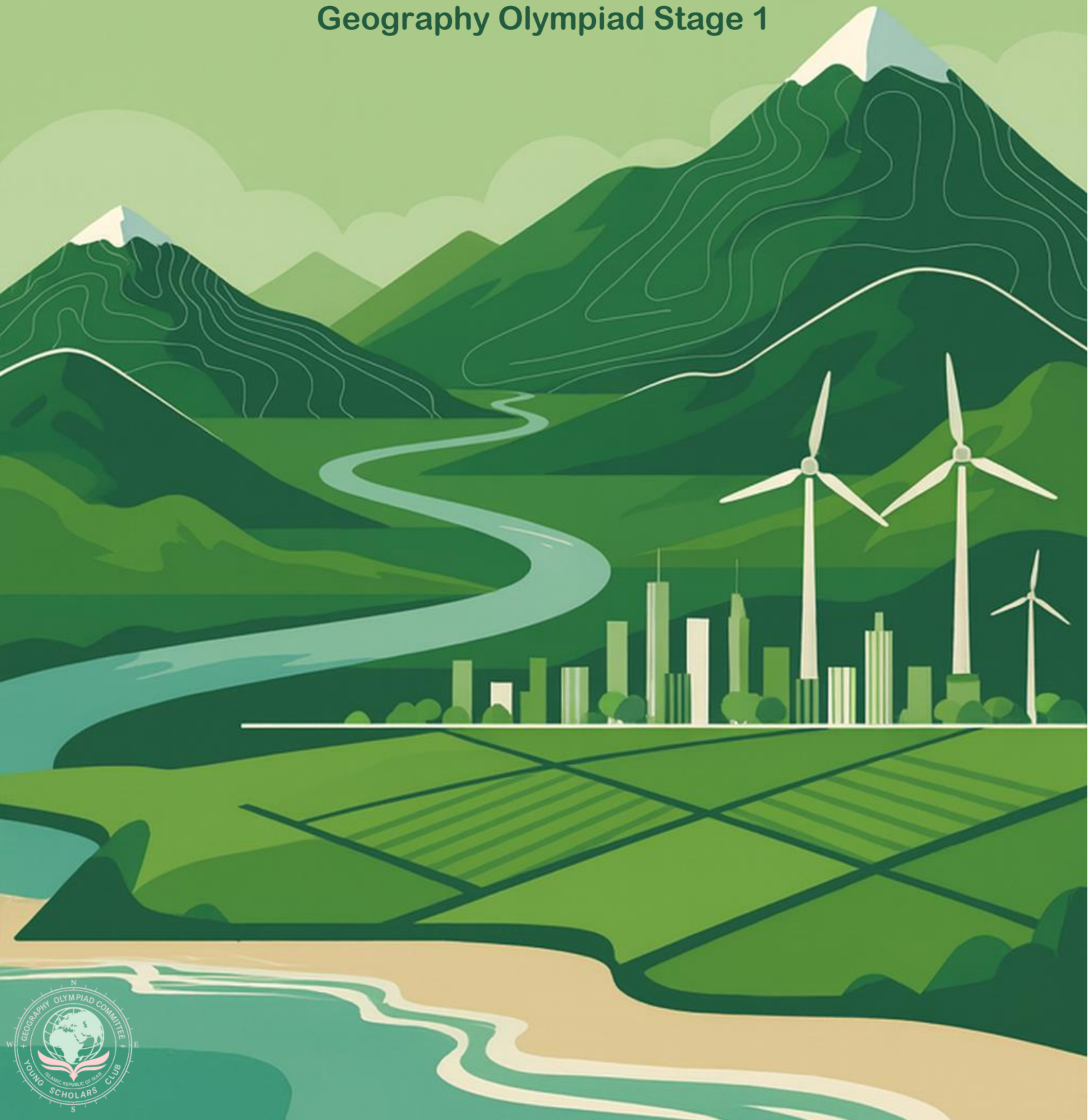


The World Unveiled: IGCSE & O Level Geography for Iranian Olympiad

Core Concepts, Skills & Preparation for National
Geography Olympiad Stage 1



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Preface

Welcome to *Complete Geography for Cambridge IGCSE® & O Level – Olympiad Edition*! This study guide is designed to help you excel in your geography studies and prepare for National Olympiad competitions.

Mostafa Khaledi,

Member of National Committee of IRAN Geography Olympiad

Introduction: The World at Your Fingertips

What is Geography? The Three Pillars

Geography is far more than the study of maps; it is the study of the Earth's surfaces, features, inhabitants, and phenomena. It seeks to answer the fundamental questions of "Where?" and "Why there?"

At its heart, geography is a bridge between the natural sciences (studying the physical planet) and the social sciences (studying the people who live on it). To understand the subject, we organize it into three main pillars:



1. **Physical Geography (The Natural Environment):** This is the study of the Earth's natural processes and landforms. It explores the powerful forces that shape our planet, including:
 - Plate Tectonics (Volcanoes, Earthquakes)
 - River and Coastal Processes (Fluvial and Marine Landforms)
 - Weather (Meteorology)
 - Climate and Biomes (Ecosystems like Rainforests and Deserts)

2. **Human Geography (Population and Settlement):** This is the study of humanity's patterns and processes on Earth. It focuses on where and how people live, including:
 - Population Dynamics (Growth, Density, and Distribution)
 - Migration (Why and how people move)
 - Settlement (The hierarchy from villages to megacities)
 - Urbanisation (The growth and challenges of cities)
3. **Economic Development & Resource Management:** This pillar connects the first two. It investigates how humans use, develop, and manage the planet's resources. It covers:
 - Development and Globalisation (Measuring wealth, TNCs)
 - Food Supply (Agricultural systems)
 - Industry and Tourism
 - Energy and Water Resources (Management and sustainability)

Why Geography Matters: Understanding the Link

The true power of geography is not in studying these pillars separately, but in understanding how they **interact**. The most complex challenges and interesting phenomena on Earth exist at the intersection of the physical, human, and economic worlds.

A volcano (Physical) is not just a geological feature; it is a **hazard** that destroys settlements (Human) but also creates incredibly fertile soil for farming (Economic). Deforestation for palm oil (Economic) removes a rainforest biome (Physical), which can cause soil erosion, impact food security (Human), and even alter the local climate (Physical).

Geography provides the essential **context** for understanding world events. It is the key to analyzing our planet's greatest challenges, from climate change and food security to resource conflict and rapid urbanization.

Olympiad Focus: Core Concepts and Geographical Skills

This summary is a tool for the first step of the National Olympiad. It is not an exhaustive encyclopedia. Its purpose is to provide a concise and powerful review of:

Core Concepts: The fundamental ideas that define geography (e.g., Plate Tectonics, the Demographic Transition Model, Longshore Drift).

Essential Terminology: The specific vocabulary you must know (e.g., *subduction*, *xerophyte*, *sphere of influence*).

Key Processes: The step-by-step actions that create features (e.g., the formation of an oxbow lake or a headland).

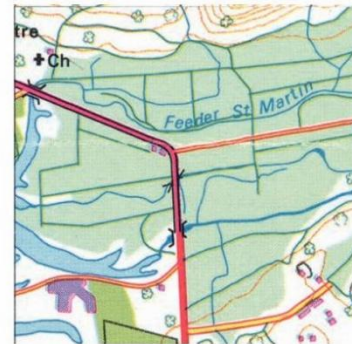
Knowledge alone, however, is not enough. Geography is a practical, applied science. The Olympiad will test your ability to *use* this knowledge by assessing your **Geographical Skills**. This summary will focus on the core knowledge, but you must also be prepared to:

1. **Interpret Maps:** Read and understand 4- and 6-figure grid references, direction, scale, and, most importantly, contour lines to identify relief and landforms.

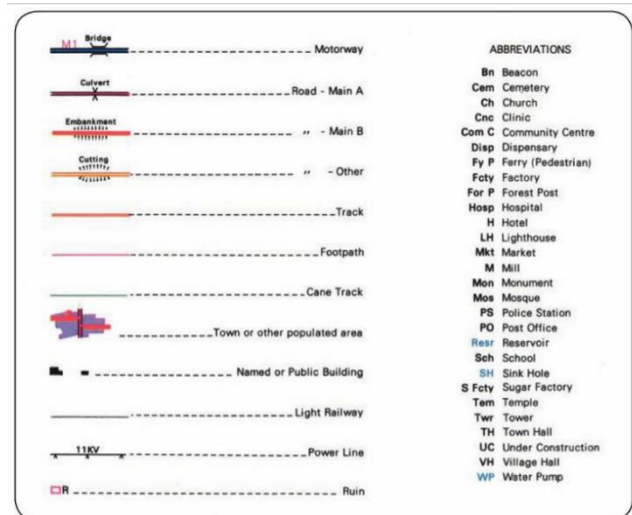
2. **Analyze Data:** Read and find patterns in graphs (line, bar, pie, scatter), charts, and population pyramids.

3. **Analyze Photographs:**

Identify and describe physical and human features from a ground-level or aerial photograph.



Symbols on a map of part of Mauritius (the church in the north-west is located where the cross-shaped symbol is, not where the letters Ch are)



An example of part of a map key

This guide will build your foundation of knowledge. Let us begin with the first pillar: Human Geography.

Part 1: Human Geography – Population and Settlement

This section explores the patterns of human life on Earth. It investigates where people live, why they move, and how their settlements—from small villages to megacities—are structured and face unique challenges.

1.1 Population Dynamics

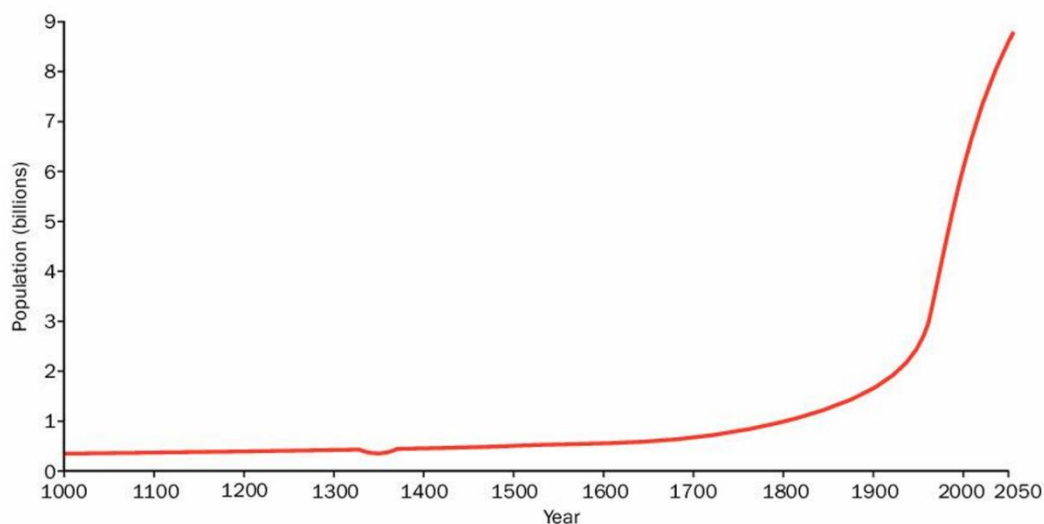
Population dynamics is the study of how and why populations change over time.

Key Concepts

- **Birth Rate (BR):** The number of live births per 1,000 people in a population in one year.
- **Death Rate (DR):** The number of deaths per 1,000 people in a population in one year.
- **Natural Increase (or Decrease):** The difference between the birth rate and the death rate. A positive result is a natural increase; a negative result is a natural decrease.

Population Growth

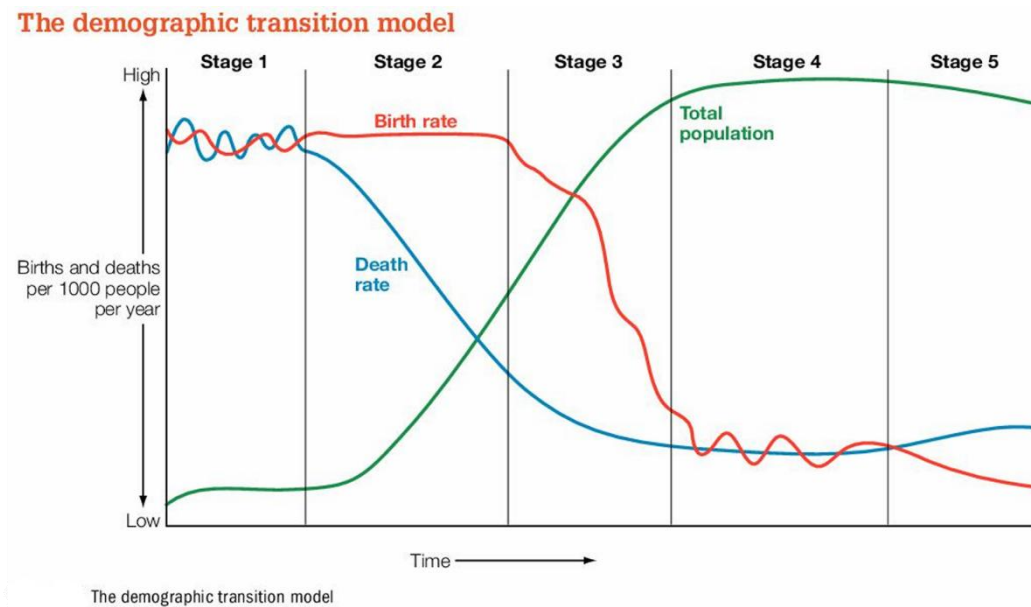
For most of human history, population growth was extremely slow, as high birth rates were balanced by high death rates. Around the 1750s, the "Population Explosion" began. This was not due to a rise in birth rates, but a dramatic fall in death rates (due to medical advances, sanitation, and better food production).



