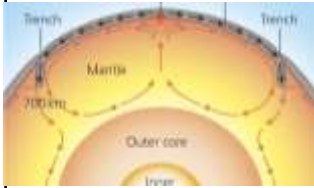

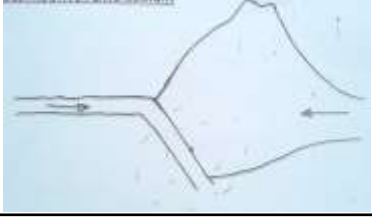
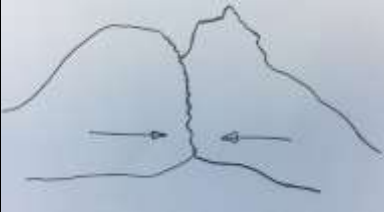
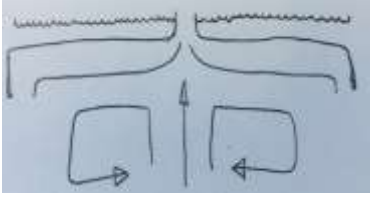
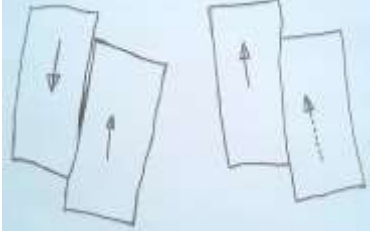


## Section A: The Challenge of Natural Hazards (Parts 1-5)

- *Tectonic hazards: **Chile and Nepal earthquakes***
- *Tropical storm: **Typhoon Haiyan***
- *Extreme weather event: **Somerset Floods***



<b>4 layers of the earth</b>	<ul style="list-style-type: none"> <li>Crust: outer layer of the earth (solid, thin layer)</li> <li>Mantle: layer beneath the crust (semi-liquid, thick)</li> <li>Outer core: layer beneath the mantle (liquid iron)</li> <li>Inner core: centre layer (solid iron)</li> </ul>	<b>Natural Hazard</b>	<b>A natural process that poses a threat to people and property.</b> If it poses no threat to humans it is called a natural event.
	<b>Tectonic Plates</b> The crust is split into several pieces. These large pieces of rock are called tectonic plates. They float on the mantle.	<b>Meteorological hazard</b>	A hazard that occurs in the atmosphere (e.g. hurricane, thunder and lightning, tornado, drought)
		<b>Geological/ Tectonic hazard</b>	A hazard that occurs due to the movement of tectonic plates (e.g. volcanoes and earthquakes)
		<b>Hazard risk</b>	<b>The probability that a natural hazard occurs.</b> It is affected by: <ol style="list-style-type: none"> <li>Urban vs rural: urban areas have a higher risk due to high population densities = more people at risk.</li> <li>LIC vs HIC: LICs have a higher risk as they have poor quality buildings and less planning and prediction strategies.</li> <li>Type of hazard: e.g. earthquakes are harder to predict than tropical storms, floods happen more than volcanic eruptions.</li> <li>An effect of climate change is more extreme weather events.</li> </ol>
<b>Oceanic Crust</b>	Crust found under the oceans (thin, young, more dense)	<b>Slab Pull</b>  At destructive plate margins dense/heavy plates sink into the mantle, which pulls the rest of the plate with it.	
<b>Continental Crust</b>	Crust found under land (thick, old, less dense)		
<b>Continental Drift</b>	Theory that states the earth's continents are very slowly moving and that once all the continents were joined together to form a super-continent called Pangea. The tectonic plates move due to convection currents and slab pull.		
<b>Convection Currents</b>	<b>Circular currents within the mantle that cause the overlying tectonic plates to move.</b> <i>The mantle is made up of semi molten rock. Mantle rock is heated by the core. The warm material rises to earth's surface. As it rises, the material starts to cool and sink. This motion of rising and sinking rock forms circular currents known as <b>convection currents</b>.</i>		

<b>Destructive Plate Margin</b>		2 plates move towards each other due to convection currents/slab pull. The denser oceanic plate is pushed beneath the lighter continental plate. This process is called <b>SUBDUCTION</b> and occurs at a <b>subduction zone</b> . <ul style="list-style-type: none"> <li><b>Volcanoes</b> – as the oceanic plate sinks into the mantle, it melts = magma. This rises to the earth's surface = explosive volcanic eruptions.</li> <li><b>Earthquakes</b> – as the plates slide past each other, they can get stuck = pressure builds up. The plates suddenly move, releasing the pressure = violent earthquakes</li> </ul>	<b>Collision Plate Margin</b>  
<b>Constructive Plate Margin</b>		2 plates move away from each other due to convection currents/slab pull, leaving a gap between the two plates. Magma rises up from the mantle to fill the gap, creating <b>NEW CRUST</b> (new land). This usually happens under the oceans. The new creation of land is called <b>SEA-FLOOR SPREADING</b> . <ul style="list-style-type: none"> <li><b>Volcanoes</b> – the magma rises to fill the gap between the two plates – gentle eruptions.</li> <li><b>Earthquakes</b> – as the magma rises it causes small tremors (gentle earthquakes).</li> </ul>	2 plates of the same density move towards each other due to convection currents/slab pull. As they are the same density neither subducts. Instead the plates collide and are forced upwards = mountain ranges. These are known as <b>FOLD MOUNTAINS</b> . <ul style="list-style-type: none"> <li><b>No volcanoes</b> (no subduction and so no melting)</li> <li><b>Earthquakes</b> – the two colliding plates crash together creating a huge amount of pressure which when suddenly releases causes <b>VIOLENT EARTHQUAKES</b>.</li> </ul>
<b>Conservative Plate Margin</b>		Two plates slide past each other due to convection currents/slab pull. They can be moving in opposite directions or moving in the same direction but at different speeds. The line between the two plates is called the <b>FAULT LINE</b> . <ul style="list-style-type: none"> <li><b>No volcanoes</b> (no subduction and so no melting)</li> <li><b>Earthquakes</b> – as the two plates slide past each other, they can get stuck = pressure builds up. The plates suddenly move, releasing the pressure = violent earthquakes.</li> </ul>	

# KS4 – The Geography Knowledge – THE CHALLENGE OF NATURAL HAZARDS (part 2) Chile and Nepal

## CHILE EARTHQUAKE (NEE)

**Where:** off the coast of central Chile, S. America. SW of capital, Santiago  
**Plate Margin:** destructive plate boundary. Nazca plate is being subducted beneath the south American plate.  
**When:** 27<sup>th</sup> January 2010  
**Magnitude:** 8.8 on the Richter Scale.

## NEPAL EARTHQUAKE (LIC)

**Where:** Nepal, Central Asia  
**Plate Margin:** Collision zone between Eurasian and Indo-Australian plate  
**When:** 25<sup>th</sup> April 2015  
**Magnitude:** 7.9 on the Richter Scale.  
**Epicentre:** 80km NW of Kathmandu

