THE LIVING WORLD: ECOSYSTEMS

WHAT IS AN ECOSYSTEM?

The interaction of living (biotic) and non-living (abiotic) components.

Biotic:

- Animals, e.g. mammals, insects, birds and fish.
- Plants, e.g. trees and shrubs (provide food and shelter)
- Bacteria/fungi – decomposers – important in nutrient cycle

Abiotic:

- Air – oxygen for respiration; carbon dioxide for photosynthesis
- Sunlight for photosynthesis and plant growth
- Water and minerals (soil and rock)

NUTRIENT CYCLING

Plants/animals die – decomposers help to recycle the nutrients ready for plant/animal growth. Decayed material adds nutrients to the soil – which are taken up by plant roots.

ENERGY TRANSFER

Food chains: Show transfer of energy in the form of food from organism to organism (arrows show energy transfer).

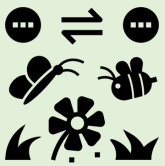
Food webs: Show food chains in an ecosystem – if you remove part it affects the whole web(interdependent).

GOODS AND SERVICES

Goods: Biomass, water, goods to sell, e.g. timber, ingredients, e.g. for medicines and toiletries.

Services:

- Plants filter water and air to remove pollutants
- Leaf litter for nutrient cycling
- Carbon storage
- Pollination



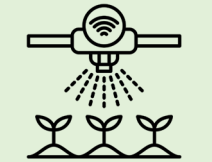
- Water storage
- Cooling effect
- Roots bind soil together – stops soil being eroded or washed away
- Planting trees reduce noise/visual impact

- Reduces flood risk

HUMAN IMPACT ON ECOSYSTEMS

Deforestation: To make way for housing developments, road construction, mining, and use as timber products.

Farming:



- Irrigation – water taken from ponds/rivers – water depletion harms marine life
- Fertilisers – washed into waterways causing eutrophication – algae grows and starves water of oxygen, killing fish

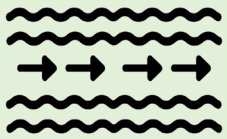
- Profit - hedgerow removal to make fields bigger, destroying habitats and food webs

GLOBAL BIOMES

Large-scale ecosystem known for its dominant vegetation type. Vegetation varies because of…

Altitude: Temperature falls with height above sea level (air is thinner so can't retain heat) so trees are replaced by tough grasses on steep mountains.

Ocean currents: E.g. cold currents create dry conditions (lack of evaporation), whereas the warm Gulf Stream makes western Europe warmer despite the latitude.



Mountain ranges: Forces air to rise upwards – relief rainfall over mountainous areas, but moisture is quickly lost so the other side of the mountain is dry (rain shadow effect).

THE LIVING WORLD: TROPICAL RAINFORESTS

RAINFOREST STRUCTURE

Emergents: Tallest trees (up to 50m) – grown tall to reach the sun.

Canopy: Densest layer (up to 30m) – most sunlight, most species.

Under canopy: Trees grow up to 15m – damp layer than only gets 10% of sunlight.

Forest floor: Very dark, lots of leaf litter – large predators, e.g. jaguars.

RAINFOREST FEATURES

- Found along the equator
- Warm and wet year round
- Average temp = 27°C
- Annual rainfall = 2500m+
- Dense/lush vegetation
- Hot and humid – ideal for nutrient cycling
- Poor soils – thin/not very fertile, nutrients washed away by heavy rain (leaching)

PLANTS AND ANIMALS

Home to half of global species.

Animals adapt to conditions…

Monkeys: Prehensile tails for balance/swinging.

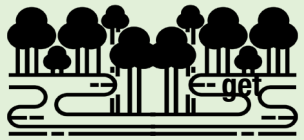
Poison arrow frogs: Brightly coloured to warn predators of danger.

Plants adapt to survive humidity…

Leaves: large surface areas, and leaf angling to maximise photosynthesis, waxy surfaces/drip tips, so they don't rot.

Buttress roots: Massive ridges above the ground to support tree base.

Lianas: Vines that twist around tree trunks to reach sunlight, or also hang down from branches.



Epiphytes: Sit on branches in the canopy – nutrients from water and air instead of soil.

RATE OF DEFORESTATION

- Half of all rainforest has been cleared
- Increase in rate in South America, Asia and Africa, especially in Peru/Indonesia
- Decreased in Amazon (but 20% already lost)
- 60 hectares per minute lost around the world

CAUSES OF DEFORESTATION

Logging: For timber for building materials or furniture.

Mining: To explore/exploit minerals below ground.

Energy: Large rivers = high HEP potential – land cleared to build dams.

Farming: Huge areas cleared for cattle ranches and cash crop plantations

Road building: opens up the rainforest – makes it commercially accessible

IMPACTS OF DEFORESTATION

Global:

- Climate change
- Loss of biodiversity

Local:

- Less evapotranspiration – drier
- Soil erosion/loss of fertility
- River pollution
- Harms indigenous tribes

RAINFOREST MANAGEMENT

International agreements: Restrictions on trade in tropical rainforest hardwoods, making it harder to sell them/make money from them; 'Debt for nature' – HICs cancel debt in LICs so they can invest in conservation projects.

National strategies: Can bring in laws to protect environment and can stop exploitation, can set up national parks – but reluctant to limit exploitation due to impact on the economy.

Local strategies: e.g. selective logging only fells fully grown trees (less valuable ecologically); ecotourism which educates visitors, is small-scale and local, and money invested into conservation.

THE LIVING WORLD: HOT DESERTS (OPTION)

KEY FEATURES

- 20° and 30° north and south of the Equator
- 14% of land surface

Extremely arid: Less than 250 mm of rainfall a year, but most only get 100-200 mm!