World population growth since the year 1000

The Demographic Transition Model (DTM)

This model shows how a country's population changes as it develops. It has five stages:



Stage 1: High Stationary

- ✓ High BR and high DR.
- ✓ Low natural increase (population is stable).
- ✓ *Example: Isolated uncontacted groups.*

Stage 2: Early Expanding

- ✓ High BR, but DR falls rapidly.
- ✓ Very high natural increase (population "explosion").
- ✓ *Example: Many LEDCs, e.g., Niger.*

Stage 3: Late Expanding

- ✓ BR begins to fall, DR remains low.
- ✓ Natural increase is still high but slowing down.
- ✓ *Example: Many NICs, e.g., Brazil, India.*

Stage 4: Low Stationary

- ✓ Low BR and low DR.
- ✓ Low or zero natural increase (population is stable).
- ✓ *Example: Most MEDCs, e.g., USA, UK, France.*

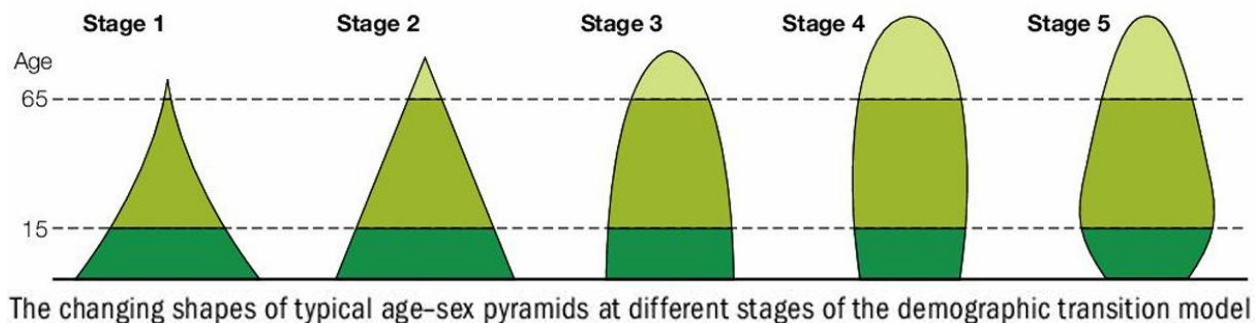
Stage 5: Declining

- ✓ BR falls below the DR.
- ✓ Negative natural increase (population declines).
- ✓ *Example: Japan, Germany.*

Population Structure

Population structure refers to the composition of a population, typically shown by age and gender.

Age-Sex (Population) Pyramids These graphs show the percentage or number of males and females in different age groups. The shape of a pyramid is directly linked to its DTM stage.



Interpreting Pyramids:

- **Dependents:** The parts of the population that are not in the main workforce.
 - **Young Dependents:** Aged 0-14.
 - **Elderly Dependents:** Aged 65+.
- **Economically Active:** The workforce, aged 15-64.
- **Dependency Ratio:** The ratio of dependents (young + elderly) to the economically active population. A high dependency ratio places a greater burden on the workforce.

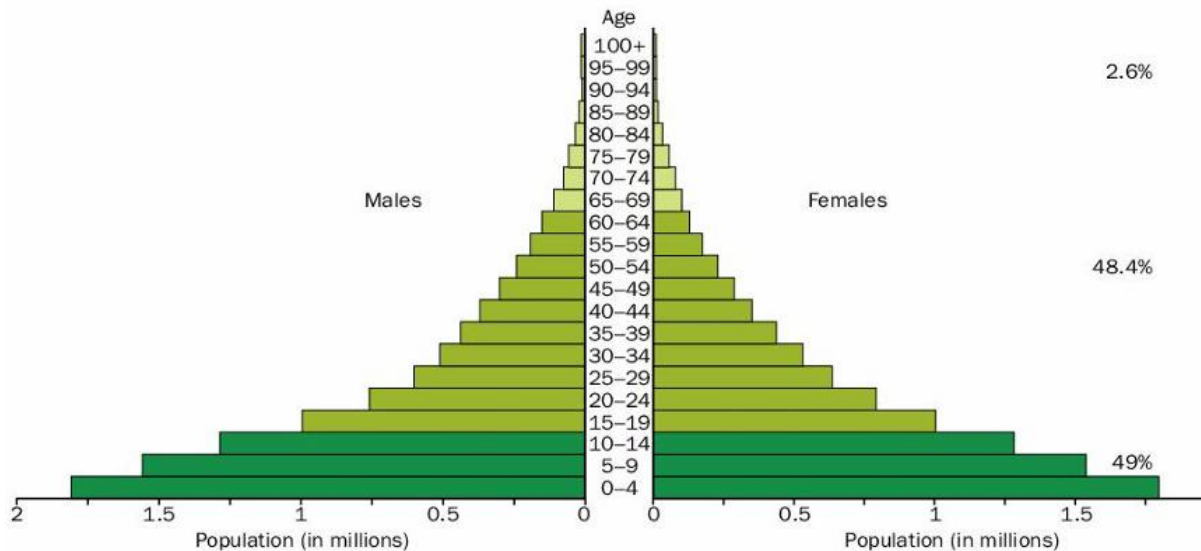
Pyramid Shapes:

1. Youthful Population (Stage 2):

- ✓ **Shape:** A wide base and narrow top (a "classic" pyramid).
- ✓ **Indicates:** High birth rate, high death rate, low life expectancy.
- ✓ **Problems:** High youth dependency, pressure on schools and child healthcare, high future unemployment.

✓ **Case Study (High Young Dependency): Niger.**

Niger, a country with a high young dependent population



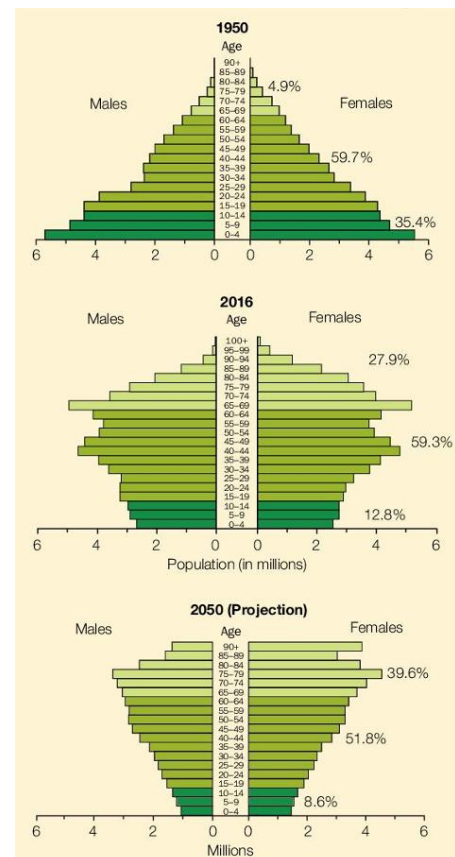
Niger's population structure in 2016. The median age in Japan was almost 47; in Niger it is only 15

2. Ageing Population (Stage 5):

- ✓ **Shape:** A narrow base and a wide top (often described as a "coffin" shape).
- ✓ **Indicates:** Low birth rate, low death rate, high life expectancy.
- ✓ **Problems:** High elderly dependency, pressure on healthcare and pensions, future workforce shortages.
- ✓ **Case Study (High Elderly Dependency):** Japan.

Population Density and Distribution

- **Distribution:** The way people are *spread out* over an area (e.g., clustered, linear, sparse).
- **Density:** The number of people *per square kilometer* (km²).



Japan's population structure in 1950, 2016 and 2050

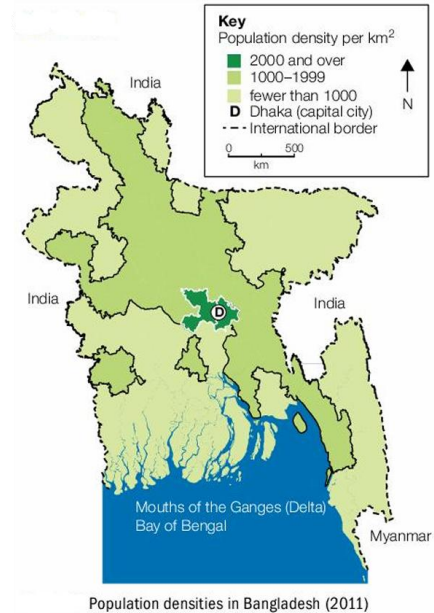
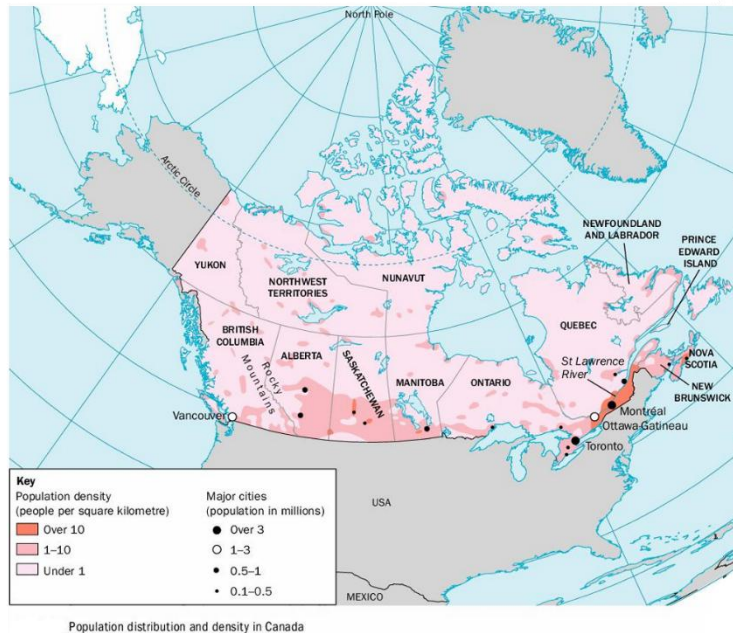
Factors Influencing Density and Distribution:

Physical (Favorable): Flat land (relief), fertile soil, reliable water, temperate climate.

Physical (Unfavorable): Steep slopes, desert (climate), dense rainforest, no water.

Economic: Job opportunities, good transport links, resources (e.g., mines).

Political: Government policy (e.g., moving a capital city), conflict.



Key Concepts in Population

- **Over-population:** When there are too many people in an area to be supported by the available resources (food, water, jobs) and technology to a good standard of living. This is *not* the same as high density.

Example: Bangladesh - High density on a fertile delta, but low GDP, pressure on resources, and vulnerable to flooding.

- **Under-population:** When there are too few people in an area to fully utilize the available resources.

Example: Australia - Very large area with vast mineral wealth and farmland, but a small population. It could support more people with a high standard of living.

- **Population Policies:**

Anti-natalist: A government policy designed to *reduce* the birth rate.

- *Example: China's "One-Child Policy" (1979-2015).* A coercive policy with rewards and penalties. It successfully slowed growth but created an ageing population and a gender imbalance.

Pro-natalist: A government policy designed to *increase* the birth rate, often in response to an ageing population.

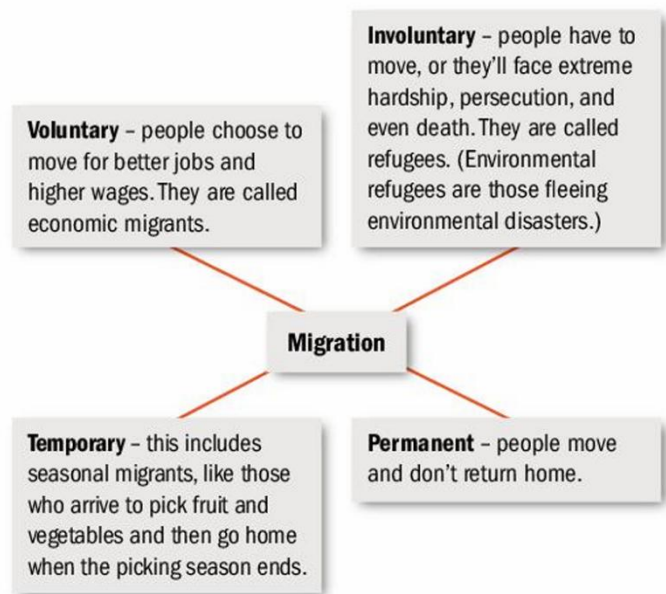
- *Example: Japan or France.* Uses incentives like extended parental leave, financial bonuses, and state-subsidised childcare.

1.2 Human Migration

Migration is the movement of people from one place to live in another.

Key Concepts

- **Emigrant:** A person who *leaves* (exits) their country.
- **Immigrant:** A person who *enters* (moves into) a new country.
- **Voluntary Migration:** When a person chooses to move, often for economic reasons.
- **Involuntary (Forced) Migration:** When a person has no choice but to move, often as a **refugee** fleeing war, persecution, or natural disaster.



Push and Pull Factors

- **Push Factors:** Negative reasons that "push" people to leave a place.
 - ✓ War or conflict
 - ✓ Poverty / Low wages
 - ✓ Lack of jobs
 - ✓ Natural disasters (drought, famine, flood)
 - ✓ Persecution
- **Pull Factors:** Positive reasons that "pull" people to a new place.
 - ✓ Safety and stability

- ✓ Better job opportunities
- ✓ Higher wages
- ✓ Good services (healthcare, education)
- ✓ Joining family or friends

Impacts of Migration

Migration creates impacts on both the country of origin (source) and the country of destination (host).