PRIMARY EFFECTS	SECONDARY EFFECTS	PRIMARY EFFECTS	SECONDARY EFFECTS
<ul style="list-style-type: none"> <li>500 dead</li> <li>12,000 injured, 800,000 affected</li> <li>220,000 homes, 4500 schools, 53 ports, 56 hospitals and other public buildings destroyed</li> <li>Port of Talcahuano and Santiago airport badly damaged</li> <li>Much of Chile lost power, water supplies and communications</li> </ul>	<ul style="list-style-type: none"> <li>1500km of roads damaged, mainly by landslides – remote communities cut off for many days</li> <li>Several coastal towns devastated by Tsunami waves – waves approached at 800km/ph</li> <li>Several Pacific countries struck by Tsunami</li> <li>A fire at a chemical plant near Santiago – the area had to be evacuated</li> </ul>	<ul style="list-style-type: none"> <li>9000 dead</li> <li>20,000 injured – 8 million people affected</li> <li>7000 schools destroyed</li> <li>50% of shops destroyed</li> <li>Centuries-old buildings were destroyed at UNESCO World Heritage sites in the Kathmandu Valley, including some at the Changu Narayan Temple and the Dharahara Tower.</li> <li>3 million made homeless</li> </ul>	<ul style="list-style-type: none"> <li>1.4 million needed food, water and shelter</li> <li>Avalanches on Everest killed 19</li> <li>Avalanche in Langtang left 250 missing</li> <li>Landslide blocked Kali Gandaki river – many people evacuated due to flood risk</li> <li>Blocked roads hampered relief efforts</li> <li>Harvests reduced and lost</li> <li>Estimated economic loss of 35% GDP</li> </ul>
IMMEDIATE RESPONSE	LONG TERM RESPONSE	IMMEDIATE RESPONSE	LONG TERM RESPONSE
<ul style="list-style-type: none"> <li>Emergency services acted quickly – international help supplied field hospitals, satellite phones and floating bridges</li> <li>Temporary repairs made to Route 5 (north/south highway) within 24 hours – enabling swift transportation of aid</li> <li>Power/water restored to 90% of homes within 10 days</li> <li>National appeal raised US\$60 million – enough to build 30,000 emergency shelters</li> </ul>	<ul style="list-style-type: none"> <li>Month after: housing reconstruction plan launched by govt to help 200,000 households</li> <li>Chile strong economy – based on copper exports – could rebuild without much foreign aid</li> <li>President claimed it could take 4 years for Chile to fully recover</li> </ul>	<ul style="list-style-type: none"> <li>UK, India and China provided swift medical support</li> <li>Helicopters rescued many people caught in avalanches on Everest and delivered supplies to villages cut off by landslides</li> <li>300,000 migrated from Kathmandu to find shelter</li> <li>90% of soldiers from Nepalese army deployed</li> <li>Red cross helped to helicopter evacuate</li> </ul>	<ul style="list-style-type: none"> <li>aid was donated by a huge number of countries. The UK gave £73 million, of which £23 million was donated by the government and £50 million was donated by the public. The UK also provided 30 tonnes of humanitarian aid and 8 tonnes of equipment.</li> <li>Stricter controls on building codes</li> <li>June 2015: Nepal hosts international conference to discuss reconstruction</li> <li>August 2015: repairs to Everest walking routes</li> </ul>

## How can we protect ourselves from future earthquakes?

We cannot prevent an earthquake from occurring, however we can **PROTECT** ourselves by:

- PLAN** to prepare for when an earthquake occurs (emergency kit, practice drill, earthquake proof buildings, hazard mapping, evacuation routes).
- Monitor earthquake prone areas in order to **PREDICT** when it will occur (previous data, unusual animal behaviour, measure for small tremors)

### MEASURE FOR SMALL TREMORS

Just before a larger earthquake often there is an increase in the number of small tremors. Scientists use seismometers to record any ground movement.

### EMERGENCY KIT

Residents are encouraged to have an emergency kit ready in case of an earthquake, including a *torch, canned food, batteries, radio, medical kit, dust mask, water...etc.*

### PREVIOUS EARTHQUAKE DATA

Historical records can be used to show patterns and trends. These can then be used to predict future earthquakes.

### EARTHQUAKE PROOF BUILDINGS

Buildings are created to withstand the ground shaking during an earthquake. Examples shown in next box.

### PRACTICE DRILLS

Educate people about to do should an earthquake occur. *e.g. in Japan on 1<sup>st</sup> September everyone practices what to do in an earthquake. It is called Disaster Prevention Day.*

*e.g. Using flexible steel frames which sway as the ground moves.  
e.g. Rubber foundations that absorb the shockwaves/shaking.  
e.g. A building with a larger base than top will be less likely to topple over (pyramid shape).*

### UNUSUAL ANIMAL BEHAVIOUR

Animals often act strangely before an earthquake. In China, the city of Haicheng was evacuated following strange animal behaviour. Days later a 7.3 magnitude earthquake struck. It is estimated it saved 150,000 lives.

### HAZARD MAPPING

Prevent building on loose or weak ground and control the height of buildings in different parts of the city. This means that in high-risk areas, stronger and lower buildings can be used.

# KS4 – The Geography Knowledge – THE CHALLENGE OF NATURAL HAZARDS (part 3) Tropical storms

## GLOBAL ATMOSPHERIC CIRCULATION

**Global atmospheric circulation** is the global system of winds, which travel from areas of **high air pressure** to areas of **low air pressure**. **Wind** is the movement of air from one place to another.

Winds move in a circular motion called **CELLS**, transferring **heat** and **moisture** from one place to another. This creates different **world climate zones**.

**Warm air rises** creating low pressure and **precipitation** **Cold air sinks** creating high pressure and **dry conditions**

### CLIMATE AT THE EQUATOR e.g. Amazon rainforest

It is **hot and wet** (humid) at the equator (0°). It is hot because there is **direct sunlight**. It is wet because air is heated by the over head sun and rises, creating a **low pressure system**. As it rises, it cools, **water vapour condenses** and forms clouds and **heavy precipitation**.

### CLIMATE IN THE DESERT REGIONS. E.g. North Africa

It is hot and dry (arid) 30°N and 30°S of the equator. It is hot because there is **direct sunlight**. It is dry because **cold air sinks** creating a **high pressure system**. As the air sinks it warms and **no condensation** occurs resulting in clear skies.

### WEATHER AT THE POLES e.g. Antarctica

It is cold and dry at the north pole (90°N) and south pole (90°S). It is cold because there is **no direct sunlight**. It is dry because **cold air sinks** creating a high pressure system. As the air sinks, **no condensation occurs** resulting in clear skies.

**A tropical storm is a storm that is formed over warm water, near the tropics. It has wind speeds of over 74mph and torrential rain.**

- **Hurricanes** (USA and Caribbean),
- **Typhoons** (Japan and the Philippines)
- **Cyclones** (SE Asia and Australia).



### Conditions needed to form a tropical storm:

- **Form over warm oceans (>27°C)**. As a result they are often found in tropical areas and occur in the summer/autumn when seas are at their hottest.
  - **Latitudes between 5 - 20° north and south of the equator**. Between 5-20° north and south of the equator the earth's spin is strong enough to spin the clouds creating a tropical storm.
- Tropical storms are measured using the **Saffir-Simpson scale**. There are 5 categories.

### TROPICAL STORM FORMATION:

HEAT	1. The strong overhead sun <b>HEATS</b> the sea/ocean <b>EVAPORATING</b> it
EVAPORATE	2. Water vapour <b>RISES</b> carried by warm, rapidly rising air
REPLACE/REPEAT	3. More air rushes in to <b>REPLACE</b> the air that is rising. It is also rises carrying more water vapour in to the storm. This forms <b>LOW PRESSURE</b>
CONDENSATION/ CLOUDS	As the water vapour rises it <b>COOLS</b> and <b>CONDENSES</b> to form thick storm <b>CLOUDS</b> .
SPIN/SPIRAL	The clouds <b>SPIN</b> because of the rotation of the earth, forming a <b>SPIRAL</b> .
SINKING AIR = EYE	Cold air <b>SINKS</b> in the centre of the storm forming the <b>EYE</b> of the storm.
MOVE	The storm <b>MOVES</b> in the prevailing wind direction. Gathering <b>POWER</b> and <b>ROTATING FASTER</b> as it is <b>FUELED</b> by more warm moist ocean water.
LAND/LOSE ENERGY	On <b>LAND</b> it <b>LOOSES ENERGY</b> as no warm water is being evaporated.

The eye – in the center of the tropical storm cold air sinks. There are no clouds or wind. It is very calm.

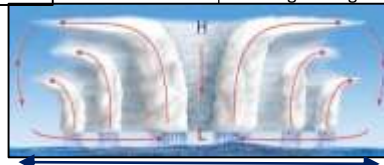
On either side of the eye is the eye wall – a tall bank of cloud with rapidly rising air. Weather - very strong winds, heavy rain, thunder and lightning.

