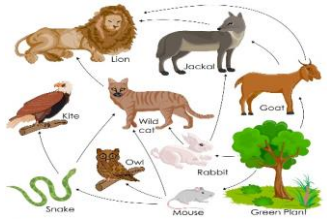
What is an Ecosystem?

An ecosystem is a system in which organisms interact with each other and with their environment.

Ecosystem's Components

Abiotic	These are **non-living**, such as air, water, heat and rock.
Biotic	These are **living**, such as plants, insects, and animals.
Flora	**Plant life** occurring in a particular region or time.
Fauna	**Animal life** of any particular region or time.



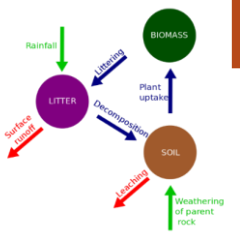
Food Web and Chains

Simple **food chains** are useful in explaining the basic principles behind ecosystems. They show only one species at a particular trophic level. **Food webs** however consists of a network of many food chains interconnected together.

Nutrient cycle

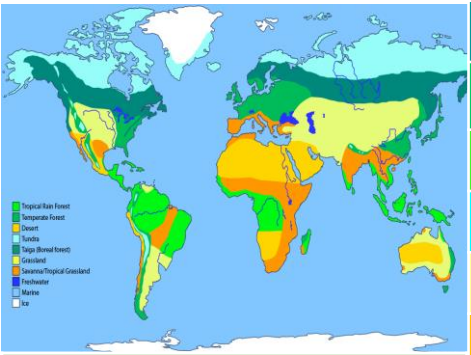
Plants take in **nutrients** to build into new organic matter. Nutrients are taken up when animals eat plants and then returned to the soil when animals die and the body is broken down by **decomposers**.

Litter	This is the **surface layer** of vegetation, which over time breaks down to become **humus**.
Biomass	The total **mass of living organisms** per unit area.



Biomes

A biome is a **large geographical area of distinctive plant and animal groups**, which are adapted to that particular environment. The climate and geography of a region determines what type of biome can exist in that region.



	Coniferous forest
	Deciduous forest
	Tropical rainforests
	Tundra
	Temperate grasslands
	Tropical grasslands
	Hot deserts.

The **most productive biomes** – which have the greatest biomass- grow in climates that are **hot and wet**.

Biome's climate and plants

Biome	Location	Temperature	Rainfall	Flora	Fauna
Tropical rainforest	Centred along the Equator.	Hot all year (25-30°C)	Very high (over 200mm/year)	Tall trees forming a canopy; wide variety of species.	Greatest range of different animal species. Most live in canopy layer
Tropical grasslands	Between latitudes 5°- 30° north & south of Equator.	Warm all year (20-30°C)	Wet + dry season (500-1500mm/year)	Grasslands with widely spaced trees.	Large hoofed herbivores and carnivores dominate.
Hot desert	Found along the tropics of Cancer and Capricorn.	Hot by day (over 30°C) Cold by night	Very low (below 300mm/year)	Lack of plants and few species; adapted to drought.	Many animals are small and nocturnal: except for the camel.
Temperate forest	Between latitudes 40°-60° north of Equator.	Warm summers + mild winters (5-20°C)	Variable rainfall (500-1500m /year)	Mainly deciduous trees; a variety of species.	Animals adapt to colder and warmer climates. Some migrate.
Tundra	Far Latitudes of 65° north and south of Equator	Cold winter + cool summers (below 10°C)	Low rainfall (below 500mm/ year)	Small plants grow close to the ground and only in summer.	Low number of species. Most animals found along coast.
Coral Reefs	Found within 30° north – south of Equator in tropical waters.	Warm water all year round with temperatures of 18°C	Wet + dry seasons. Rainfall varies greatly due to location.	Small range of plant life which includes algae and sea grasses that shelters reef animals.	Dominated by polyps and a diverse range of fish species.

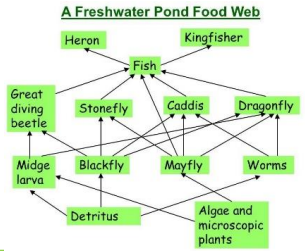
Tropical Rainforest Biome

Tropical rainforest cover about **2 per cent** of the Earth's surface yet they are home to **over half of the world's plant and animals**.

Interdependence in the rainforest

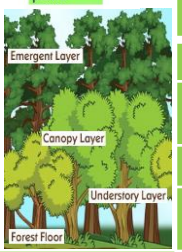
A rainforest works through **interdependence**. This is where the plants and animals **depend on each other** for survival. If one component changes, there can be **serious knock-up effects** for the entire ecosystem.

The Living World



Distribution of Tropical Rainforests

Tropical rainforests are **centred along the Equator** between the Tropic of Cancer and Capricorn. Rainforests can be found in South America, central Africa and South-East Asia. **The Amazon** is the world's largest rainforest and takes up the majority of northern South America, encompassing countries such as Brazil and Peru.