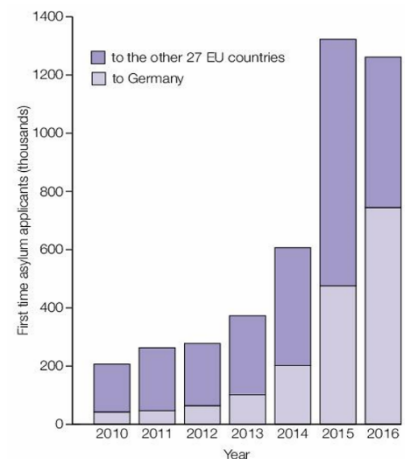
• Case Study: Syria to Germany/EU (2014-2016)

• Impacts on Source (Syria):

- ✓ "Brain Drain" as skilled/educated people leave.
- ✓ Fewer people to rebuild the country.
- ✓ Reduced workforce.

• Impacts on Host (Germany):

- ✓ Fills labour shortages (especially with an ageing population).
- ✓ Cultural enrichment.
- ✓ Social pressure on services (schools, housing).

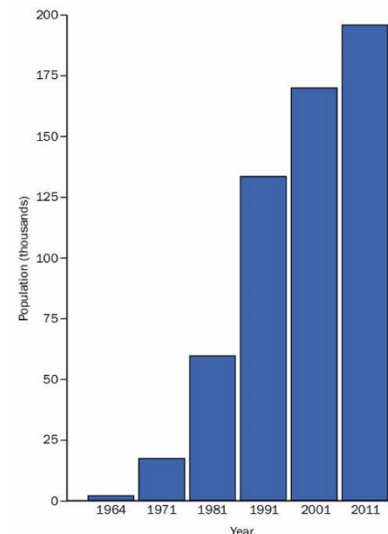


First-time asylum applicants to Germany and other European Union countries, 2010-16 (source: Eurostat)

Internal Migration

This is migration *within* a country. The most important global migration is **Rural-to-Urban** migration (moving from the countryside to the city). This is the main driver of urbanisation in LEDCs.

- *Example: Migration to Gaborone, Botswana.* People are pushed from rural areas by drought and lack of jobs, and pulled to the capital by opportunities in offices, shops, and industry.

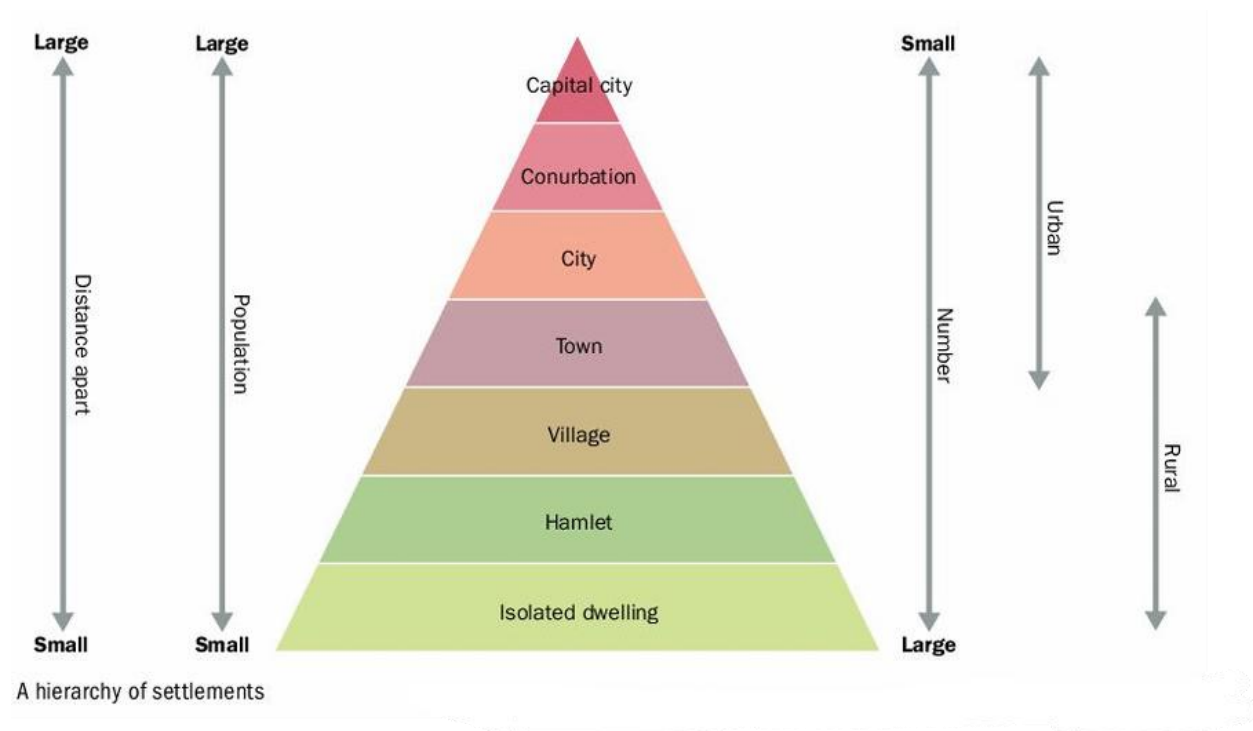


The growth of Gaborone's population: it was expected to reach 264 000 in 2017

1.3 Settlement Patterns

Settlement Hierarchy

Settlements are places where people live. They can be arranged in a **hierarchy** from smallest to largest.



- **High-Order Settlements** (e.g., Cities): Few in number, far apart, offer high-order services.
- **Low-Order Settlements** (e.g., Hamlets): Many in number, close together, offer low-order services.

Key Service Terms:

- **Sphere of Influence:** The area a settlement serves. A city has a large sphere of influence; a village has a small one.
- **Threshold Population:** The minimum number of people needed to support a service (e.g., a hospital needs a high threshold; a post box needs a low one).
- **Range:** The maximum distance a person is willing to travel to use a service.

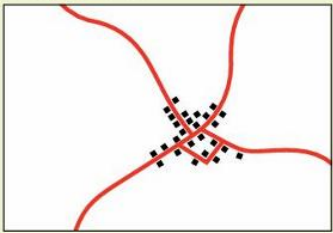
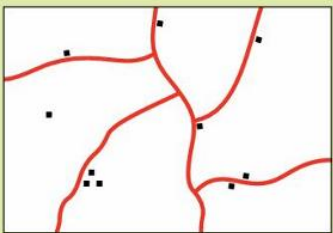
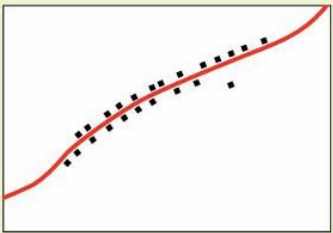
Rural Settlements

- **Site:** The actual piece of land a settlement is built on. Key site factors include:

- **Water Supply:** (e.g., at a *wet point* like a spring, or a *dry point* to avoid floods).
- **Defence:** (e.g., on a hilltop).
- **Land/Soil:** (e.g., on fertile ground for farming).
- **Situation:** The settlement's position in relation to its surroundings (e.g., at a river crossing, at a route centre).

Rural Settlement Patterns:

1. **Nucleated:** Buildings are clustered together, often around a central point (like a crossroads or village green).
2. **Dispersed:** Buildings are scattered or isolated, common in areas with poor farmland.
3. **Linear:** Buildings are in a long line, often following a road, river, or coastline.

Type of settlement pattern	Reasons for this pattern
Nucleated Dwellings are clustered together as villages, with fewer isolated dwellings. The shape of the villages is compact and more square or circular. 	● People can enjoy the social benefits of living close to their neighbours. ● They have easy access to services like shops and schools. ● Being close to others may be helpful for defence in times of attack. ● This pattern often develops in areas with rich agriculture, where farmers can live in the village but still be near their fields. ● The culture of the people might favour this pattern. <i>Reasons for the location of the individual villages are given in the next section on site and situation.</i>
Dispersed There are scattered isolated dwellings and small hamlets – with few villages. 	● Sometimes this pattern develops where the agricultural land is poor and people need to farm large areas, e.g. as grazing. It would be very hard for farmers to live in a village and still be within easy travelling distance of their land. ● Cultural reasons can also play a part, where it is not the tradition to live grouped together in villages. ● This settlement pattern is also found in some relatively modern settlements, such as on the Canadian Prairies, where commercial farms can be huge.
Linear Settlements are in long thin rows, often along roads or tracks. 	● This pattern allows each dwelling to have access to a road or track for transport, and also to an area of farming land at right angles to the road. ● Physical geography can also play a part. The settlements might be along a river or a line of springs, for water supply, or along a valley floor to avoid the steep valley sides. ● Settlements might also be in a line just above the floodplain of a river. ● In other cases, people don't waste good farming land, e.g. irrigated land, for buildings but place their houses in a line next to the fertile land.

Rural Issues (mainly in MEDCs)

Many rural areas in MEDCs face challenges:

Rural Depopulation: Young, educated people move to cities for better jobs and education.

Service Decline: As people leave, services (shops, post offices, schools, bus routes) lose customers and are forced to close, making life harder for those who remain (especially the elderly).

Second Homes: Wealthy city-dwellers buy houses for holidays, which can be empty most of the year and drive up house prices, forcing local young people out of the market.

- *Example: Rio Poqueira Valley, Spain.*

1.4 Urbanisation

Urbanisation is the *increase in the percentage* of a country's population living in towns and cities. This is one of the most significant human processes on the planet today, happening fastest in LEDCs.

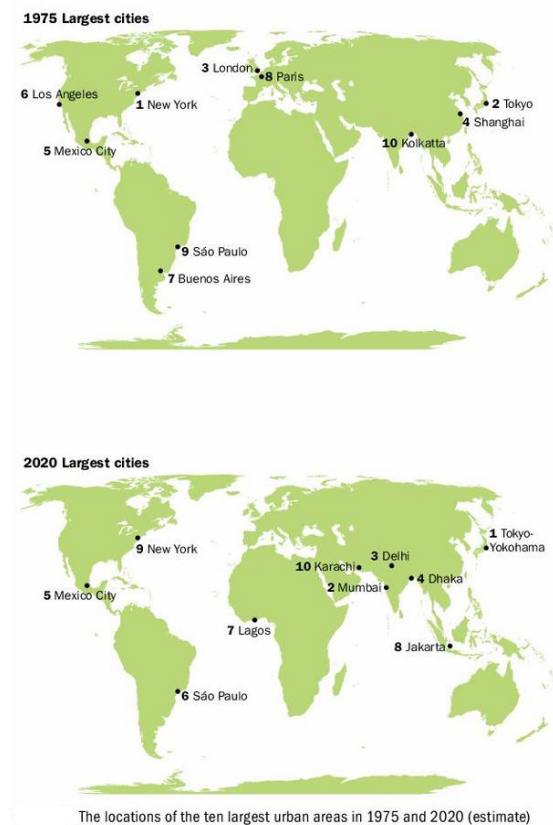
Megacity: A city with over 10 million people (e.g., Mumbai, Tokyo, São Paulo).

Conurbation: When two or more cities grow and merge together to form one continuous urban area (e.g., Tokyo-Yokohama).

Urban Land Use Models

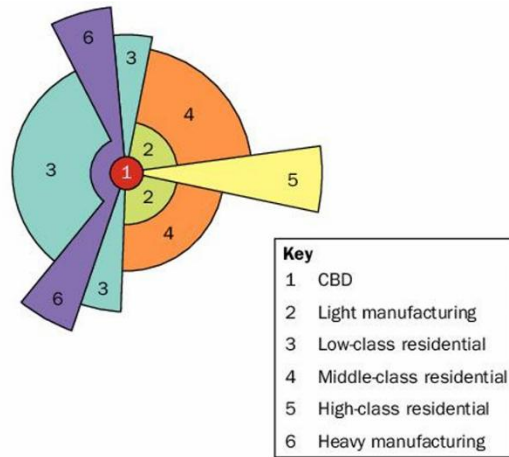
These models try to explain the layout of cities.

- **Burgess (Concentric Zone) Model:** Based on Chicago (1925). Sees cities as growing outwards in rings, with the CBD in the middle, surrounded by zones of industry, low-class, and then high-class housing.

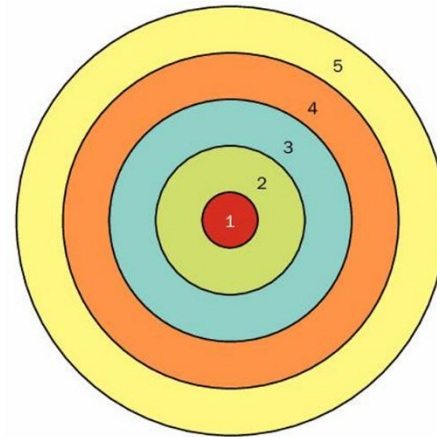


The locations of the ten largest urban areas in 1975 and 2020 (estimate)

- **Hoyt (Sector) Model:** (1939) A refinement of Burgess. Sees cities as growing outwards in *sectors* or "wedges," often along main transport routes (e.g., industry follows a railway, high-class housing follows a main road).



Hoyt's sector model



Burgess's concentric zone model

Urban Problems (LEDC): Squatter Settlements

Also known as *informal settlements*, *shanty towns*, *favelas* (Brazil), or *bustees* (India).