### How can we protect ourselves from future tropical storms?

- We cannot prevent a tropical storm from occurring, however we can protect ourselves.
- **PLAN** to prepare for when a tropical storm occurs (emergency kit, practice drill, earthquake proof buildings, hazard mapping, evacuation routes).
  - Monitor tropical storm prone areas in order to **PREDICT** when it will occur (previous data, unusual animal behaviour, measure for small tremors)
  - **PREPARE** when a tropical storm approaches. Board up windows, prepare emergency supplies, evacuate the area

### Features

Spin anti-clockwise in Northern hemisphere  
Spin clockwise in Southern hemisphere  
A large disc of cloud  
Has a visible eye



Heavy rain and thunderstorms

Up to 400 miles across

## TYPHOON HAIYAN

**Where:** Philippines, Asia

**When:** November, 2013

**Saffir-Simpson Scale:** category 5

Saffir-Simpson Hurricane Scale		
Category	Wind speed (mph)	Storm surge (feet)
5	156	More than 18
4	131-155	13-18
3	111-130	6-12
2	96-110	4-6
1	74-95	4-5

### PRIMARY EFFECTS

- 6,300 dead
- 27,000 injured
- 1.1 million homes damaged
- 30,000 fishing boats destroyed
- Schools, hospitals and shops destroyed.
- 400m of rain flooded agricultural land.
- Transportation routes (roads, rail, ports, airports) blocked by trees and debris Specifically the Tacloban airport was damaged
- Service lines (water, gas, electricity) destroyed

### SECONDARY EFFECTS

- Trauma and diseases from dead bodies.
- 1.1million people in temporary camps
- Increase in unemployment – ¾ farmers and fishermen lost their jobs
- Crops destroyed. loss of \$53million as rice crop were destroyed
- Surface and groundwater was contaminated by polluted floodwater and sewage
- Looting and violence in Tacloban
- Aid supplies could not reach victims.
- Some areas had no power for 1 month
- Shortages of water, food and shelter led to disease.

### IMMEDIATE RESPONSE

- People were evacuated to 1200 evacuation centres that were created
- USA sent aircraft/helicopters for search and rescue
- People cleared rubble and damage by hand
- Emergency food from Philippine Red Cross
- Emergency hospitals from France, Belgium and Israel
- Emergency shelter from UK

### LONG TERM RESPONSE

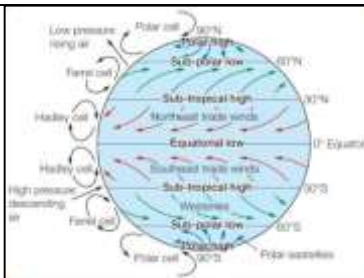
- Reconstruction and relocation – 1000s of new homes built in flood safe areas
- Reconstruction of roads, bridges & airports
- NGOs (e.g. Oxfam) replaced fishing boats. Fishing industries were re-established.
- UN, UK, Australia, Japan and USA provided long-term medical supplies and financial aid
- US, Australia and EU provided financial support for people to start new lives
- Cash for work programmes were created to help people earn money in the long term

### Tropical storm hazards

**Storm surge:** The low pressure of the storm sucks up the sea by several metres and pushes it inland causing severe coastal flooding  
**Intense rainfall:** causes flooding of land, towns and rivers  
**Strong winds:** blow down power lines and destroy buildings and infrastructure

### Prediction and Preparation for tropical storms

Use **PREVIOUS TROPICAL STORM DATA** to predict the track of a current storm  
**TRACK TROPICAL STORMS USING SATELLITE IMAGERY** so that people can be warned in time  
**WARNING SYSTEMS** Hurricane watch warns people of a possible hurricane, Hurricane warning warns people of a likely hurricane strike.  
**PLANNED EVACUATION ROUTES** People know how to evacuate should a tropical storm occur. Signs clearly show evacuation routes and meeting points  
**EVACUATION CENTRES** Public buildings prepared with supplies to receive evacuees  
**EMERGENCY KIT** Residents are encouraged to have an emergency kit ready in case of a tropical storm





Weather	The day-to-day conditions of the atmosphere.
Extreme weather	Weather events that are significantly different from the normal.
Evidence that weather is becoming more extreme	<ul style="list-style-type: none"> <li>➤ <b>International Disaster Database</b> shows the number of <b>floods has increased since 1960s</b>.</li> <li>➤ <b>2003 Heatwave</b> affected the whole of Europe between June to August. Tourism increased in the UK due to hot weather, however 2045 people died in the UK due to heat.</li> <li>➤ It is raining more. <b>2007 Gloucestershire Floods</b>, <b>2004 Boscastle Floods</b> and <b>2014 Somerset Floods</b> due to heavy rain.</li> <li>➤ <b>2010 Big Freeze</b> due to heavy snow. In December, 2010, temperatures dropped to -20C in Scotland, schools and businesses closed, motorways/airports/railways closed, crops were destroyed.</li> </ul>

#### An example of a recent extreme weather event in the UK: THE SOMERSET FLOODS

Where	Somerset, south-west England
Physical landscape	Somerset is low lying farmland. There are several rivers, including the Tone and Parrett, which flow into the Severn Estuary.
When	January and February, 2014
Why	350mm of rain in January and February (100mm above average), high tides, storm surges, rivers had not been dredged in 20 years and so were clogged with sediment

Social Effects	<ul style="list-style-type: none"> <li>• 600 houses flooded. People in temporary accommodation for months.</li> <li>• 16 farms were evacuated</li> <li>• Villages (e.g. Moorland) were cut off by the floodwater. This meant resident could not attend school, work or shop.</li> <li>• Power supplies were cut off.</li> <li>• Local roads and railway lines were flooded.</li> </ul>
Economic Effects	<ul style="list-style-type: none"> <li>• Somerset County Council estimated the cost at £10 million.</li> <li>• 14,000 hectares of farmland under water for weeks = could not sell crops.</li> <li>• Over 1000 livestock had to be evacuated, which was very expensive for farm and insurance companies.</li> <li>• Local roads and railway lines were flooded. These needed to be repaired.</li> </ul>
Environmental Effects	<ul style="list-style-type: none"> <li>• Floodwater contained sewage and chemicals which contaminated farmland.</li> <li>• Habitats were lost.</li> </ul>

#### To reduce the risk of future floods, a £20 million Flood Action Plan was launched.

Dredging	In March 2014, 8km of the River Tone and the River Parrett were dredged. This is when material/soil/mud is removed from the river bed. As a result the river channel is larger and can hold more water. This prevents the river overflowing its banks.
Elevated roads	Roads have been elevated in places. As a result even if a flood occurs, people can still drive on the elevated roads. This also helps the economy by allowing import/export.
Flood defences	Settlements in areas of flood risk have flood defences. As a result they are able to protect themselves.
Embankments	River banks have been raised. These are called embankments. This means the river channel can hold more water and therefore it is less likely to overflow.

#### GLOBAL ATMOSPHERIC CIRCULATION

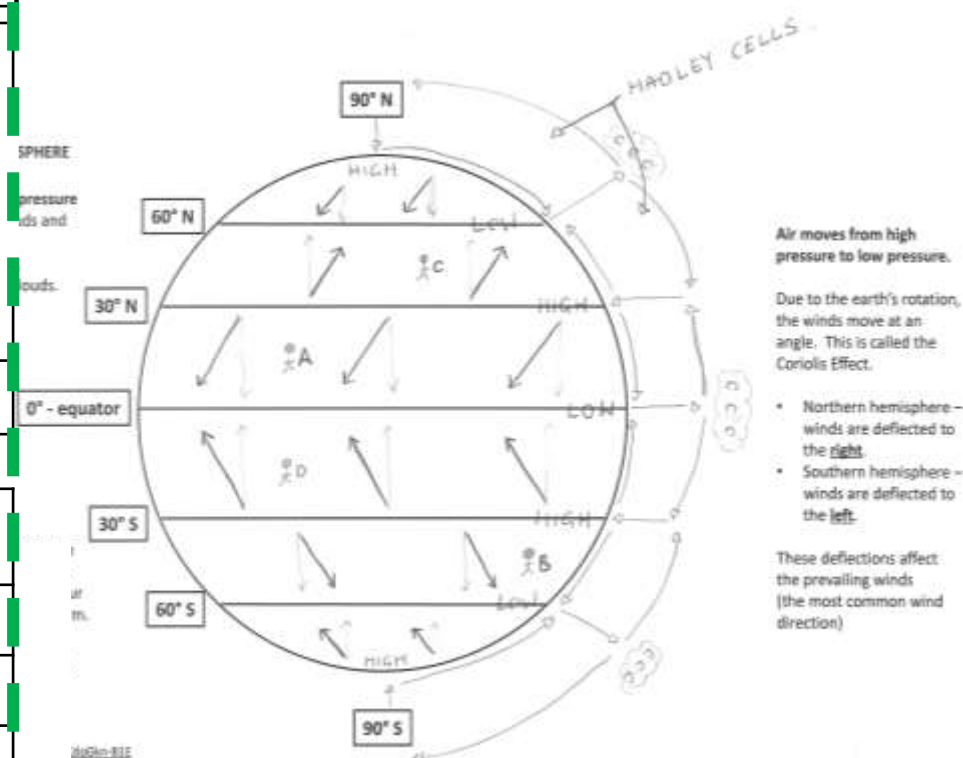
Global atmospheric circulation is the world's system of winds, which transport heat from equator to poles. It is the main factor determining global weather and climate patterns.