Layers of the Rainforest

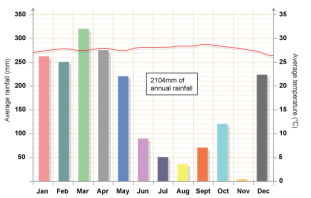
Emergent	Highest layer with trees reaching **50 metres.**
Canopy	Most life is found here as It receives **70% of the sunlight** and **80% of the life.**
U-Canopy	Consists of trees that reach **20 metres high.**
Shrub Layer	Lowest layer with **small trees** that have adapted to living in the **shade.**

Rainforest nutrient cycle

The **hot, damp conditions** on the forest floor allow for the **rapid decomposition** of dead plant material. This provides plentiful nutrients that are easily absorbed by plant roots. However, as these nutrients are in high demand from the many fast-growing plants, they do not remain in the soil for long and stay close to the surface. If vegetation is removed, the soils quickly become **infertile**.

Climate of Tropical Rainforests

- Evening temperatures rarely fall below **22°C.**
- Due to the **presence of clouds**, temperatures rarely rise above **32°C**.
- Most afternoons have heavy showers.
- At night with no clouds insulating, temperature drops.



Key Term	Definition
Consumer	Creature that eats animals and/or plant matter.
Decomposer	An organism such as a bacterium or fungus, that breaks down dead tissue, which is then recycled to the environment.
Producer	An organism or plant that is able to absorb energy from the sun through photosynthesis.
Bio-Diversity	The variety of life in the world or a particular habitat.
Fragile Environment	An environment that is both easily disturbed and difficult to restore if disturbed. Plant communities in fragile areas have evolved in highly specialised ways to deal with challenging conditions. As a result, they cannot tolerate environmental changes.

CASE STUDY: Small Scale Ecosystem – Fresh Water Pond

Components & Interrelationships

Pond Margin	Shallow water, lots of oxygen & light with shelter for plants and insects for small animals to eat – Heron, Marsh Marigold.
Above & pond surface	Pond surface – lots of light and oxygen. Food fond on pond surface or in the water. Birds like kingfishers and ducks. Plants include Water Lilies & algae.
Mid Water	Animals breathe through gills or skin. Fish are main predators. Food found in water or on surface – Fish like Perch, Stickleback
Pond Bottom	Little oxygen or light, plenty of shelter and food. Decomposers and scavengers live here – Rat tailed maggot, water worm.

Tropical Rainforests: Case Study Malaysia

Malaysia is a LIC country is south-east Asia. 67% of Malaysia is a tropical rainforest with 18% of it not being interfered with. However , Malaysia has the fastest rate of deforestation compared to anywhere in the world

Adaptations to the rainforest

Orangutans	Large arms to swing & support in the tree canopy.
Drip Tips	Allows heavy rain to **run off leaves easily**.
Lianas & Vines	**Climbs** trees to reach sunlight at canopy.

Rainforest inhabitants

Many tribes have developed sustainable ways of survival. The rainforest provides inhabitants with…

- **Food** through hunting and gathering.
- **Natural medicines** from forest plants.
- **Homes and boats** from forest wood.

Issues related to biodiversity

Why are there high rates of biodiversity?

- **Warm and wet climate** encourages a wide range of vegetation to grow.
- There is **rapid recycling of nutrients** to speed plant growth.
- Most of the rainforest is **untouched.**

Main issues with biodiversity decline

- **Keystone species** (a species that are important of other species) are extremely important in the rainforest ecosystem. Humans are threatening these vital components.
- **Decline in species** could cause tribes being unable to survive.
- **Plants** & **animals** may become **extinct.**
- Key medical **plants** may become **extinct.**

Impacts of deforestation

Economic development

+ Mining, farming and logging creates employment and tax income for government.
+ Products such as palm oil provide valuable income for countries.
- The loss of biodiversity will reduce tourism.

Soil erosion

- Once the land is **exposed by deforestation,** the soil is more **vulnerable to rain**.
- With **no roots to bind soil together**, soil can easily **wash away.**

Climate Change

-When rainforests are cut down, the climate becomes **drier.**
-Trees are **carbon 'sinks'**. With greater deforestation comes more greenhouse emissions in the atmosphere.
-When trees are burnt, they **release more carbon in the atmosphere**. This will enhance the **greenhouse effect.**

What are the causes of deforestation?

Logging

- Most widely reported cause of destructions to biodiversity.
- Timber is harvested to create **commercial items** such as furniture and paper.
- **Violent confrontation** between indigenous tribes and logging companies.

Agriculture

- Large scale **'slash and burn'** of land for ranches and palm oil.
- Increases **carbon emission**.
- **River saltation** and **soil erosion** increasing due to the large areas of **exposed land.**
- Increase in **palm oil** is making the **soil infertile**.

Mineral Extraction

- **Precious metals** are found in the rainforest.
- Areas **mined** can experience **soil and water contamination**.
- **Indigenous people** are becoming **displaced** from their land due to roads being built to transport products.