Characteristics:

- ✓ Houses are built illegally on land not owned by the residents (e.g., on steep slopes, river banks, next to railways).
- ✓ Housing is made from scrap materials (e.g., wood, metal sheets, plastic).
- ✓ Overcrowding is common, with no privacy.
- ✓ Lack of basic services like clean water, sanitation (sewers), electricity, or rubbish collection.
- ✓ High rates of disease, crime, and unemployment.

Case Study: Dharavi, Mumbai, India

- ✓ Dharavi is a massive squatter settlement in the middle of Mumbai.
- ✓ It has a huge **informal economy**, with thousands of small-scale workshops recycling rubbish, making pottery, and sewing clothes.
- ✓ **Solutions:**
 - **Self-Help Schemes:** The government provides basic materials (e.g., bricks, roofing) and services (a water tap, a sewer line), and residents use their own skills to improve their homes.

- **Redevelopment:** Large-scale, top-down projects like "Vision Mumbai" aim to demolish the slums and replace them with high-rise apartment blocks, funded by selling some of the valuable land to private developers.



In Mumbai, rich and poor live side by side with very little spare space

Urban Problems (MEDC): Traffic Congestion

Case Study: London, United Kingdom

- **Causes:**
 - High population and high car ownership.
 - Large numbers of commuters and tourists.
 - An old, narrow road network not designed for cars.
 - Key "bottlenecks" like river crossings.
- **Solutions (An Integrated Transport Policy):**
 - **Discouraging Cars:** The **London Congestion Charge** charges vehicles to enter the central zone, reducing traffic and funding public transport.
 - **Improving Public Transport:** Upgrading the Underground ("Tube"), building new lines like **Crossrail**, and creating dedicated bus lanes.
 - **Managing Traffic Flow:** Ring roads to divert traffic *around* the city, and park-and-ride schemes.



The Crossrail Project

Part 2: Physical Geography – The Natural Environment

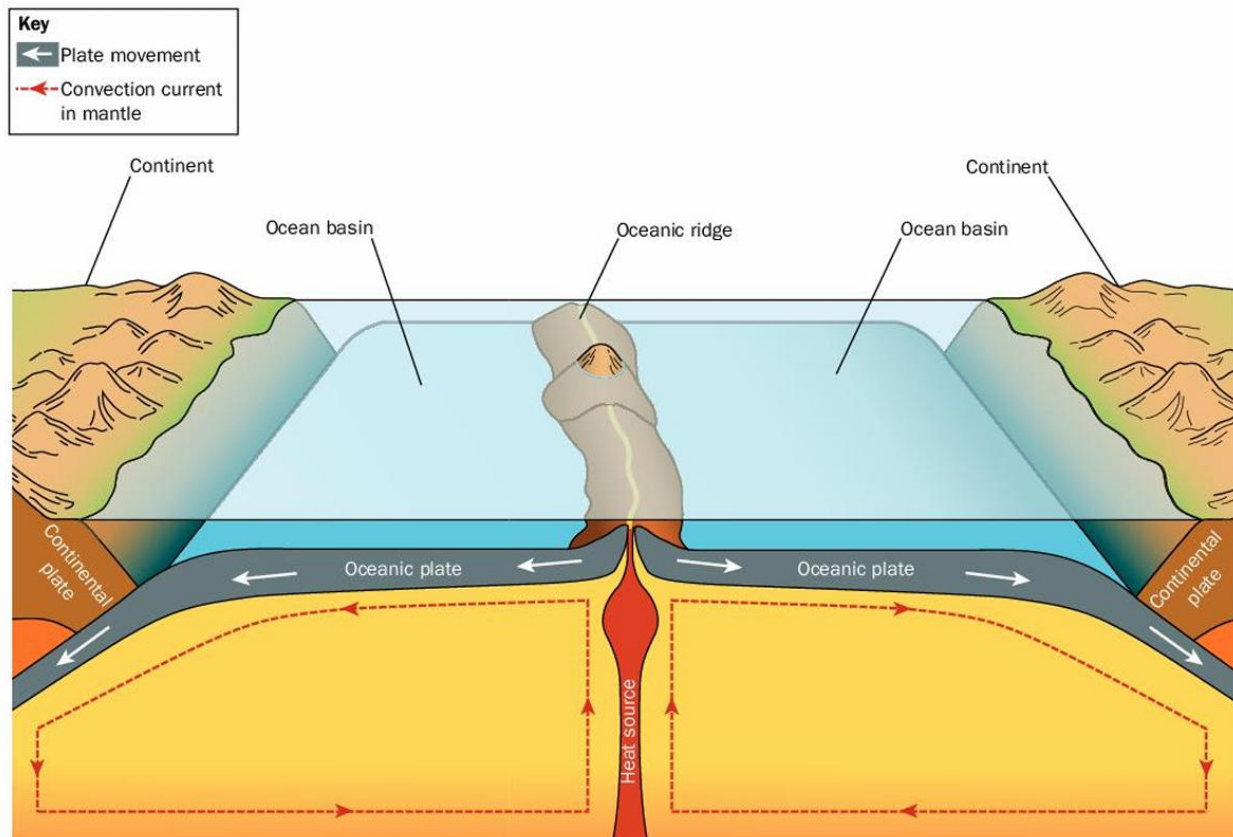
This section covers the dynamic forces and processes that create the Earth's physical landscapes, from mountains and volcanoes to rivers and coastlines. It also examines the world's major climates and the ecosystems they support.

2.1 Plate Tectonics and Geological Hazards

Core Concept: Plate Tectonics

The Earth's crust (the lithosphere) is not one solid piece. It is broken into massive sections called **tectonic plates** that float on the semi-molten mantle (the asthenosphere).

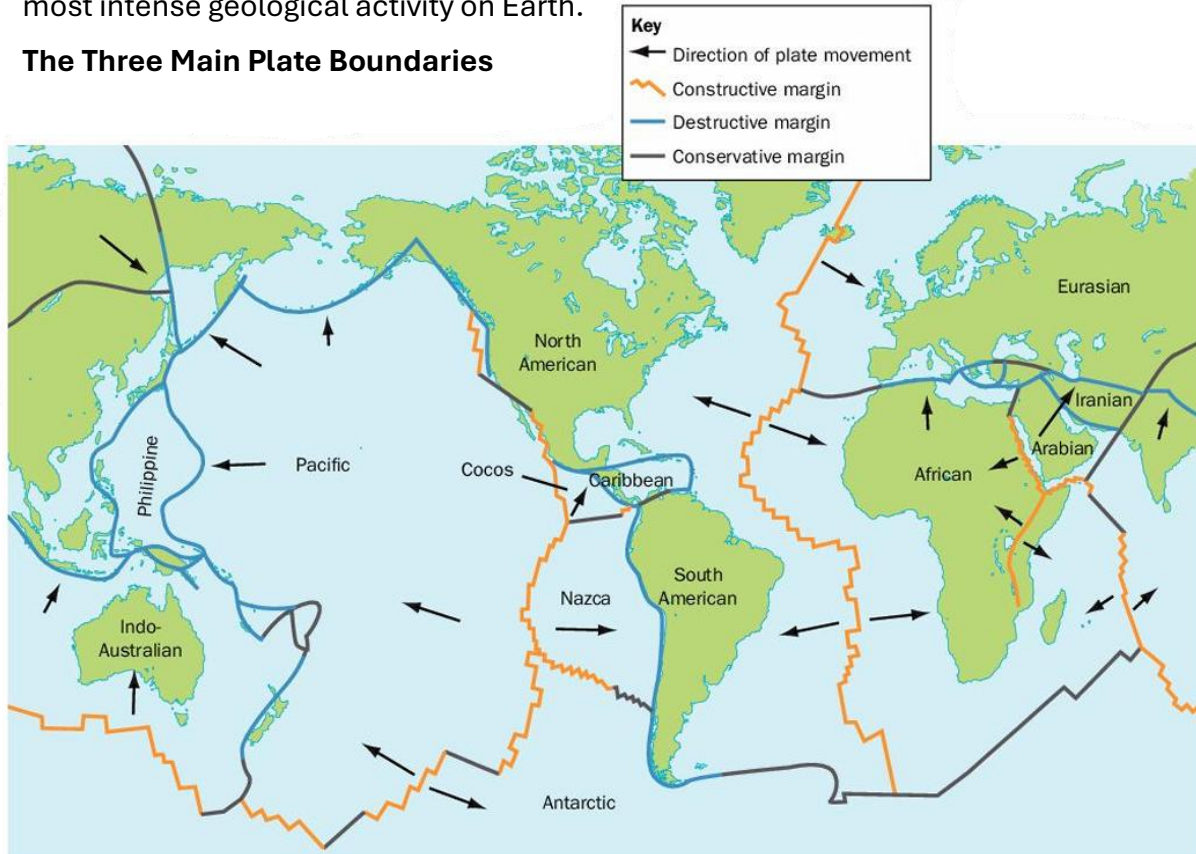
The movement of these plates is driven by **convection currents** in the mantle. Hot magma rises, cools, and sinks in a circular motion, dragging the plates above like a conveyor belt.



How convection currents in the mantle cause the plates to move

Where these plates meet, we find **plate boundaries**, which are responsible for the most intense geological activity on Earth.

The Three Main Plate Boundaries



1. Constructive (Divergent) Boundary

Movement: Plates pull *apart*.

Process: Magma rises from the mantle to fill the gap, creating new crust.

Landforms: Mid-ocean ridges (e.g., Mid-Atlantic Ridge) and **shield volcanoes** (e.g., Iceland).

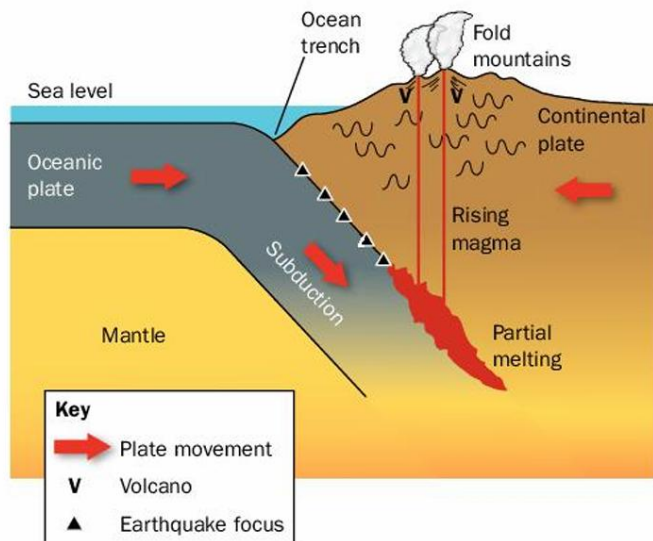
Hazards: Small earthquakes and effusive (runny) volcanic eruptions.

2. Destructive (Convergent) Boundary

Movement: Plates collide *together*.

Process: What happens next depends on the type of plates:

- **Oceanic-Continental:** The denser oceanic plate is forced *under* the continental plate. This is called **subduction**.
- **Oceanic-Oceanic:** The faster or denser oceanic plate subducts under the other.



A cross-section through the Andes, showing the destructive plate margin and the process of subduction

- **Continental-Continental:** The plates buckle and push upwards.
 - **Landforms:**
 - Subduction creates: Deep **Ocean trenches**, explosive **stratovolcanoes**, and **fold mountains** (e.g., the Andes).
 - O-O collision creates: **Island arcs** (e.g., Japan).
 - C-C collision creates: High **fold mountains** (e.g., the Himalayas).
 - **Hazards:** Major earthquakes and violent volcanic eruptions.

3. Conservative (Transform) Boundary

Movement: Plates slide *past* each other (in different directions or at different speeds).

Process: The plates "stick" and build up pressure. When this pressure is released, the plates jolt past each other.

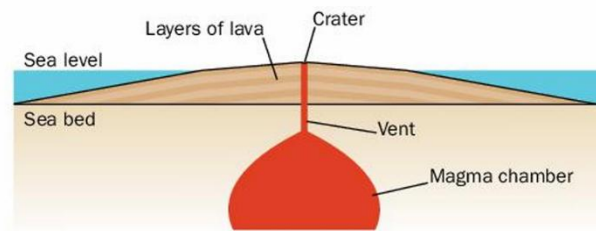
Landforms: Fault lines (e.g., San Andreas Fault).

Hazards: Severe **earthquakes** only. **No volcanoes** are formed here as no crust is being created or destroyed.

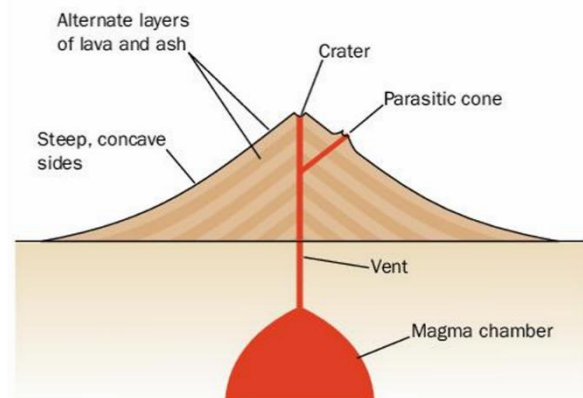
Volcanoes

A volcano is an opening in the Earth's crust through which magma, gases, and ash erupt.