- Warm air rises = low pressure.
- Cold air sinks = high pressure
- Air moves from areas of high pressure to areas of low pressure.

It is hot and rainy (humid) at the equator (0°). It is hot because there is direct sunlight. It is rainy because the hot air rises creating a low pressure system. As it rises, it cools, condenses and forms clouds. Once the clouds reach saturation, they precipitate.

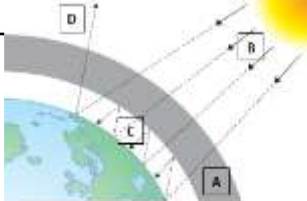
*It is hot and dry (arid) at the 30°N and 30°S. It is hot because there is direct sunlight. It is dry because the air sinks creating a high pressure system. As the air sinks, no condensation occurs resulting in clear skies.*

It is cold and dry at the north pole (90°N) and south pole (90°S). It is cold because there is no direct sunlight. Also many of the sun's rays are deflected off the earth's surface. It is dry because the air sinks creating a high pressure system. As the air sinks, no condensation occurs resulting in clear skies.



**CLIMATE CHANGE IS A CHANGE IN THE EARTH'S CLIMATE.** There is a lot of evidence that shows climate change has been occurring during the Quaternary Period (covers from 2.6 million years ago to today).

<b>Thermometer recordings</b>	Show that average global temperatures have risen by 0.74°C during the last 100 years and by 0.5°C since 1980.	<b>Ice cores</b>	Ice sheets are made up of layers of ice (1 layer is formed each year). Scientists drill into ice sheets to get long cores of ice. By analysing the gases trapped in the layers of ice, they can tell what the temperature was each year. One ice core from Antarctica shows the temperature changes over the last 400,000 years.
<b>Photographs</b>	Show many of the world's glaciers have retreated in the last 50-100 years. It is estimated up to 25% of global mountain glacier ice could disappear by 2050	<b>Tree Rings</b>	As a tree grows it forms a new ring each year. The tree rings are thicker in warm, wet weather. Scientists take tree cores and look at the rings to see what the climate was like in previous years.
<b>Paintings</b>	Show that the River Thames was frozen over in 1677. People are shown ice skating over the frozen river		

<b>Natural causes of climate change</b>		<b>Human causes of climate change</b>	
<b>Solar output</b>	A sunspot is dark patch on the sun that appears from time to time. Every 11 years the number of sunspots changes from very few to lots to very few again. <i>Lots of sunspots = warmer      Very few sunspots = cooler</i> <i>Between 1645 – 1715 there were very few sunspots. During this time, there was a very cold period known as the 'Little Ice Age'. Paintings show that the Thames completely froze over.</i>	<b>The Greenhouse Effect</b>	A) Greenhouse gases create a blanket around earth. B) Sunlight travels to earth as shortwave radiation. C) Sunlight bounces off the earth's surface as long-wave radiation. This reflected sunlight is trapped in the earth's atmosphere by the greenhouse gases = earth heats up. 
<b>Volcanic Activity</b>	Violent volcanic eruptions blast lots of ash, gases (e.g. sulphur dioxide) and liquids into the atmosphere. Major volcanic eruptions lead to a brief period of global cooling. This is because the ash, gases and liquids can block out the sun's rays, reducing the temperature. <ul style="list-style-type: none"> <li>e.g. <i>Krakatoa 1883 eruption = world temperatures fell by 1.2°C for a year.</i></li> <li>e.g. <i>Pinatubo 1991 eruption = world temperatures fell by 0.5°C for a year.</i></li> </ul>	<b>The Enhanced Greenhouse Effect</b>	Due to human actions, there are extra greenhouse gases in the atmosphere which trap more heat = global warming.
<b>Orbital Change</b>	Orbital change refers to changes in how the earth moves round the sun. It affects how close the earth is to the sun and therefore how much energy we get from the sun. When the earth is very close to the sun, it is warmer. When the earth is further away from the sun, it is cooler. a) <b><i>Eccentricity: how the earth orbits the sun. Every 100,000 years the orbit changes from circular to elliptical (egg-shaped).</i></b> b) <i>Axial tilt: the angle of the earth changes every 41,000 years between 22.5° to 24.5°.</i> c) <i>Precession: the natural wobble of the earth around its axis. Wobble cycles take 26,000 years.</i>	<b>Methane</b>	Produced by cattle and sheep. Rising incomes and population = increased demand for meat = more animals farmed = more methane produced. <i>250% rise since 1850.</i>
		<b>Carbon dioxide</b>	Produced by burning fossil fuels. Rising population = increased demand for electricity = more carbon dioxide produced. <i>30% rise in carbon dioxide production since 1850.</i>
		<b>Nitrogen dioxide</b>	Produced by car exhausts and airplanes. Rising incomes and population = increased cars and air travel = more nitrogen dioxide produced. <i>16% rise in nitrous oxide since 1850.</i>
		<b>Deforestation</b>	= less trees = less photosynthesis = less CO2 removed from the atmosphere.
<b>Mitigation: remove greenhouse gases from the atmosphere to slow down climate change.</b>		<b>Adaptation: responding to the effects of climate change.</b>	
<b>Carbon capture</b>	Carbon dioxide is captured from the power stations, transported in pipes and stored deep underground or in oceans so it doesn't go into the atmosphere.	<b>Changes in agriculture:</b>	<b>Problem:</b> changing rainfall patterns and temperatures will affect productivity of farms. <b>Adaptation:</b> use drought-resistant crops, grow different types of crops, implement irrigation systems to water crops during droughts, plant trees to shade vulnerable crops from strong sunlight, change crops grown.
<b>Afforestation</b>	Planting trees = more trees = more photosynthesis = more carbon dioxide removed from the atmosphere = fewer greenhouse gases = less global warming. Trees remove 3 billion tons of carbon every year! <i>e.g. China has had afforestation programs since 1970s. Forest cover has increased from 12% to 16%.</i>	<b>Changes to water supply:</b>	<b>Problem:</b> dry areas are likely going to get drier = water shortages. <b>Adaptation – decrease the use of water:</b> drip irrigation, recycle water, water meters, dual flush system. <b>Adaptation – increase the supply of water:</b> build reservoirs, collect rainwater.
<b>Renewable energies</b>	Generating energy from natural renewable sources (e.g. solar panels, hydro-electric power, wind turbines, tidal energy). They do not produce greenhouse gases.	<b>Reduce risk of sea level rise:</b>	<b>Problem:</b> melting glaciers = sea level rise (rise of 20cm since 1900 and estimated future rise of 82cm by 2100). <b>Adaptation:</b> coastal management (sea walls, rock armour, gabions), build houses on stilts in flood prone areas, invest in monitoring and prediction strategies, invest in planning strategies (e.g. hazard mapping, warning alarm, emergency kits).
<b>International agreements</b>	Climate change is a global issue and requires global solutions. International agreements are when countries come together to agree on large scale, international strategies. <ul style="list-style-type: none"> <li>➤ <b>The Kyoto Protocol (1997):</b> over 170 countries agreed to reduce carbon emissions by 5.2%.</li> <li>➤ <b>Copenhagen meeting (2009):</b> world leaders agreed to reduce carbon emissions, with HICs giving LICs financial support to help them cope with impacts of climate change.</li> <li>➤ <b>The EU</b> agreed to cut carbon emissions by 20% between 1990 and 2020.</li> </ul>		

## Section B: The Living World (Parts 1-5 )

- *Small scale ecosystem: **the pond***
- *Tropical rainforest: **The Malaysian Rainforest***
- *Cold environments **Svalbard***



# KS4 – The Geography Knowledge – THE LIVING WORLD (part 1) Ecosystems

**Ecosystem** - a natural system made up of plants, animals and the environment. Examples include a pond, a hedgerow or a tropical rainforest.