Soils: Stony/sandy – infertile with little organic matter (lack of vegetation/water) and formed by weathering. Dry but can soak up water rapidly, but this evaporates rapidly.

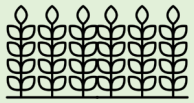
High diurnal range: Difference between day and night temperatures – cloudless skies = high insolation in the day but freezing at night.

ECONOMIC ACTIVITIES

Mineral extraction: Abundance of minerals (used in construction) – important source of income.

Energy development: Oil fields and coal deposits, renewable potential (sunny skies and wind).

Farming: Mainly subsistence but some commercial farming to irrigation.



Tourism: Multiplier effect – local people provide food/ accommodation – jobs, e.g. camel safaris.

HOT DESERT ANIMALS

Rodents: Nocturnal and live underground to keep cool.

Snakes/lizards: Waterproof skin to retain moisture.

Camels: Fat in humps, 2 pairs of eyelashes to protect from sun, stretchy nostrils to close in sandstorms, webbed feet to stop sinking in the sand, light woolly coat to reflect sun and for insulation (cool during the day/ warm at night).

CHALLENGES

Extreme temperature: Can exceed 50°C, work is dangerous – farmers need to irrigate crops and provide shade for livestock.

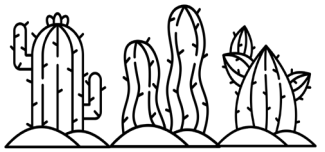
Water supply: Increase demand for water (more people) – lack of rain + extreme heat + strong winds = high evaporation

Accessibility: Vast barren land – heat melts tarmac and sand is blown across roads.

HOT DESERT PLANTS

Xerophytic: Adapt features to suit desert conditions, e.g.

- Waxy cuticles – reduce water loss
- Short wide tree trunks – store water
- Thick bark – fire-resistant
- Succulents – store water in tissue
- Spikes – to reduce water loss and stop animals eating them



Ephemeral: Change behaviour to suit environmental conditions, e.g. desert flowers lay dormant for years and germinate quickly after rain, completing lifecycle in just a few weeks.

CAUSES OF DESERTIFICATION

Population growth: More pressure on food and water resources.

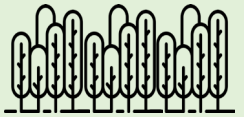
Deforestation: Fewer leaves to provide shade = soil dries out; no roots to bind soil = soil erosion; no leaf litter = less nutrient cycling.

Climate change: Drier and hot – stops water reserves recharging.

Over-grazing: Too many animals on the land – strips vegetation and trample land = soil erosion.

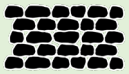
Over-cultivation: Too many crops are grown on the land - exhausts soil of nutrients.

REDUCING DESERTIFICATION



Afforestation: Tree roots bind soil together, leaves provide shade – stops ground drying out, leaf litter for nutrient cycling, e.g. Great Green Wall.

Water management/soil techniques: e.g. magic stones, sand dams, drip irrigation.



THE LIVING WORLD: COLD ENVIRONMENTS (OPTION)

KEY FEATURES – POLAR BIOME

- Average temp below freezing – can be -50°C
- Very little precipitation – officially desert
- Soils permanently covered in ice – so permanently frozen
- Some mosses and lichens
- Few permanent settlements

KEY FEATURES – TUNDRA BIOME

- Average temperature can be -20°C
- Warmer and wetter than polar biome
- Permafrost – most ground is permanently frozen but melts closer to surface – causes waterlogging
- Soils have low fertility
- Tundra means 'treeless place' in Finnish

POLAR/TUNDRA ANIMALS

Polar bears: Thick fur and insulating fat, black nose and foot pads to retain heat.

Penguins: 2 layers of feathers – traps body heat, streamlined bodies – swim quickly.

Seasonal behaviour: Hibernating in winter to conserve energy, migrating to warmer regions.

POLAR/TUNDRA PLANTS

Permafrost: Frozen ground so plants need shallow root systems, e.g. mosses/lichens.

Water logging and poor drainage: Soils are dry in winter and very wet in summer (after permafrost melts) – hardy - e.g. mosses.

Strong winds: Plants grow low and close together, hairy stems (both trap air), leaves thin and waxy to reduce transpiration.

ECONOMIC ACTIVITIES

Mineral extraction: Abundance of minerals – important source of income, e.g. lead and gold.

Energy development: Fossil fuels, e.g. coal, oil and gas, some potential for geothermal.

Fishing: Cold water = abundant fish stocks, e.g. Barents sea – over 150 species of fish.

Tourism: Spectacular scenery and activities, e.g. snow mobiles, dog sleds, also cruise passengers.

CHALLENGES

Extreme cold: Dangerous to work outside (down to -50°C) – serious risk of frostbite.

Building: Construction projects have to ensure permafrost doesn't melt – complex and expensive

Inaccessibility: Roads covered in snow or thick ice, waterlogging from melted permafrost – dangerous to drive off-road.

INTERNATIONAL AGREEMENTS

International agreements are important in protecting cold environments.

Antarctic Treaty: Signed in 1959 has stopped economic development, despite all the valuable resources, and has protected this fragile environment.

Arctic Council: Aiming for sustainable development across region, e.g. setting fishing and hunting quotas.

NATIONAL MANAGEMENT STRATEGIES

Balance interests of different groups…

Arctic National Wildlife Refuge: Protects 12 million acres in Alaska from exploitation.

Western Arctic Reserve: Bans oil exploration and drilling – protects habitats.

LOCAL MANAGEMENT STRATEGIES

NGOs, e.g. Greenpeace and the WWF work to conserve the environment and traditional ways of life in wilderness areas – they often work with scientific organisations and oil companies,