Feature	Shield Volcano	Stratovolcano (Composite Cone)
Shape	Wide base, gentle slopes.	Narrow base, steep cone-shaped.
Lava	Thin, runny (low viscosity).	Thick, viscous (sticky).
Eruption	Effusive, frequent, gentle.	Explosive, infrequent, violent.
Boundary	Constructive (e.g., Iceland).	Destructive (e.g., Andes, Japan).
Materials	Lava only.	Alternating layers of ash and lava.



A cross-section through a shield volcano



A cross-section through a stratovolcano

Volcanic Hazards:

- **Pyroclastic Flow:** A superheated (800°C+), fast-moving cloud of gas and ash. It is the most deadly hazard.
- **Lahar:** A mudflow of volcanic ash mixed with water (from rain or melted ice). It flows down river valleys.
- **Ash Fall:** Can collapse roofs, destroy crops, and disrupt air travel.
- **Volcanic Gases:** Poisonous gases (like sulfur dioxide) can be released.

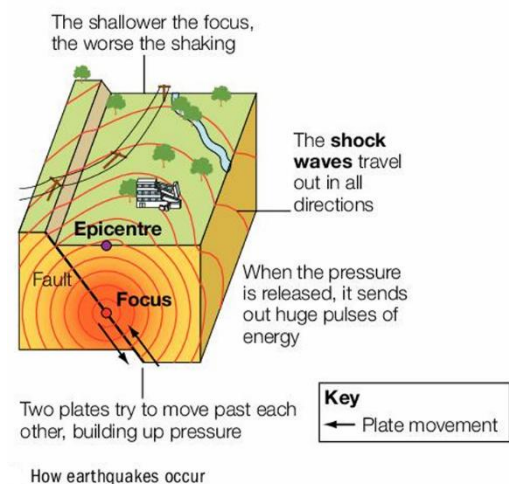
Opportunities from Volcanoes:

- **Fertile Soils:** Volcanic ash is rich in minerals, creating excellent land for farming.
- **Tourism:** Volcanoes attract many visitors, creating jobs in hotels, transport, and guiding.
- **Geothermal Energy:** The heat from magma can be used to boil water and drive turbines to generate electricity.

Earthquakes

An earthquake is the sudden, violent shaking of the ground caused by the release of pressure at a plate boundary.

- **Focus:** The point *within* the Earth where the earthquake originates. A shallow focus is more dangerous.
- **Epicentre:** The point on the Earth's *surface* directly above the focus, where the shaking is strongest.



Measuring Earthquakes:

- **Richter Scale:** Measures the **magnitude** (energy) of the earthquake using a seismometer. It is a logarithmic scale (e.g., magnitude 7 is 10x stronger than 6).
- **Mercalli Scale:** Measures the **intensity** (damage) of the earthquake based on observations. It uses Roman numerals (I - XII).

Earthquake Hazards:

- **Ground Shaking:** Collapses buildings, bridges, and roads.
- **Liquefaction:** Solid ground turns into a liquid-like state, causing buildings to sink or topple.
- **Tsunami:** A giant sea wave (or series of waves) caused by a large-scale displacement of water, usually from an undersea earthquake.

Feature	LEDC: Haiti Earthquake (2010)	MEDC: Japan Earthquake (2011)
Hazard	Mag 7.0 earthquake. Shallow focus near the capital.	Mag 9.0 earthquake. Epicentre offshore. Triggered a massive tsunami.
Preparation	Very low. No building codes, no warning systems, no public education.	Very high. Aseismic (quake-proof) buildings, 10m sea walls, regular drills.
Impacts	Catastrophic. Over 220,000 deaths. Buildings pancaked. Cholera outbreak followed.	Severe. ~20,000 deaths (90% from tsunami). Tsunami overtopped sea walls. Fukushima nuclear disaster.
Response	Slow and chaotic. Government collapsed. Dependent on international aid, which was delayed by a damaged port/airport.	Fast and organized. Self-Defence Force mobilized in hours. Rapid search and rescue.
Long-Term	Recovery is extremely slow; years later, many people were still in temporary camps.	Rapid rebuilding of infrastructure (roads, ports). Economy recovered, but long-term nuclear clean-up.

Hazard Response: MEDC vs. LEDC

A country's ability to cope with a hazard depends on its level of development.

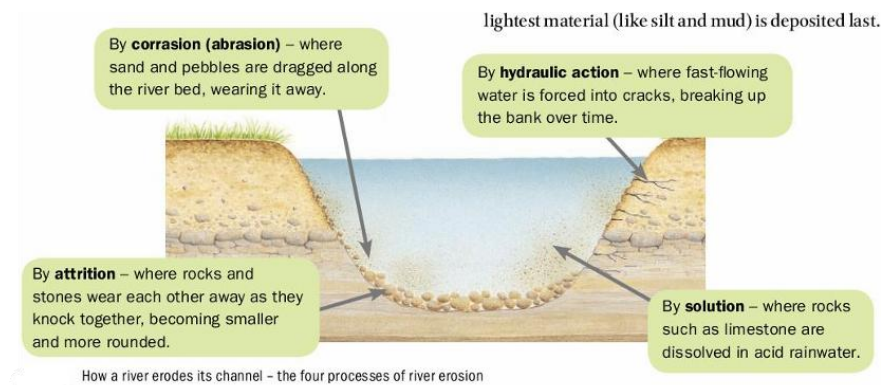
2.2 Fluvial (River) and Coastal Processes

River Processes

Rivers shape the landscape through three main processes:

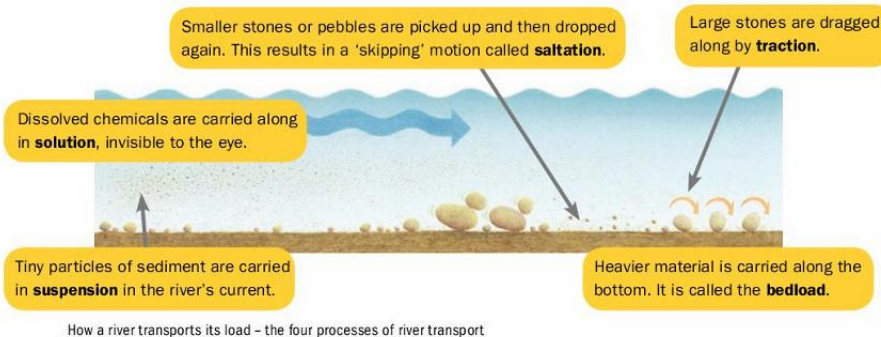
1. Erosion:

- ✓ **Hydraulic Action:** The sheer force of the water hitting the bed and banks.
- ✓ **Corrasion (Abrasion):** The river's load (rocks) scrapes and scours the bed and banks.
- ✓ **Attrition:** Rocks in the river's load smash into each other, breaking down to become smaller and rounder.
- ✓ **Solution (Corrosion):** River water dissolves soluble minerals (like chalk and limestone).



2. Transportation:

- ✓ **Traction:** Large boulders are *rolled* along the riverbed.
- ✓ **Saltation:** Pebbles are *bounced* along the riverbed.
- ✓ **Suspension:** Fine silt and clay are *carried* within the water.
- ✓ **Solution:** Dissolved minerals are *carried* in the water.



3. Deposition:

- ✓ A river deposits its load when it loses energy (velocity).
- ✓ This happens when: the river slows down, the gradient becomes gentler, the river enters a lake or sea, or during a dry spell.

River Landforms (From Source to Mouth)

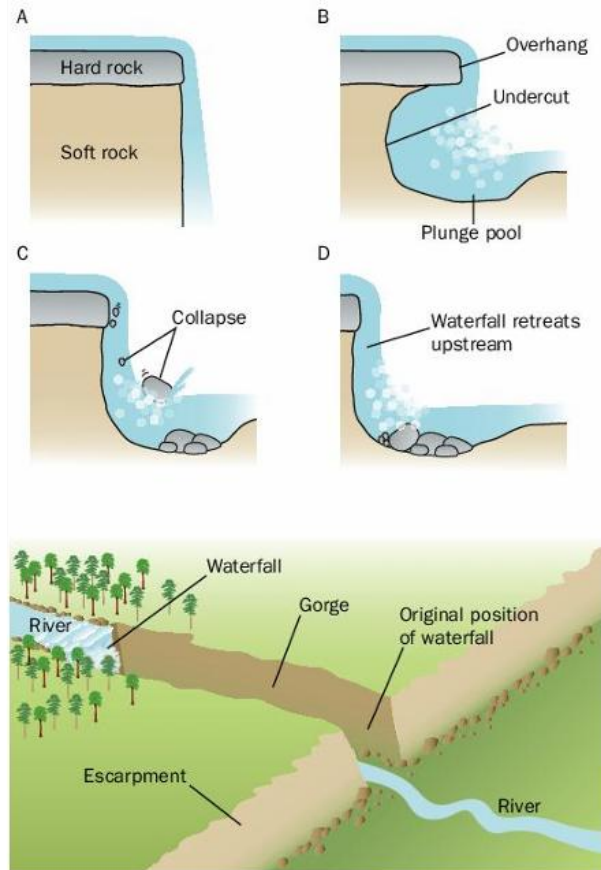
- **Upper Course:**

V-Shaped Valley: Steep-sided valley formed by vertical (downward) erosion.

Interlocking Spurs: Hillsides that the river winds around.

Waterfall: Forms where a river flows over a band of hard rock onto softer rock. The soft rock is eroded more quickly, undercutting the hard rock, which eventually collapses. The waterfall retreats upstream, leaving a...

Gorge: A steep-sided valley left behind by a retreating waterfall.

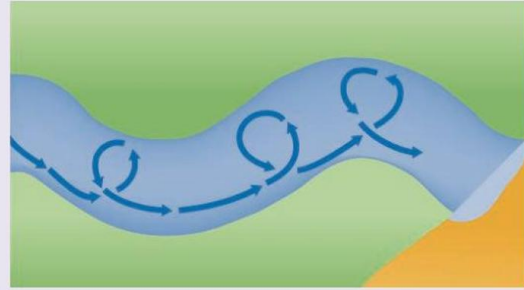


The formation of a waterfall (A-D) and the formation of a gorge by waterfall retreat

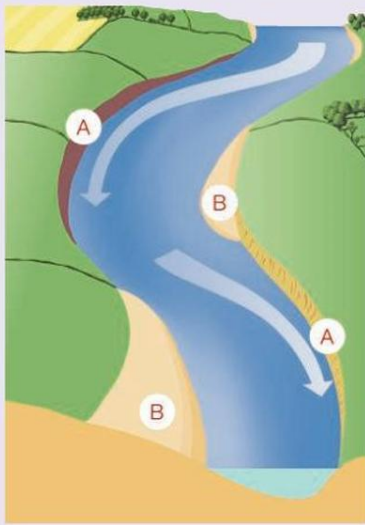
- **Middle/Lower Course:**

- **Meander:** A large bend in a river. Erosion (corrasion) is fastest on the **outer bend** (forming a *river cliff*), while deposition occurs on the **inner bend** (forming a *slip-off slope*).
- **Oxbow Lake:** Formed from a meander.

1 The water in a river flows naturally in a corkscrew pattern. This is called **helical flow**.

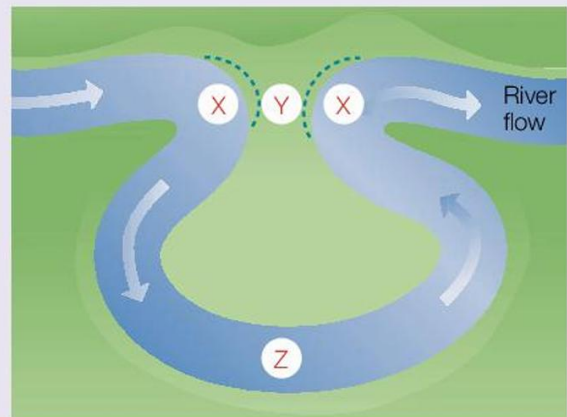


2 Helical flow sends the river's energy to the sides (laterally). The fastest current is forced to the outer bend (A), where it undercuts and erodes the bank to form a **river cliff**. The helical flow then transports sediment from (A) across the channel to the inner bank (B), or **slip-off slope**, where the slower-moving water deposits it to form a **point bar**.



1. Erosion on the outer bends of a meander causes the "neck" of the meander to narrow.
2. During a flood, the river breaks through the neck to take a shorter, straighter route.
3. Deposition seals off the old bend, leaving a C-shaped oxbow lake.

3 Continued erosion sometimes creates a narrow neck between two meanders (X). Eventually, the neck is cut through at Y, and the river creates a new channel for itself across the neck of the meander (an easier route for the water). The old meander then becomes an **oxbow lake** (Z) when deposition seals the ends – completely separating it from the river.



- **Floodplain:** The wide, flat area of land on either side of a river, which is flooded when the river bursts its banks.
- **Levee:** Raised river banks (natural or man-made).

- **Delta:** A fan-shaped area of sediment deposited where a river meets a sea or lake, splitting the channel into **distributaries**.