**Biome** – a global ecosystem. Examples include tropical rainforest or polar biomes

**Biotic** – Living things within an ecosystem. Examples include fish or insects. They rely on **abiotic** things to survive. Example. Fish need oxygen, Plants need sunlight

**Abiotic** – Non-living things within an ecosystem. Examples include sunlight, soil or water

**Flora** – Are plants (producers) within an ecosystem

**Faura** – Are animals (consumers) within an ecosystem

**Habitat** – Homes within an ecosystem where different flora and fauna live

**Detritus** – Dead and decaying plant and animal matter forming mud on the pond bottom



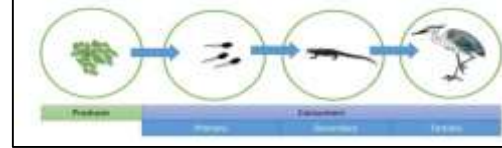
**Consumers**  
either eat producers (primary consumers) or other consumers (secondary and tertiary consumers)  
Example - Heron



**Producers**  
convert sunlight into sugars in order to grow.  
Example - Reeds or algae in a pond.

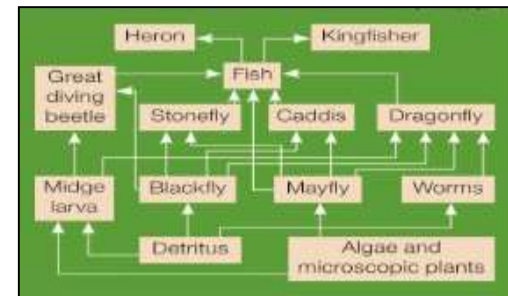


**Decomposers**  
break down dead plant or animal matter and return it to the soil or detritus.  
Example – a worm.



A **Food chain** shows how producers and consumers are linked in an ecosystem. Example – Algae, tadpole, newt, heron) The arrows show who eats who (or the direction of energy flow)

Ecosystems are complicated. A **food web** shows all the links between the consumers and producers in an ecosystem like a pond.



**Food webs** are easily damaged. If the producers are removed, consumers higher up the chain lose their food source and numbers drop. If tertiary consumers are removed their will be an explosion of creatures further down the chain.



Ecosystems can be **restored** if they are damaged. Lake beds can be cleared and **dredged** to increase water depth and water oxygenation, improving conditions for fish. Algae can be removed to increase oxygen levels. New, shallow water **habitats** can be planted to encourage pond life and nesting water birds.

Different **habitats** in a pond contain different flora and fauna because of the different conditions.

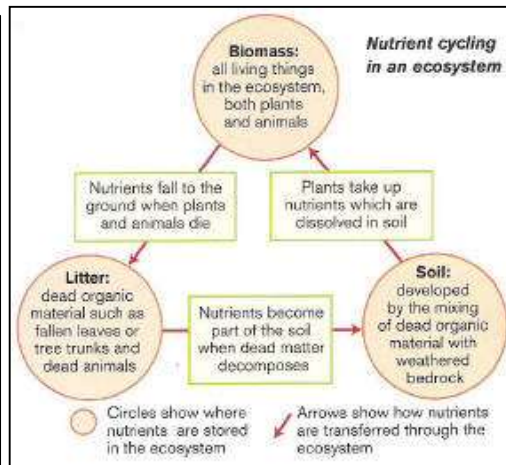
**The Detritus layer** has little oxygen or light. Decomposers, scavengers and the larva of water insects live here. Example - Water worms or May fly larva.

**Deeper water.** Oxygen and protection from predators. Animals that breath through gills or skin live here. Examples - Perch, Stickleback, Great diving beetle.

**Shallow water.** Plenty of oxygen and sunlight. Producers grow here, rooting in the detritus. Insects and birds shelter here. Examples include Reeds, Dragon fly, Waterlily, Moorhen.

**Water surface.** Lots of light and oxygen. Producers and consumers. Examples pond algae, water boatman, water weed.

**Pond banks** – Fertile soil and sunlight. Water loving plants and trees. Example Willow tree.



Producers also need **nutrients from the soil or detritus** on the bottom of a pond in order to grow. **Nutrients are re-cycled.** Dead plant and animal matter from the **biomass** falls to the **soil layer**, or **pond bottom** where it is **decomposed** to form **litter** or **detritus**, releasing **nutrients**, which are re-absorbed by the **biomass** through their roots or **absorbed** if dissolved in water. This is called the **nutrient cycle**.

Ecosystems are easily damaged **naturally** or by **humans, especially by farming**

**Natural causes**

**Drought** – The pond level drops and marginal plants dry up and die. The pond may become de-oxygenated and fish die.

**Human causes**

**Eutrophication** – Farm fertilizers get into the water and cause algae to grow rapidly. Algae use up all the oxygen so fish die.

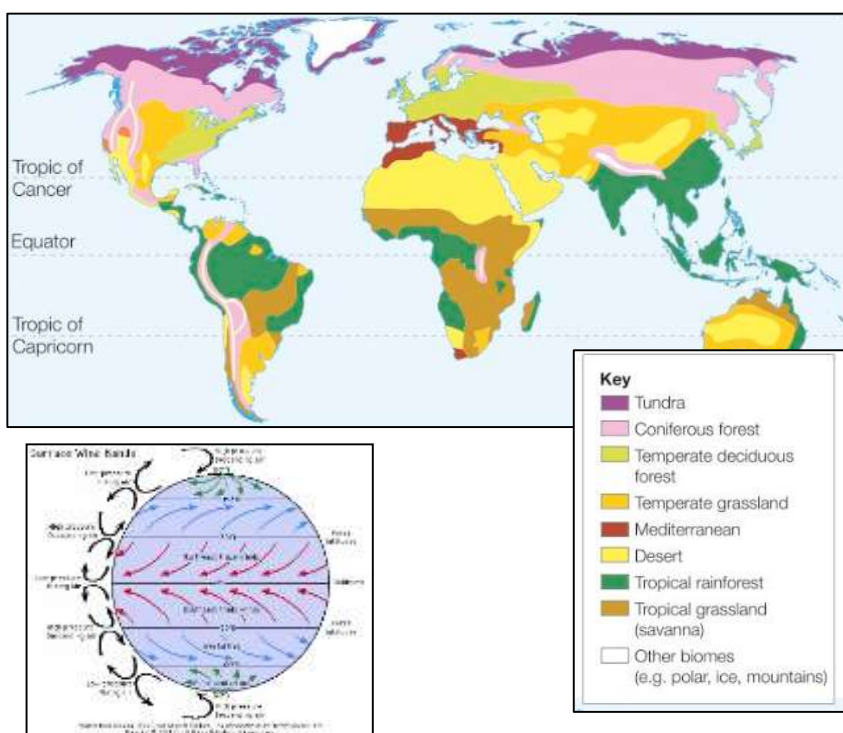
**Drainage** – Ponds are drained for farmland causing the whole ecosystem to collapse.

**Industrial pollution** - released into the water, killing fish and insects.

**Hedgerows** - cut down to increase the size of fields for farming, destroying the hedgerow ecosystem.



**Global ecosystems** are called **Biomes**. They run in bands stretching **east to west** across the land masses of the globe. Each biome has distinct and different **characteristics**. (flora and fauna) This is due to the different **climates** experienced in different areas due to **global atmospheric circulation**.



The **sun** drives **Global atmospheric circulation**. At the **equator** warm rising air causes **low air pressure** which brings **hot, wet conditions**. The **deserts** occur because cold air sinks causing **high pressure**. **Rain cannot form** here. The **UK** experiences a mixture of **High and Low pressure** systems so our climate is a mixture of **wet and dry** conditions

Tropical rainforests are located in a band around the equator Example Malaysia and Amazon

