature swapping between USA and Indonesia, USA relieved Indonesia of their \$300m debt so that they can put the money towards conservation and can protect 13 areas of natural rainforest



Very low-growing (5-15cm off the ground) to enable it to survive the strong winds

Stems have a thick bark for stability in the windy conditions

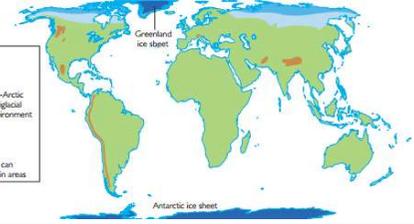
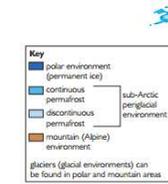
Hairy stems help to retain heat

Small leathery leaves help retain water in this dry environment

Bright red berries are eaten by birds and owls, and this helps to distribute seeds

Adaptations of vegetation

- Flowering and seed formation happens in a short time so that reproduction can take place in short summers
- Plants are low-growing and cushion-like to protect and insulate against strong winds
- Hairy stems help keep plants warm
- Thin waxy leaves reduce water loss



Characteristics of cold environments

	Polar	Tundra
Climate	Winter temperatures often fall below -50°C These areas have low precipitation totals	Winter temperatures may drop to -20°C Brief summers can be quite warm Amounts of precipitation can be high in coastal regions
Soils	Permanently covered by ice so permanently frozen	Frozen (Permafrost) but upper surface melts in summer Infertile due to water draining through soils that removes nutrients Become waterlogged since water is trapped in permafrost
Plants	Some plants such as mosses and lichens are found on fringes of ice	Low-growing flowering plants such as bearberry, Arctic moss Low bushes and small trees may grow in warmer regions
Animals	Polar bears well adapted to environment in Arctic In Antarctic, penguins lay their eggs on land and bring up their young before returning to ocean	Several animals live here, including the Arctic fox and Arctic hare Bird such as ptarmigans and insects such as midges and mosquitos are abundant in the summer

SVALBARD

Location: Norwegian territory in the Arctic Ocean, most northerly permanently inhabited group of islands in the world

Landscape: 60% of land is covered by glaciers, rest of the land is tundra, no arable farming, no trees

- Five major islands, the largest of which is Spitzbergen
- A population of about 2700, mostly living in main town of Longyearbyen
- More polar bears and snow mobiles than people

Mineral extraction	Energy developments	Fishing	Tourism
Svalbard has rich reserves of coal → Main economic activity → Coal mines have been set up → 300 people employed in mines and support staff	Svalbard is located close to the MidAtlantic Ridge → It is on a constructive plate margin, so magma is close to surface → It has great potential for geothermal energy as source of renewable energy	Svalbard is surrounded by the cold Barents Sea which is one of the richest fishing grounds in the world → There are 150 different species of fish → Extremely important breeding and nursery grounds → Controlled and monitored by Norway and Russia to ensure sustainable fishing	Svalbard is situated in a stunning natural environment → Popular tourist destination, 70,000 visited Longyearbyen in 2011 → Provides 300 jobs for local people → Harbour has been enlarged to cope with increased cruise ships → Explore environment – fjords, polar bears, Northern Lights...

Challenges of development

Temperature	Winter temperatures can fall below -30°C → Dangerous to work outside, with serious risk of frostbite → Dress very warmly, making outdoor work difficult
Buildings	There are many forms of construction outside: building houses, maintaining roads, enlarging harbour, mining operations. → Most construction work is carried out during summer → Gravel roads are built (not tarmac) and raised above ground to prevent them freezing and cracking → Houses built on the permafrost can become unstable and tip and fall when the permafrost melts in the summer
Services / Infrastructure	Include water, electricity and sanitation → Sewage and water pipes need to be kept off the ground to prevent them causing any possible thawing of permafrost
Inaccessibility	Located in remote area and can only be reached by plane or ship → Airport built in Longyearbyen with flights to Russia and Norway and small aircraft to fly between the islands → There is only 50km of roads in Longyearbyen and none to outlying communities so most residents use snowmobiles

Why should cold environments be protected?

- Cold environments are very fragile** → they are easily damaged and therefore take a long time to recover
- Biodiversity** → many birds, plants and animals such as penguins, polar bears and the arctic fox, as well as tundra vegetation, many rare species
- Tourism** → stunning landscapes with potential for adventure activities → tourists bring huge benefits to countries including Norway, Iceland and Alaska
- Indigenous people** → Inuit people in Alaska depend on the environment around them and its resources for survival
- Provide resources** → they provide opportunities for forestry and fishing, which provide a major source of income
- Unpolluted and unspoilt area** → they provide significant outdoor laboratories for scientific research such as the effects of climate change

Cold environments under threat

- Off-road vehicle driving** is a popular tourist activity in Alaskan wilderness as people may be hunting wild animals or want to travel to remote areas.
→ Usually takes place in Summer when upper surface of soil is melted and soggy, which causes deep tyre tracks
→ As other vehicles skirt the muddy pools, damage extends over a large area
→ It takes many years for this land to recover from damage that took just a few minutes
- Oil spills** from broken pipelines running through cold environments
→ Risk of fire, either started deliberately or by a lightning strike
→ Rivers/water source becomes polluted and totally lifeless
→ Vegetation surrounding it may never recover due to the extensive pollution
- Extraction of resources** such as oil, gas and precious minerals
→ Roads must be constructed through forests and across the tundra
→ Housing for hundreds of workers also needs to be constructed, which changes an area of natural vegetation into concrete

Managing cold environments

Method	E.g.	How it helps to manage the environment
The use of technology	The trans-Alaskan pipeline	<ul style="list-style-type: none"> Pipeline passes beneath rivers to minimise impact on mountainous landscape (Brookes Ranges) (Prudo Bay-Port of Valdez) Is raised and insulated to prevent the hot oil from melting the permafrost Supported and can slide if earthquakes happen, flow automatically stops if earthquakes happen Is raised to allow Caribou to migrate underneath Visual pollution, destroying a natural and unspoilt area, expensive and needs maintenance
Action by governments	Alaska, USA	<ul style="list-style-type: none"> National Environmental Policy Act – companies involved in oil protect natural environment and recognise the rights of native people West Arctic Reserve – a 9 million hectare protected wilderness (home to Caribou, migratory birds, musk ox, wolves, polar bears) National Oceanic and Atmospheric Administration (NOAA) – oversees sustainable fisheries, protects marine habitats Change of government can remove the refuge status
International agreements	The Antarctic Treaty	<ul style="list-style-type: none"> In 1959, signed by countries with international claims to Antarctica Recognises the importance of the continent for scientific research, particularly climate change Controls tourism and keeps disturbance to a minimum The same cannot be done in the Arctic since it is surrounded by powerful countries that wish to exploit it
Conservation groups	WWF in Canada	<ul style="list-style-type: none"> Works with local communities to manage critical ecosystems e.g. Beaufort Sea Supports scientific research to help protect important species e.g. Polar bears, narwhals, Greenland shark Polar bear patrols means that they stop them from being shot (Fitting them with satellite radio collars) Works with oil companies to provide regulations and a sustainable future