Coastal Processes

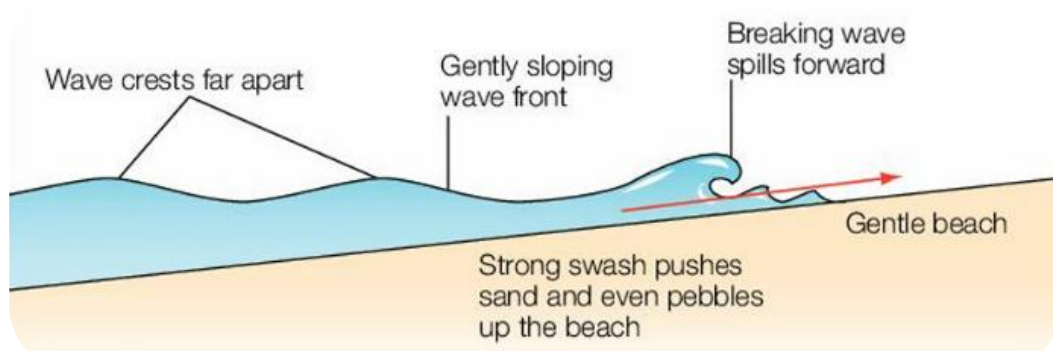
- **Waves:**

Fetch: The distance of open water the wind blows over to create a wave.

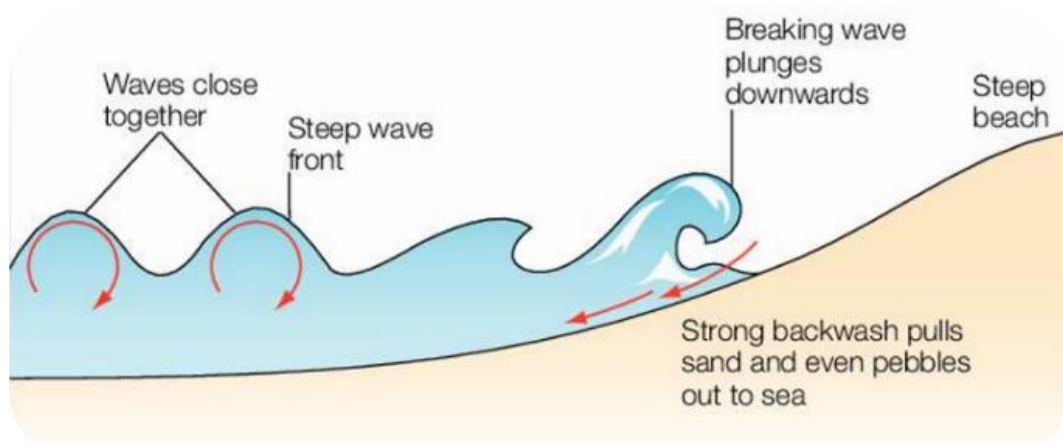
Swash: The water that rushes *up* the beach.

Backwash: The water that drains *back* down the beach.

Constructive Waves: Strong swash, weak backwash. **Builds (deposits)** the beach.



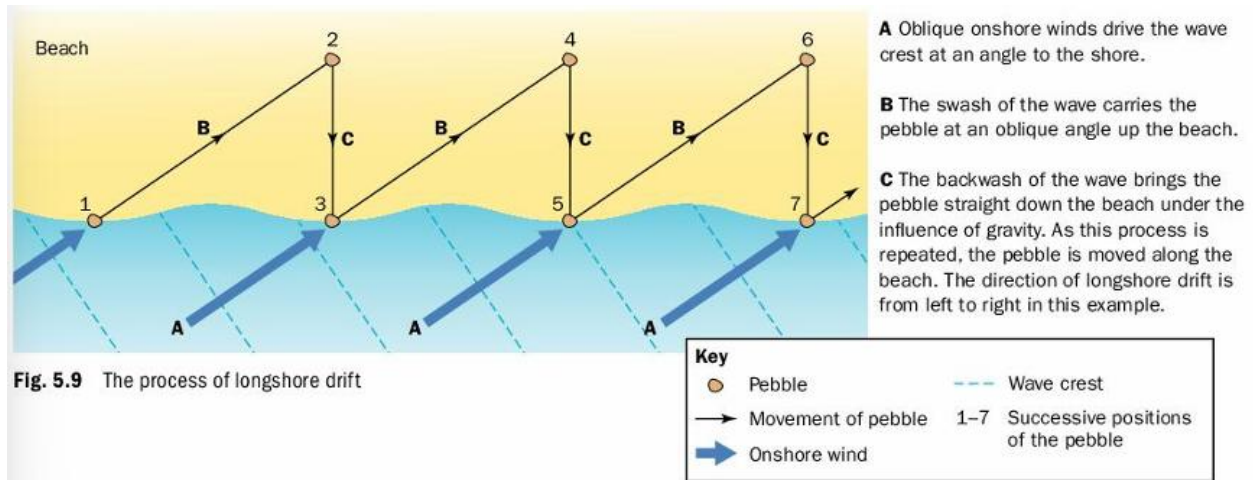
Destructive Waves: Weak swash, strong backwash. **Destroys (erodes)** the beach.



- **Longshore Drift (LSD):**

- The zigzag movement of sediment along the coastline.
- Waves approach the beach at an angle (due to prevailing wind), carrying sediment up the beach (swash).
- Gravity pulls the sediment straight back down the beach (backwash).

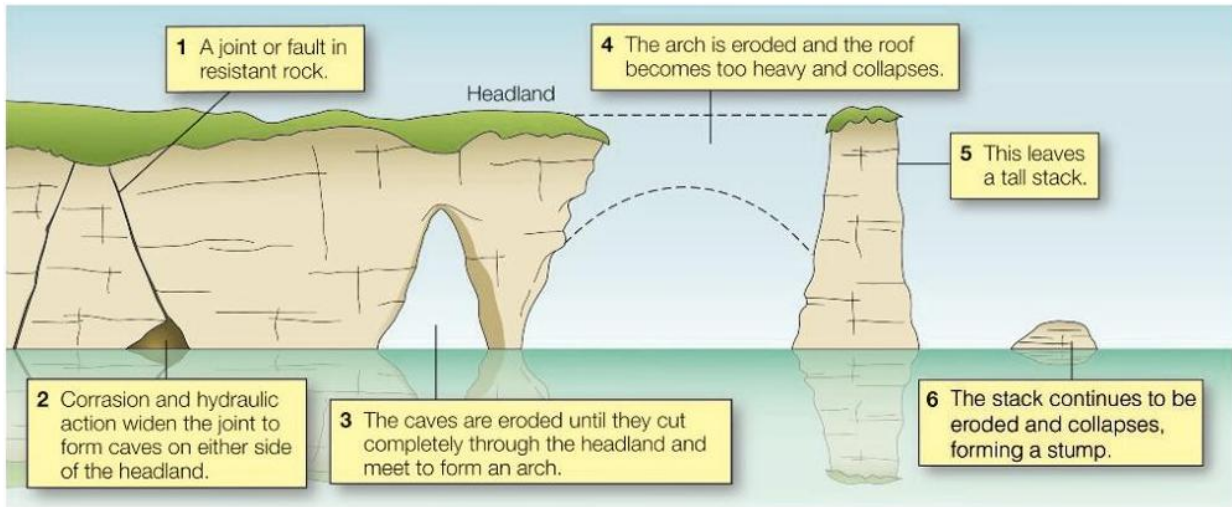
- This gradually moves material along the coast.



Coastal Landforms of Erosion

- **Headlands and Bays:** On **discordant coasts** (where hard and soft rock are at 90° to the sea), the soft rock is eroded faster to form bays, leaving the resistant hard rock sticking out as headlands.
- **Cliffs and Wave-Cut Platforms:**
 1. Waves attack the base of a cliff (hydraulic action, corrasion), forming a *wave-cut notch*.
 2. The notch deepens until the cliff above is unsupported and collapses.
 3. This process repeats, causing the cliff to retreat.
 4. It leaves behind a flat, rocky area at the base called a *wave-cut platform*.
- **Cave, Arch, Stack, Stump:**
 1. Waves attack a line of weakness (a fault) in a headland, forming a **Cave**.
 2. The cave erodes all the way through the headland, forming an **Arch**.
 3. Erosion and weathering attack the roof of the arch until it collapses, leaving a **Stack** (a tall column of rock).

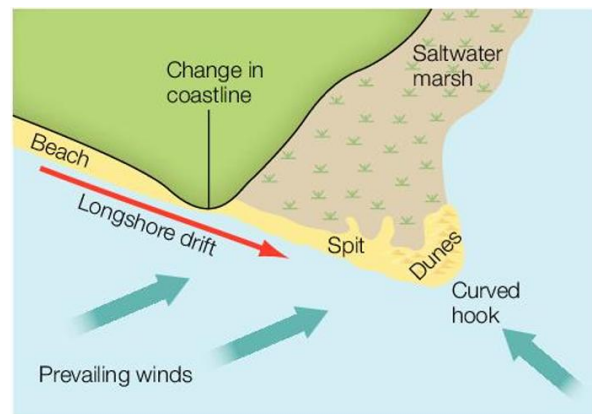
4. The stack is eroded by the sea and collapses, leaving a small **Stump**.



How caves, arches, stacks and stumps form

Coastal Landforms of Deposition

- **Beaches:** Formed by constructive waves, often in sheltered bays.
- **Spit:** A long, narrow ridge of sand or shingle formed by **Longshore Drift**. It is joined to the land at one end and just out into the sea at the other.



How a spit forms

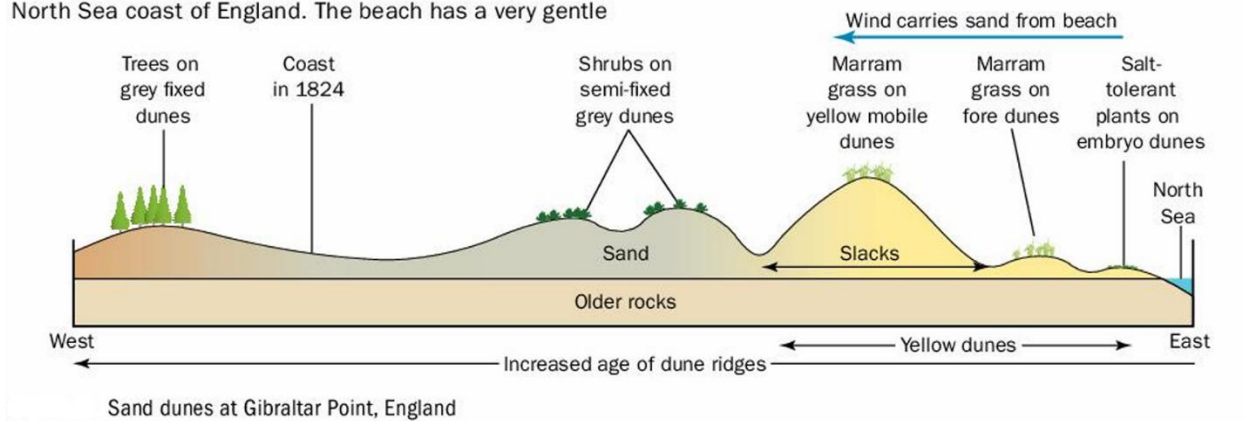
- **Bar:** A spit that grows all the way across a bay, trapping a **Lagoon** behind it.
- **Sand Dunes:** Ridges of wind-blown sand found at the back of a beach.
Succession: Embryo Dune -> Fore Dune -> Yellow Dune -> Grey Dune -> Climatic Climax.

- **Marram Grass:** A key plant with long roots that binds the sand together, stabilizing the dunes and allowing them to grow taller.

The sand dune system at Gibraltar Point

These dunes have formed just south of Skegness on the North Sea coast of England. The beach has a very gentle

gradient, so the onshore wind blows over a wide expanse of sand – picking up and carrying dry sand for dune building.



2.3 Weather, Climate, and Biomes

- **Weather:** The short-term, day-to-day conditions of the atmosphere.
- **Climate:** The average weather conditions of a place taken over a long period (e.g., 30 years).

Weather Measurement

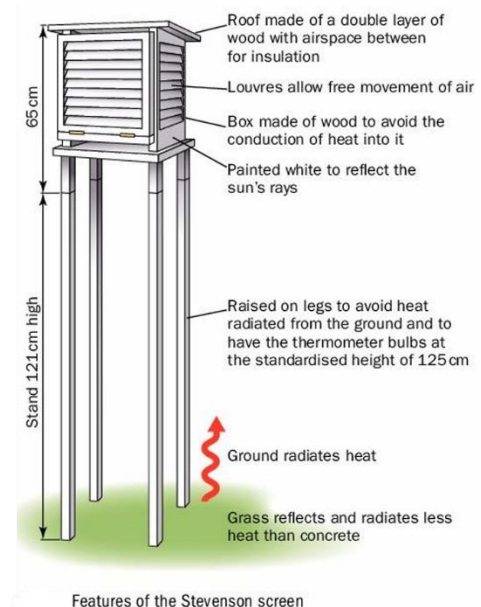
Instruments must be sited correctly to give an accurate reading. The most important piece of equipment is the **Stevenson Screen**.

Stevenson Screen: A white wooden box on legs with louvered (slatted) sides.

Purpose: To house thermometers and hygrometers in "fair test" conditions.

Features:

- ✓ **White:** Reflects sunlight.
- ✓ **Louvered sides:** Allows air to circulate but blocks direct sun.
- ✓ **On legs:** Prevents heat from the ground affecting the reading.
- ✓ **Double roof:** Insulates from the sun.