**Cold environments** are **polar and tundra** biomes. Example Svalbard, Norway

Global ecosystem	Location	Links to global atmospheric circulation
<b>Tropical rainforest</b>	Close to the Equator	High temps and heavy rainfall created by low pressure belt. Ideal conditions for plants to grow. Rainforests cover 6% of earth's surface and are home to half the world's species of plants and animals and 25% of all medicines.
<b>Desert</b>	Roughly 30 degrees north and south of the Equator	Cover 20% of land surface. Associated with sub-tropical high pressure belts. Sinking air stops clouds from forming – results in high daytime temps, low night time temps and low rainfall. Plants and animals must be well adapted to survive.
<b>Polar</b>	Arctic/Antarctic	Cold air sinks in north and south poles creating very low temps and dry conditions.
<b>Deciduous and coniferous forests</b>	Roughly 50-60 degrees north of the equator	Deciduous trees shed leaves in winter to retain moisture. Coniferous trees retain leaves to maximise photosynthesis during short summer months. UK is good example of deciduous woodland, Canada is dominated by coniferous woodland.
<b>Temperate grassland</b>	Roughly 30-40 degrees north and south of the Equator, inland away from coasts, hot summers, cold winters	Vast areas of grassland in N. America (Prairies) & Eastern Europe (Steppes). Warm, dry summers and cold winters. Grasses can tolerate these conditions, this land is mainly used for grazing.
<b>Mediterranean</b>	Roughly 40-45 degrees north of the Equator. Isolated locations south of the equator (S. Africa and W. Australia)	Hot, sunny and dry summers & mild winters. This is due to pressure belts migrating slightly north and south during year. Vegetation includes olive trees and fruit trees (lemon, orange). Other areas have a similar climate (California, South Africa and parts of Australia).
<b>Tropical grassland (savannah)</b>	Between 15-30 degrees north and south of the Equator	Low latitude – distinct wet and dry seasons. Dry season can be very hot and wild fires can break out. Thunderstorms can occur in wet season. Large herds of animals graze on these grasslands, along with predators such as lions and leopards.
<b>Tundra</b>	Arctic circle to about 60-70 degrees north (Canada, Northern Europe). Few areas in S Hemisphere due to lack of land	Characterised by low growing plants adapted to retain heat and moisture in the cold, windy, dry conditions. Mostly found in northern Canada and northern Europe. A fragile ecosystem that is easily damaged by humans and threatened by developments such as oil exploitation and tourism. Animals such as reindeer are adapted to survive the cold.

<b>Location</b>	Rainforests are located along the <b>equator</b> (0° latitude). Examples: South America (Brazil), Asia (Indonesia), Africa (Congo).
<b>Climate</b>	Hot and wet ( <b>humid</b> ). No seasons Temperature range: 20-30°C (due to direct sunlight from the sun) Precipitation range: 160 – 330mm/month or 2000mm per year
<b>Vegetation</b>	Very <b>dense</b> and <b>varied</b> (e.g. banana and rubber trees).
<b>Animals</b>	Very <b>dense</b> and <b>varied</b> (e.g. apes, parrots, jaguars, insects)
<b>Soil</b>	Not very fertile, as heavy rainfall washes nutrients away. This is known as <b>leaching</b> . Most nutrients are in the top layer of the soil due to nutrient cycling from the decayed leaves. As a result most trees have a shallow root system.
<b>People</b>	Tribes have lived in rainforests for a long time (sustainable). New groups of people and companies have arrived more recently, trying to make money from the rainforests through logging, energy, mining...etc (unsustainable)
<b>Biodiversity</b>	The variety of organisms living in a particular area (plants and animals)
<b>Biodiversity in the rainforest</b>	Deserts have very high biodiversity. Rainforests contain around <b>50% of the world's plants, animals and insect species</b> .
<b>Threats to the rainforest</b>	Deforestation is causing a loss of biodiversity in the rainforest, as many animals and plants become endangered or extinct.

**All parts of the rainforest ecosystem are linked together (climate, soil, water, animals, plants and people). If one of them changes, everything else is affected.**



### VEGETATION ADAPTATIONS

<b>Layers</b>	The rainforest has four layers (emergent, upper canopy, lower canopy and shrub & ground layer). Vegetation adapts to each layer.
<b>Trees (height, buttress roots, bark)</b>	The trees can grow to over 40 meters high in order to find sunlight. To help support their height, they have buttress roots. These are large root systems above the ground that act as an anchor and support the tall trees. Trees have a smooth, thin bark = helps water to run off easily.
<b>Lianas</b>	Woody vines that use trees to climb up to the upper canopy where they spread from tree to tree to get as much light as possible.
<b>Leaves</b>	On the shrub and ground layer, it is very dark due to the canopy. As a result, their leaves have a large surface area to catch as much sunlight as possible. Many leaves have drip tips and a waxy coating. This help shed water easily. Some plants, e.g. the fan palm, have large fan-shaped leaves which are segmented so that excess water drains away easily.

### ANIMAL ADAPTATIONS

<b>Spider monkey</b>	Have long, strong arms and tails so they can swing between the trees in the upper canopy. Some animals spend their entire lives in the upper canopy.
<b>Leaf-tailed gecko &amp; chameleon</b>	Are camouflaged so can blend into their surroundings to hide from predators
<b>Jaguar</b>	Can swim due to high rainfalls and many rivers.
<b>Red-eyed tree frog</b>	Have suction cups on their feet and hands to help them climb up trees and leaves.
<b>Anteater</b>	Some animals have adapted to the low light levels in the shrub and ground layer. Have a sharp sense of smell and hearing so they can detect predators without seeing them. This helps them survive in the low light levels in the shrub & ground layer.

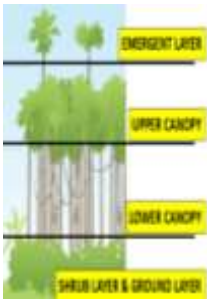
- The humid climate = dead plants and animals decompose quickly by decomposers (fungi and bacteria) on the forest floor = the nutrients from the decaying plants/animals makes the top layer of the soil very nutrient rich = lots of plants can grow.
- Plants pass on their nutrients when they are eaten by animals  
There is a lot of vegetation = lots of animals.
- People remove trees (deforestation) = less carbon dioxide is removed from the atmosphere = more greenhouse gases = more climate change.
- Trees absorb water = this water travels through the tree to the leaves = transpiration evaporates water from the trees' leaves to the atmosphere = condensation in the atmosphere creates clouds = precipitation. The trees are one of the main reasons there is so much rainfall in the rainforest.

### Tropical rainforest features

<b>Location</b>	Equator, South America (Brazil), Asia (Malaysia and Indonesia), Africa (Congo).
<b>Climate</b>	Hot and wet (humid). No seasons. Temperature range: 25-35°C Precipitation range: 160 – 330mm/month – 2000mm+ per year
<b>Vegetation</b>	Very dense and varied (e.g. banana and rubber trees)
<b>Animals</b>	Very dense and varied (e.g. apes, parrots, jaguars, insects)

#### ADAPTATIONS

- The trees can grow to over 50 meters high in order to find sunlight because of competition in the all year growing season
- Lianas are woody vines that start at ground level and use trees to climb up to the upper canopy where they spread from tree to tree to get as much light as possible.
- The leaves have drip tips to shed heavy rain.
- Large buttress roots support the tall trees.
- Some plants have very large leaves so they can catch as much sunlight as possible. Plants, such as the fan palm, have large fan-shaped leaves which are segmented so that excess water drains away easily.
- The forest floor is very dark and damp. There is little growth here as the sunlight cannot reach this layer.
- Trees have shallow roots as there is only a shallow layer of fertile soil.



### Deforestation in Malaysia – Environmental and economic gains and losses

<b>Logging</b>	Cutting down hardwood trees to sell. (e.g. Malaysia is worlds largest hard wood exporter <b>Good:</b> jobs, tax to Government, money for development <b>Bad:</b> habitat loss, loss of biodiversity, loss of carbon sink, climate change, soil erosion, leaching of nutrients, loss of medicines from plants
<b>Hydro-electric energy</b>	Build dam and reservoir to create and sell hydro-electric energy. (e.g. Bakun dam in Malaysia) <b>Good:</b> jobs, money for development, cheap, clean, renewable energy <b>Bad:</b> habitat loss, tribes forced to move, loss of animal biodiversity
<b>Mining</b>	Digging to extract iron ore, aluminum, copper, tin and gold to sell. (e.g. Tin mining in Peninsular Malaysia) <b>Good:</b> jobs, money for development, tax to Government <b>Bad:</b> habitat loss, loss of biodiversity, climate change, water pollution
<b>Building roads</b>	Logging companies, cattle ranches, farms, mines need roads to reach them and transport products to the coast to export = roads built. <b>Good:</b> jobs, improved transportation, easier import/export industries <b>Bad:</b> habitat loss, loss of animal biodiversity, climate change
<b>Monoculture and Palm Oil</b>	Large areas of rainforest are cut down and replaced with a single crop such as palm oil (e.g. Malaysia is the world's largest palm oil producer) <b>Good:</b> Creates thousands of jobs and wealth from growth and export <b>Bad:</b> bio-diversity loss as most fauna is not adapted to live on oil palm
<b>Subsistence farming</b>	When you farm enough food to live off, not to sell to make money. It is a sustainable farming practice. They use slash and burn to clear the land. <b>Good:</b> sustainable (only farm what they need) <b>Bad:</b> slash and burn = habitat loss, loss of animal biodiversity

#### INTERNATIONAL AGREEMENT – DEBT RELIEF

Areas of the rainforest are given monetary value and used to repay outstanding debt. e.g. *The USA cancels part of their debt in exchange for an agreement that Peru will conserve/look after part of their rainforest.*

#### SELECTIVE LOGGING

Trees are only felled (cut down) when they are mature (fully grown). As a result the rainforest canopy is preserved where many of the animals live. Logged areas are re-planted

Unfortunately, sometimes when a mature tree is felled, up to 30 other trees are damaged getting the tree out of the forest.