Tourism

- **Mass tourism** is resulting in the building of hotels in extremely **vulnerable areas**.
- Lead to **negative relationship** between the government and indigenous tribes
- Tourism has **exposed animals** to human **diseases.**

Energy Development

- The **high rainfall** creates ideal conditions for **hydro-electric power (HEP).**
- The **Bakun Dam** in Malaysia is key for creating energy in this developing country, however, both people and environment have suffered.

Road Building

- **Roads** are needed to bring supplies and **provide access** to new mining areas, settlements and energy projects.
- In Malaysia, logging companies use an **extensive network of roads** for heavy machinery and to transport wood.

Sustainability for the Rainforest

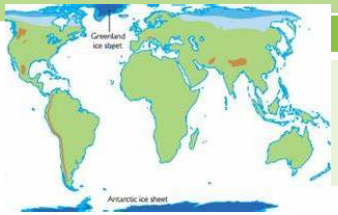
Uncontrolled and unchecked exploitation can cause irreversible damage such as loss of biodiversity, soil erosion and climate change.

Possible strategies include:

- **Agro-forestry** - Growing trees and crops at the same time. It prevents soil erosion and the crops benefit from the nutrients.
- **Selective logging** - Trees are only felled when they reach a particular height.
- **Education** - Ensuring those people understand the consequences of deforestation
- **Afforestation** - If trees are cut down, they are replaced.
- **Forest reserves** - Areas protected from exploitation.
- **Ecotourism** - tourism that promotes the environments & conservation

Cold Environments – Svalbard & Arctic

Svalbard is a Norwegian territory in the Arctic Ocean. It has a polar climate with 60% of the land covered by glaciers. The rest of the land is tundra. Population is 2700 who mainly live in Longyearbyen (the capital). There are more polar bears and snowmobiles than people! .

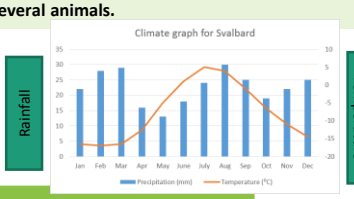


Types of Cold Environments

Polar – temps can drop -50C, permanently covered by ice, low precipitation (snow falls).
Few plants and some animals, penguins and polar bears.
Tundra – less extreme max -20C, snowfall can be high, low growing plants & bushes, permafrost, infertile soils, several animals.

Distribution of the world's cold environments

Polar – found at high latitudes, Arctic and Antarctic areas.
Tundra – lower latitudes, from Arctic circle to 60-70 degrees N, including Canada, Northern Europe. Little tundra in southern hemisphere as there is a lack of land.



Permafrost	• **Permanently frozen ground. Surface layer thaws in summer. Lower layers are permanently frozen**

Adaptations to the desert

Bearberry	• Low growing to survive strong winds. • Thick bark to retain heat and stability in wind. • Small leathery leaves to retain water. • Hairy stems to retain heat. • Bright red berries to attract birds who distribute seeds.
Polar Bear	• Thick fur to retain heat. • **Insulating layer of fat to retain heat.** • **Black nose and foot pads to absorb heat and walk on snow.**

Opportunities and challenges in the cold environments

Opportunities

- Mineral Extraction – coal mining is main economic activity as lots of coal reserves. 300+ staff employed. 2014 new mine opened. BUT controversial – greenhouse gases and roads built over glaciers to access reserves.
- Energy Development – Potential for geothermal energy as located near to mid Atlantic ridge (thin crust)
- Fishing – Barents Sea south of Svalbard are rich in fish reserves – 150 species. Fishing is controlled for sustainability.
- Tourism – growing industry. 2011 70000 visitors to Svalbard, nearly half from cruise ships. Harbour enlarged at Longyearbyen to cope, 300 jobs created for local people. Tourists are attracted to glaciers, northern lights and wildlife.

Challenges

- Extreme temperatures – it is dangerous to work in the extreme cold due to risk of frostbite – protective clothing makes some industries hard eg building.
- Limited daylight in winter – hard to develop construction industries in winter due to limited light in winter. Construction only happens in summer period.
- Permafrost – permanently frozen ground means services have to be provided above ground.
- Accessibility – Svalbard is isolated. Only reached by plane or ship. Limited transport beyond Longyearbyen. Only one airport and 50km of road. Main transport in winter is snowmobile.

Threats

Off road vehicle damage – popular tourist activity occurs in summer leaving deep tyre tracks and damaging vegetation.
Natural habitats destroyed by building roads to access fossil fuels reserves and pollution such as oil spills from transporting resources.

Why protect

Indigenous people – the original populations of an area.
Wildlife – home to protected birds, animals and plants.
Scientific research – unspoilt environments all study of issues such as climate change.
Provide opportunities for economic development – tourism, fishing.

Strategies to reduce damage

- Use technology – careful planning of pipelines so they are off ground but then run beneath rivers and are flexible reduces risk of spills during earthquakes and prevents permafrost from melting.
- Government action – USA has National Environment Act to protect Arctic. This prevents oil drilling in sensitive areas.
- International Agreements – the Antarctic Treaty.
- Conservation groups – WWF in Canada