Key Instruments:

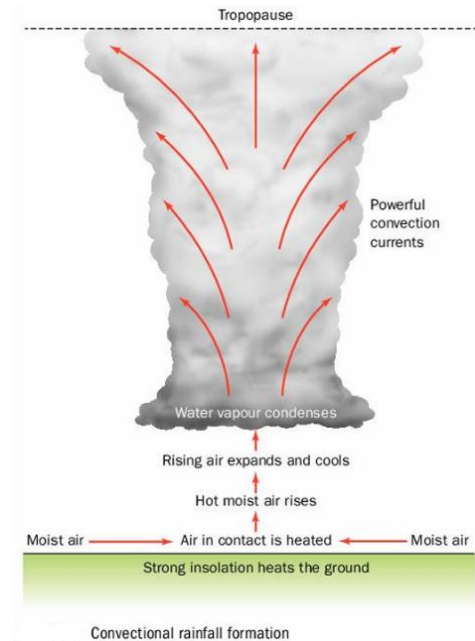
- ✓ **Rain Gauge:** Measures precipitation (mm). Sunk into the ground in an open space.
- ✓ **Max-Min Thermometer:** Records the highest and lowest temperature of the day.
- ✓ **Hygrometer (Wet/Dry Bulb):** Measures humidity.
- ✓ **Barometer:** Measures air pressure (millibars).
- ✓ **Anemometer:** Measures wind speed. Placed high on a mast.

Rainfall Types

Rain is formed by air rising, expanding, cooling, and condensing.

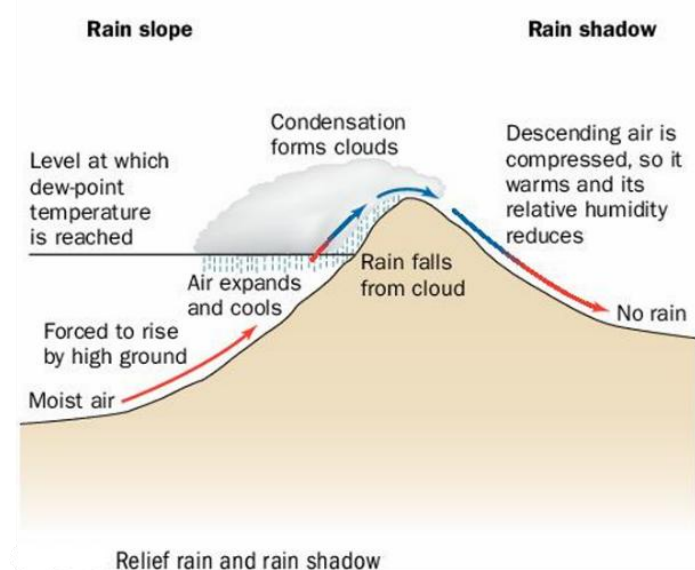
1. Convective Rainfall:

- The sun heats the ground.
- The ground heats the air above it, which rises.
- The air cools, condenses, and forms large cumulonimbus clouds.
- *Result: Heavy, intense thunderstorms (common in tropical/equatorial areas).*



2. Relief (Orographic) Rainfall:

- Prevailing winds force moist air to rise over mountains.
- The air cools, condenses, and forms clouds and rain on the **windward** side.
- The air (now dry) sinks on the other side, warming up. This creates a **rain shadow** (a dry area).



Ecosystem 1: Equatorial Climate & Tropical Rainforest

- **Climate:** Hot (avg. 27°C) and wet (2000mm+ rain) *all year long*. There are no seasons.
- **Vegetation (Tropical Rainforest):** The most biodiverse biome on Earth.

Structure: A 5-layer vertical structure (Ground, Shrub, Under-Canopy, Main Canopy, Emergent).

Adaptations:

- **Buttress Roots:** Large roots to support tall trees in shallow soil.
- **Drip-Tips:** Pointed leaves to shed water quickly.
- **Lianas:** Vines that climb trees to reach sunlight.

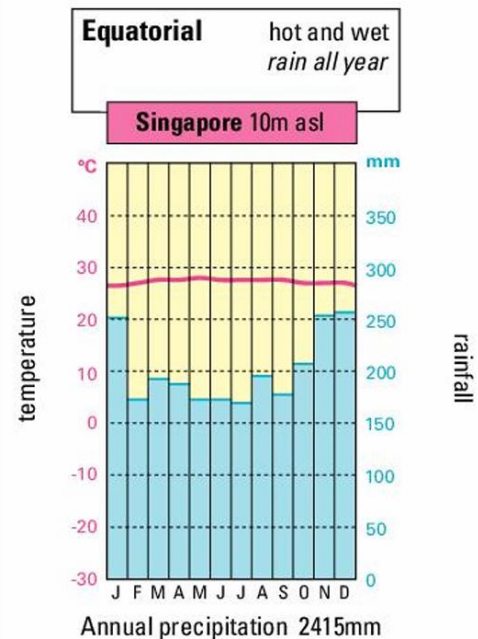
Soils: Surprisingly infertile. Heavy rain **leaches** (washes out) nutrients. Most nutrients are stored in the **biomass** (the plants themselves).

Issues: Deforestation

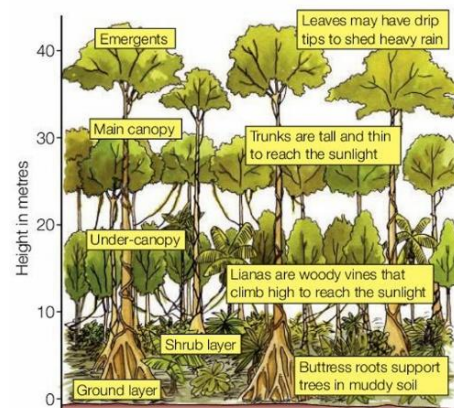
Example: Borneo.

Causes: Logging (timber), mining, HEP dams, and clearance for **palm oil plantations**.

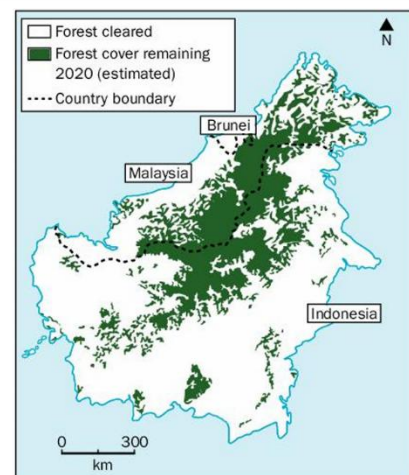
Impacts: Loss of biodiversity, soil erosion (leading to mudslides), loss of indigenous homes, and **global warming** (less CO₂ absorbed).



The climate of Singapore



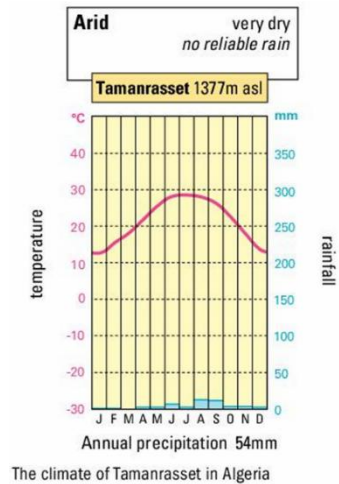
The structure and characteristics of tropical rainforest



Large-scale deforestation in Borneo

Ecosystem 2: Hot Desert Climate & Vegetation

- **Climate:** Very hot days ($>40^{\circ}\text{C}$) but cold nights (high *diurnal* range). Very low rainfall ($<250\text{mm}$ per year).
 - **Cause:** Located near the tropics (30° N/S) in a belt of **subtropical high pressure**, where air is *sinking*, preventing cloud formation.



- **Vegetation (Xerophytes):** Plants adapted to drought.
- **Adaptations:**

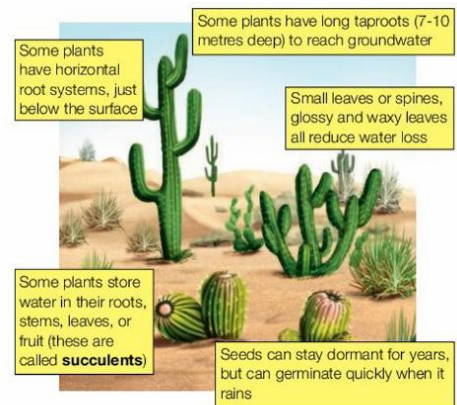
Succulents (e.g., Cactus): Store water in fleshy stems.

Spines: Reduce water loss (transpiration) and protect from animals.

Tap Roots: Very long roots to reach groundwater.

Surface Roots: Wide, shallow roots to catch any surface rain.

Ephemerals: Plants with short life cycles that only appear after rain.



Some characteristics of hot desert vegetation

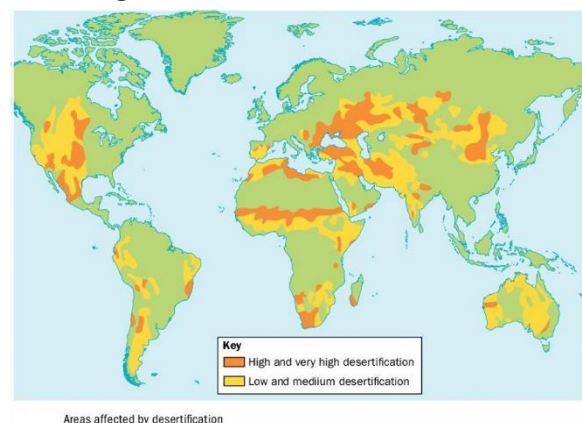
- **Issues: Desertification**

Definition: The process of land turning into desert, becoming degraded and unproductive.

Causes (Human): **Over-grazing** (removes vegetation), **over-cultivation** (exhausts soil), deforestation (for fuelwood).

Causes (Physical): Drought and climate change.

Case Study / Solution: The **Sahel** region is at high risk. The **Great Green Wall** (an 8,000km belt of trees) is a major project to stop desertification by planting trees to bind the soil and increase humidity.



Part 3: Economic Geography & Resource Management

This section connects human and physical geography by exploring how people use the Earth's resources. It covers how we measure development, produce food and goods, and manage critical resources like energy and water.

3.1 Development and Globalisation

Measuring Development

Development is the process by which a country improves the economic and social well-being (quality of life) of its people.

- **Gross Domestic Product (GDP) per capita:**
 - **What it is:** The total value of all goods and services produced in a country in one year, divided by its population (an average wealth).
 - **Limitation:** A simple average that measures *wealth* but not *quality of life*. It can be skewed by a few wealthy individuals and ignores the informal economy.
- **Human Development Index (HDI):**
 - **What it is:** A composite index (score from 0 to 1) that provides a more complete picture of development.
 - **Three Dimensions:**
 1. **A Long and Healthy Life** (measured by Life Expectancy).
 2. **Knowledge** (measured by mean years of schooling and adult literacy).
 3. **A Decent Standard of Living** (measured by GDP per capita).

	Norway	Thailand	Central African Republic
HDI	0.949	0.73	0.35
GDP per capita (\$US)	69 000	16 800	700
Death rate per 1000	8.1	7.9	13.5
Infant mortality per 1000 births	2.5	9.4	88.4
Birth rate per 1000	12.2	11.1	34.7
Life expectancy at birth	81.8	74.4	52.3
Population growth rate (%)	1.07	0.32	2.12
Adult literacy (% of population)	100	96.7	36.8
Doctors per 1000 population	4.42	0.39	0.05
Urban population (% of total)	80.5	50.4	40
Agricultural employment (% of population)	2	9	58
Access to electricity (% of population)	100	99	3
Internet use (% of population)	96.8	39.3	4.6

Different measures of development (based on the most up-to-date statistics available in 2017) for Norway, Thailand, and the Central African Republic

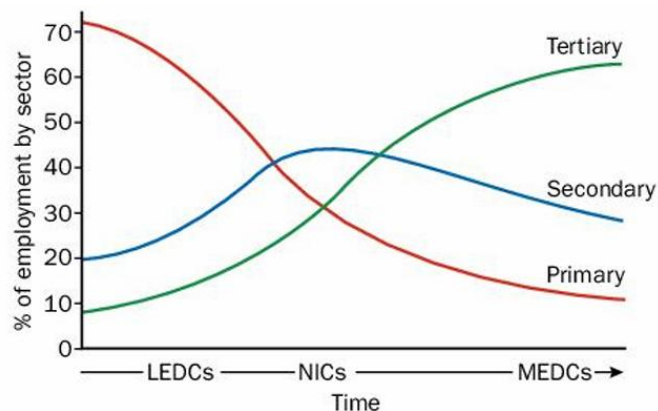
Economic Sectors

A country's workforce is divided into four main economic sectors. The proportion of people in each sector shows how developed a country is.

1. **Primary Sector:** Extraction of raw materials.
 - *Examples: Farming, mining, fishing, forestry.*
2. **Secondary Sector:** Manufacturing and processing.
 - *Examples: Car assembly, steelmaking, food processing (factories).*
3. **Tertiary Sector:** Providing a service.
 - *Examples: Teachers, doctors, shop assistants, transport.*
4. **Quaternary Sector:** High-tech research and information.
 - *Examples: IT specialists, scientific research & development (R&D), biotechnology.*

The Shift in Employment Structure: As a country develops, its main source of employment "evolves" from Primary to Secondary to Tertiary/Quaternary.

1. **LEDC (e.g., Niger):** Dominated by the **Primary** sector (subsistence farming).
2. **NIC (e.g., China):** Dominated by the **Secondary** sector (manufacturing).
3. **MEDC (e.g., Japan):** Dominated by the **Tertiary** and **Quaternary** sectors (service and information economy).



How employment in industrial sectors changes with time as a country becomes more developed

Globalisation & Transnational Corporations (TNCs)

- **Globalisation:** The process of the world becoming increasingly interconnected through trade, transport (e.g., containerization), and communications (e.g., the internet).
- **Transnational Corporation (TNC):** A large company that operates in multiple countries. They often have their headquarters (HQs) and R&D in an MEDC, and their factories or assembly plants in LEDCs.