#### PROMOTING RESPONSIBLE MANAGEMENT

**Forest Stewardship Council (FSC)** and **Rainforest Alliance** are charities that give their logo to products that are produced sustainably. Consumers can then choose to buy products from sustainable sources.

#### INTERNATIONAL AGREEMENT – CARBON SINK

Trees remove carbon dioxide during photosynthesis and are therefore known as carbon sinks. Rainforests are protected due to their role in reducing global warming. e.g. *The Gola Forest in Sierra Leone (Africa) is protected for its role in reducing global warming, using money from the European Commission, French Government and NGOs.*

#### NATIONAL PARKS

Areas are protected from development and deforestation, therefore providing safe habitats for species e.g. Orangutan e.g. The Tumucumaque National park in Brazil is the largest in the world. It protects over 38,000 square kilometres of rainforest.

#### ECOTOURISM – SUSTAINABLE TOURISM

Ecotourism aims to introduce people to the natural world whilst protecting the rainforest, and creating sustainable jobs  
Tourist resorts (hotels, restaurants) use sustainable practices to reduce their impact.

- e.g. renewable energies, water tanks, grey water, local employees, use local produce and materials.



**Polar biome** – Antarctica and Northern Greenland. Mostly above the Arctic and Antarctic circle  
**Tundra biome** – Mostly Northern hemisphere. Mostly Northern Russia (Siberia and Northern Canada)  
**Svalbard** – Most Northerly inhabited island. Territory of Norway, 77°-80°N latitude, Barents sea -Arctic Ocean

### Opportunities for Development: Svalbard

#### Mineral extraction

**Coal mining** is vital to the economy. It is the main economic activity with 300 people employed. However, some jobs have been lost due to lower world coal prices

#### Fishing

Sea south of Svalbard one of the richest **fishing grounds** in the world. 150 species of fish found here (cod, herring and haddock). Fishing controlled by Russia and Norway to ensure sustainability of ecosystem

#### Energy developments

Coal power station provides 100% of Svalbard's energy. In the future, Svalbard is likely to develop **geothermal energy** due to its close proximity to the. Iceland also gets 90% of its power from geothermal.

#### Tourism

2011: 70,000 visited Longyearbyen (30k of these were **cruise passengers**. The Harbour here has been enlarged to cope with tourist numbers. Tourism employs 300 local people. Most tourists come from Norway to **explore nature** or for **adventure tourism**.

### Cold environments under threat.

Tundra is a very fragile biome and is easily damaged by humans

**Off road vehicle driving** – popular activity. Most of this takes place in the summer. Warmer temps melt the upper layers of the soil making it extremely soggy. This leads to deep tyre tracks which damage the soil further. Minutes to damage, years to recover.

**Oil spills from pipelines** – Water pollution, risk of fire, kills trees, river habitats and ecosystems destroyed.

**Oil spills from oil tankers** – Massive destruction to coastal ecosystems. e.g. Exxon Valdez oil spill in Alaska

**Climate change** – Melts ice caps and glaciers. Melts permafrost releasing CO2 in to the atmosphere, increasing climate change.

### Why protect cold environments

1. Home to **indigenous people** – e.g. Inuit – depend on hunting wildlife to survive
2. Home to many **unique organisms** – polar bears, tundra vegetation
3. **Scientific research** – the effects of climate change
4. Their natural beauty attracts **tourism** which boost the economies of countries such as Norway, Iceland and Alaska
5. Opportunities for **forestry and fishing** in the oceans

### Managing cold environments

#### Technology – Trans-Alaskan pipeline

**Transportation of oil** from Prudhoe bay to Valdez (1300km). Pipeline is raised and insulated to prevent melting permafrost. Can slide in the event of earthquakes to prevent cracks and spillages. Oil flow stops automatically if there is a leak. Raised pipeline allows herds of caribou to migrate beneath it.

#### Action by governments – Alaska, USA

**National Environmental Policy Act** – Oil companies must protect the environment and recognise rights of native people. **National Oceanic and Atmospheric Administration** (NOAA) manages sustainable fisheries in Alaska to prevent overfishing of fish stocks. **Western Arctic reserve** – 9 million hectare protected wilderness protects habitats

#### International agreements – the Antarctic Treaty

Signed in 1959 by countries with territorial claims to Antarctica. Been successful in preventing economic development in region. Recognises importance of scientific research (especially climate change). Controls tourism and keeps disturbance to a minimum.

#### Conservation groups – WWF in Canada

Works with local people to manage critical ecosystems e.g. Beaufort Sea. Supports scientific research to help protect important species such as polar bears. Works with oil companies, local Inuit organisations and government to plan a sustainable future for the arctic.

### Challenges of Development: Svalbard

#### Extreme temperatures

Temps can fall below -30°C. This makes it dangerous to work outside. (frostbite). People wear many layers of clothing to try and combat the cold conditions but this restricts movement making work harder

#### Construction

Limited to summer due to lack of daylight and extreme cold in winter. Frozen ground (permafrost) can provide solid foundations but must be prevented from melting. Most roads are gravel, these are cheap, easy to maintain and don't crack

#### Services

Water and sanitation services are provided using **heated water and sewage pipes**, to prevent them freezing, and to allow access for repairs. They are **above ground** to prevent melting the permafrost causing houses to sink in to the ground.

#### Accessibility

Can only be reached by **plane or ship**. One **international airport** on Longyearbyen which receives flights from Norway and Canada. **Small planes** used to visit other islands. Only 50km of roads on Longyearbyen. No roads in other places so transport is by **snowmobile**

### Plant adaptations: Tundra


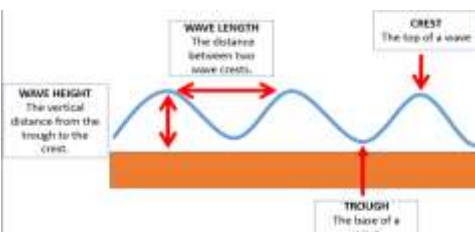


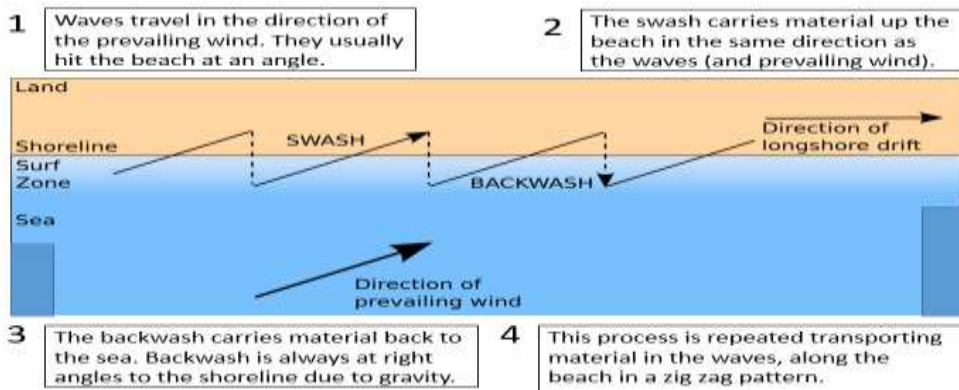
Very low growing (5-15cm from ground) to enable it to survive strong winds  
 Stems have thick bark for stability in wintry conditions  
 Small, leathery leaves help retain water in dry conditions found in the Tundra  
 Hairy stems help retain heat  
 Bright red berries are eaten by birds to help distribute seed.  
 Fast growing and flowering plants to take advantage of short summer season



## Section C: Physical Landscapes in the UK (Parts 1-6)

- *Example of a coastline to show its landforms: **Swanage Dorset***
- *Example of a coastal management scheme: **Swanage Dorset and Medmerry***
- *Example of a river to show its landforms: **River Tees***
- *Example of a flood management scheme: **Boscastle flood***