Case Study: Toyota Toyota is a classic TNC. Its headquarters and main R&D are in Japan (an MEDC), but it has manufacturing plants all over the world to access global markets, cheaper labour, and bypass trade tariffs.



Impacts of TNCs on Host Countries (LEDCs):

Advantages (Pros)	Disadvantages (Cons)
Jobs are created, reducing unemployment.	Economic Leakage: Profits are sent back to the TNC's home country (in an MEDC).
New Skills & Technology are brought into the country.	Low-Level Jobs: Assembly line jobs are created, but high-skill R&D jobs stay in the MEDC.
Investment in infrastructure (roads, ports) and taxes paid to the government help development.	Exploitation: Workers may be paid low wages and work in poor conditions.
TNCs stimulate the local economy (Multiplier Effect).	Pollution: TNCs may move to LEDCs to avoid strict environmental laws at home.

3.2 Food Supply

Agricultural Systems

Commercial: Farming with the goal of selling crops and livestock for a **profit**.

Subsistence: Farming to grow food only for the **family's survival**.

Intensive: High inputs (e.g., labour, capital, fertilizer) on a **small** area of land. Aims for high yield per hectare.

- *Examples: Terraced rice farming; feedlot cattle.*

Extensive: Low inputs on a **large** area of land.

- *Examples: Cattle ranching in Brazil; wheat farming in Canada.*

Case Study (Commercial): Large-scale wheat farming (Canadian Prairies)

Type: Commercial, Extensive, and highly Mechanized.

Physical Inputs: Vast flat lands (relief), fertile black "chernozem" soils, suitable climate (cold winter, warm summer).

Human Inputs: High **capital** (expensive machinery like combine harvesters), but very low **labour** (one family can farm a huge area). Advanced seeds and fertilizers are used.

Problem: The soil is exposed after ploughing, leading to severe **soil erosion** by wind (leading to "Dust Bowls").



On extensive commercial farms, the use of large machines (like these combine harvesters) is common

Case Study (Subsistence): Small-scale farming (Swaziland)

Type: Subsistence, Intensive, and low-technology.

Physical Inputs: Small, fragmented plots of land (1-3 hectares); often reliant on seasonal rainfall.

Human Inputs: High family **labor** (using hand tools like hoes); very low **capital** (few machines or fertilizers).

Outputs: Maize (staple food) and a few cattle (a sign of wealth).

Problems: Erratic rainfall and drought; **overstocking** of cattle and **overgrazing** leave the soil bare, leading to **soil erosion** by water (gully erosion).



Food Shortages

Food shortages can lead to **malnutrition** and **famine**.

Causes of Food Shortages:

- **Physical (Natural) Causes:**

- **Drought:** A prolonged lack of rainfall (the main physical cause, e.g., in the Sahel).
- **Floods:** Can destroy an entire harvest.
- **Tropical Storms:** Can flatten crops.

- **Pests:** Swarms of locusts can destroy crops.
- **Human (Economic & Political) Causes:**
 - **Poverty:** Farmers cannot afford seeds, fertilizer, or irrigation (the vicious circle of poverty).
 - **Conflict:** War disrupts farming, as people flee their land and food is used as a weapon.
 - **Soil Exhaustion:** Over-cultivation leaches nutrients from the soil, reducing yields.

Soil Conservation

This is the *solution* to the problems of soil erosion seen in both the Canadian Prairies and Swaziland.

Terracing: Cutting "steps" into a steep slope. This stops water from running straight downhill and washes away the soil.

Contour Ploughing: Ploughing *across* the contours (slope) instead of *down* it. The furrows act like small dams, trapping water.

Crop Rotation: Alternating crops in a field each year (e.g., planting a nutrient-depleting crop like maize one year, and a nutrient-fixing crop like beans the next).

Shelter Belts (Windbreaks): Planting rows of trees to block the wind and prevent it from eroding the soil.

3.3 Energy and Water Resources

Energy

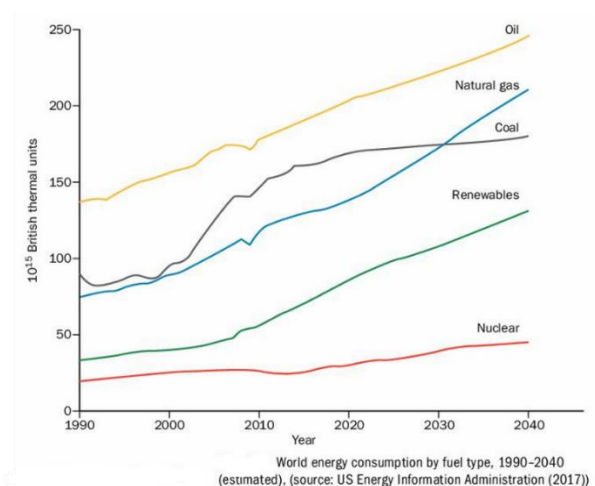
Global energy consumption is rising, driven by the industrialisation of NICs like China and India.

Non-Renewable Energy (Finite):

- **Fossil Fuels:** Formed from ancient organic matter.

Coal: Mined in two ways: **Deep (shaft) mining** or **Opencast**

(surface) mining. Causes air pollution (CO₂, acid rain).



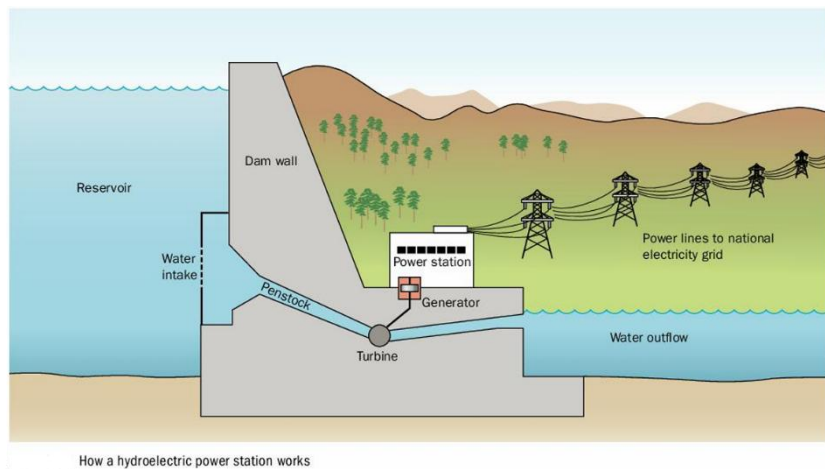
- **Oil & Natural Gas:** Extracted from underground reserves.

Nuclear Power: Uses Uranium.

- **Pros:** Produces vast amounts of electricity with **no CO2 emissions**.
- **Cons:** Radioactive waste is dangerous and difficult to store; risk of major accidents (e.g., Chernobyl, Fukushima).

Renewable Energy (Infinite):

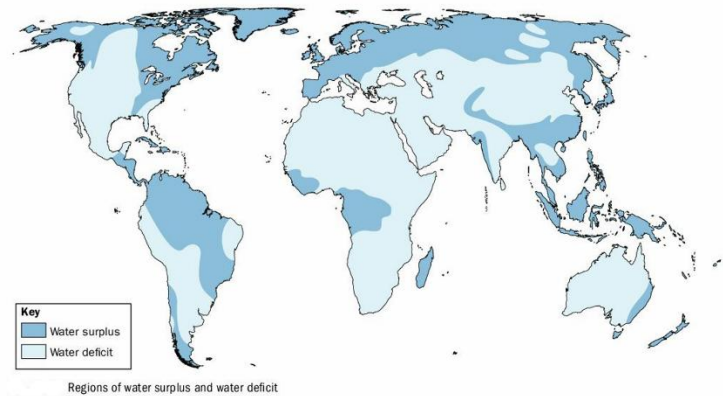
- **Fuelwood:** The main energy source for cooking/heating in many LEDCs.
 - ✓ **Problem:** Leads to massive **deforestation**, soil erosion, and desertification.
- **Geothermal:** Uses heat from the Earth's core (e.g., Iceland).
- **Wind:** Uses turbines to generate electricity.
 - ✓ **Pros:** Clean, no emissions.
 - ✓ **Cons:** Visual pollution, noisy, unreliable (not always windy).
- **Solar:** Uses photovoltaic cells to convert sunlight.
 - ✓ **Pros:** Clean, excellent for remote areas.
 - ✓ **Cons:** Expensive, doesn't work at night.
- **Hydroelectric Power (HEP):**
 - ✓ **Process:** Water is stored in a reservoir behind a **dam**. It is released to flow through pipes (penstocks), spinning a **turbine** which generates electricity.
 - ✓ **Pros:** Clean (no CO2), cheap to run, reservoir can be used for water supply and recreation.
 - ✓ **Cons:** Extremely high build cost, floods huge valleys, displaces thousands of people and destroys habitats, traps sediment (which stops fertile silt from flowing downstream).



Water Resources

Water is essential for domestic use, industry, and agriculture (which uses 70% of all fresh water).

- **Water Surplus:** An area that has more water than it needs.
- **Water Deficit:** An area that does not have enough water (an area of water scarcity).



Water Management

Humans manage water supplies in several ways:

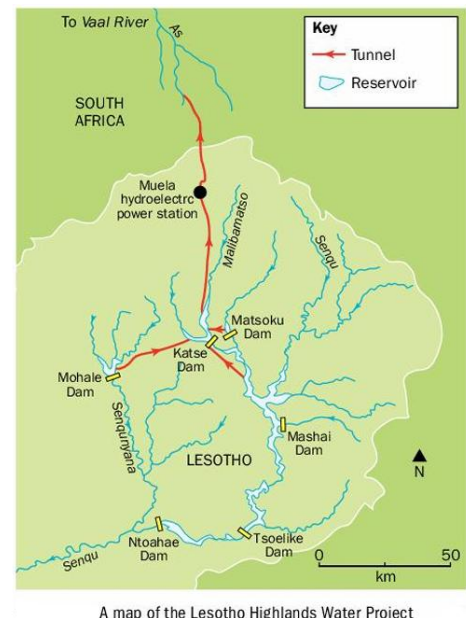
Dams & Reservoirs: Store water from rainy seasons to use in dry seasons.

Desalination: Removing salt from seawater to make it drinkable. This is very expensive and energy-intensive, so it is only used in wealthy, dry countries (e.g., Saudi Arabia, Australia).

Water Transfer Schemes: Moving water from an area of surplus (e.g., a mountain reservoir) to an area of deficit (e.g., a city) via pipes and canals.

Case Study (Water Transfer): Lesotho Highlands Water Project This is one of the largest water transfer schemes in the world.

- **What it is:** A giant system of dams and tunnels that moves water from the mountains of **Lesotho** (a water surplus) to the industrial and urban heartland of **South Africa** (a major water deficit).
- **Advantages for Lesotho:**
 - Receives a large annual fee (royalty) from South Africa, which is a major part of its national income.
 - Generates its own HEP at the Muela power station.



- **Disadvantages for Lesotho:**
 - The construction of the huge dams (like the Katse Dam) flooded valleys, **displacing over 20,000 people** from their homes and farmland.
 - Disrupted downstream river ecosystems.
 - The country is now in significant debt from the project.

Part 4: Conclusion & Key Skills Overview

Summary of Key Themes: The Interconnected World

This summary has covered the three great pillars of geography: the physical planet, the human populations that live on it, and the economic systems that link them.

The single most important theme for you to take away is **interconnectedness**. No part of geography exists in isolation. The most complex issues on Earth, and the most common Olympiad questions, are found at the intersection of these pillars.

- A **volcanic eruption** (Physical) is not just a geological event; it is a **hazard** that displaces communities (Human) while also creating fertile soils that support **agriculture** (Economic).
- The decision to build a **dam** (Economic) permanently alters a **river's processes** (Physical) and can displace thousands of people from their homes (Human).
- A high **dependency ratio** (Human) in a country like Japan puts a significant strain on its **economic** resources and shapes its national policies.
- The global demand for **palm oil** (Economic) drives **deforestation** in Borneo (Physical), which in turn destroys habitats, impacts the global climate, and threatens the lifestyles of indigenous people (Human).

Geography is the discipline that identifies and explains these complex links. Mastering these connections is the key to mastering the subject.

Essential Olympiad Skills: Applying Your Knowledge

Knowledge of the concepts in this summary is the foundation. The Olympiad will test your ability to *apply* this knowledge using core geographical skills. Be prepared to:

1. Map Skills

- Interpret large-scale topographic maps.

- Identify locations using **4-figure and 6-figure grid references**.
- Measure **distance** (using scale) and determine **direction** (compass points and 360° bearings).
- **Crucially, interpret contour lines** to identify relief, gradient (slope), and landforms (e.g., V-shaped valleys, spurs, ridges, plateau, and cliffs).

2. Data Interpretation

- Read and analyze **graphs** (line, bar, scatter) and **charts** (pie charts).
- Find patterns, trends, and anomalies in data tables.
- Deconstruct **population pyramids** to determine a country's development stage, birth/death rates, and future challenges.
- Understand specialized diagrams like **wind roses** and **climate graphs**.

3. Photograph Interpretation

- Identify and describe physical and human features from ground-level or aerial photographs.
- Use labels like **foreground, middle ground, and background** to structure your description.
- Deduce processes or activities from visual evidence (e.g., identifying soil erosion, a type of farming, or land use in a city).

-The End-



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