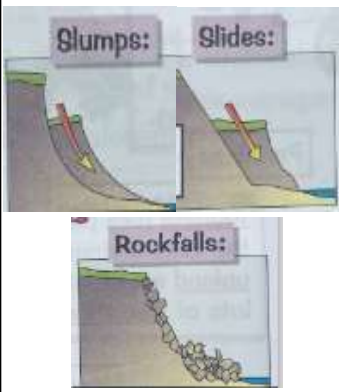


Coastline	The outline of the land. Where the land meets the sea	Erosion	The wearing away or removal of rocks. Erosion attacks the base of the cliff.
How are waves formed and how do they break?	<ul style="list-style-type: none"><li>Winds push the surface of the water in the direction it is blowing.</li><li>The water moves in a circular motion = waves.</li><li>As the waves move into shallow water, the rough sea bed = friction = water travels slower at the base of the circular wave = the top of the wave moves faster than the base.</li><li>Eventually the top of the wave breaks</li></ul> 	Hydraulic Action	The force of the waves hitting the cliffs removes material. Air bubbles in the water are pushed into cracks in the cliff and remove material due to an increase in pressure.
Wave anatomy		Abrasion	Material in the sea hits against the cliffs and removes rocks and soil, like sandpaper.
		Corrosion	Chemicals in the water dissolve the cliff.
		Attrition	Material in the sea crash into each other and break into smaller pieces. Continued attrition = smaller, smoother pebbles and sand particles.
Constructive Waves	<ul style="list-style-type: none"><li>Long wavelength and low wave height</li><li>Strong swash and gentle backwash = add material and create big beaches</li><li>Very gentle, created in calm conditions and a short fetch.</li></ul> 	Weathering	The breakdown of rocks caused by the day-to-day changes in the atmosphere. Weathering attacks the top of the cliff.
		Freeze-thaw	Water collects in cracks. At night this water freezes and expands. The cracks get larger. In the day the temperature rises and the ice melts (thaws). The repeated freezing and thawing weakens the rock = breaks apart
		Biological weathering	Plant roots grow in cracks in the rocks and break them apart. Animals burrow into weak rocks and break it apart.
Destructive Waves	<ul style="list-style-type: none"><li>Short wavelength and high wave height</li><li>Weak swash and strong backwash = remove material and erode beaches</li><li>Very powerful, created in storms and with a long fetch.</li></ul> 	Carbonation	Carbon dioxide and sulphur dioxide mix with rainwater to produce acid rain. This reacts with rocks. e.g. rainwater + CO2 = carbonic acid. Carbonic acid + calcium carbonate (in rocks such as limestone) = calcium bicarbonate which is soluble = rock dissolves.
		Transportation	The movement of sediment along the coastline.
		Longshore drift	The zig zag movement of transported material along the coastline. It is transported in the direction of the prevailing wind.
Wave fetch	The distance of water over which the wind blows (the size of the sea/ocean)		
Swash	Breaking waves rush water and sediment up the beach.	Deposition	The dropping of material carried by the water.
Backwash	The water that rushes flows back to the sea.		It takes place in areas where the flow of water slows down. Waves lose energy and can no longer carry sediment and is therefore dropped. This occurs in:
Infiltration	Water enters the ground		<ul style="list-style-type: none"><li>Sheltered bays when the wave's energy decreases.</li><li>Areas where there are constructive waves (strong swash/weak backwash)</li><li>Coastlines with groynes. These are wooden walls that are built out to sea, along the beach. They trap sediment being transported by longshore drift.</li></ul>
Saturation	Rock that is full of liquid		
Impermeable rock (non-porous rock)	Rocks that do not allow liquid to pass through		
Permeable rock (porous rock)	Rocks that allow liquid to pass through		
Slip plane	A line of weakness along which movement occurs		

## LANDFORMS: EROSION AND WEATHERING

## LANDFORMS: TRANSPORTATION AND DEPOSITION

## MASS MOVEMENT



Mass movement is the downhill movement of material caused by gravity.

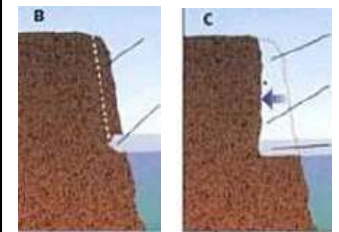
## Rotational slump and Landslide:

- Heavy rain infiltrates the permeable rock = saturated and heavier. The rocks become unstable and a line of weakness (slip plane) forms.
- Land moves downhill along the line of weakness.
- Rotational slumps – a CURVED line of weakness forms.
- Landslides – a STRAIGHT line of weakness forms.

## Rock Fall – where rocks fall down a cliff face due to gravity

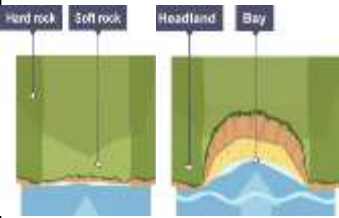
- Freeze-thaw weakens the rocks at the top of the cliff.
- These weakened rocks fall to the base of the cliff.
- The material that collects at the bottom of the cliff is called a scree slope.

## WAVE CUT PLATFORM



- Waves erode the base of the cliff between the high and low tide levels due to hydraulic action and abrasion.
- This creates a **wave cut notch** and **overhanging cliff**.
- Further erosion = the notch gets larger = overhanging cliff becomes unstable.
- Eventually the overhanging cliff collapses leaving a flat area of rock (**wave cut platform**).
- The cliff retreat.

## HEADLAND AND BAY e.g. Swanage Bay and the Foreland



A **headland** is a cliff that sticks out into the sea.

A **bay** is an indentation in the coastline between headlands

- Discordant coastlines, with different rock types, will erode at different speeds.
- **Hard rock** (granite) will erode more slowly, creating **headlands**.
- **Soft rock** (clay) will erode more quickly, creating **bays**.
- Bays are sheltered = deposition = beaches are formed.

## CAVE, ARCH, STACK e.g. Old Harry

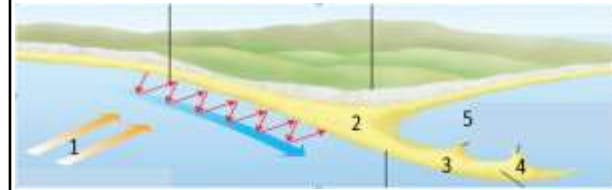


- Erosion (hydraulic action, abrasion) attacks a line of weakness in the cliff = cave.
- Continued erosion, erodes the back of the cave = arch.
- Weathering (freeze-thaw, animals, salt) weakens the top of the arch = unstable. It eventually collapses = stack.
- The stack is eroded from the base by the sea and weakened at the top by weathering = stump.

## SPIT e.g. Sandbanks



1. Longshore drift transport material along the coastline in a zigzag pattern.
2. Where there is a sudden bend in the coastline, the waves lose energy = material is deposited.
3. Continued longshore drift and deposition, deposits material out to sea = spit.
4. Strong winds and waves curve the end of the spit = recurved end.
5. The area behind the spit is sheltered from waves = low energy = deposition. Saltmarshes and mud flats are common here. They attract lots of wildlife.



A **BAR** is formed when a spit joins two headlands together. A lagoon forms behind the bar.

A **TOMBOLO** is formed when a spit joins to an island.

## BEACH e.g. Swanage Bay



## Deposits of sand and shingle (pebbles) at the coast.

Beaches are found on the coast between the high water mark (high tide line) and low water mark (low tide line). They are formed by constructive waves depositing material, such as sand and shingle.

- **Sand beach** – wide, and flat.
- **Shingle beach** – steep and narrow.

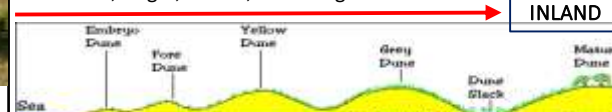
Beaches are made up of the **offshore** (out to sea), **foreshore** (between high and low tide lines) and **backshore** (high up the beach, near the sand dunes).

## SAND DUNE e.g. Studland



## SAND DUNES – mounds of sand at the back of the beach.

- Sand is moved up the beach by the wind.
- It gets trapped by obstacles (e.g. driftwood) and the sand is deposited. Over time it gets vegetated and larger = embryo dune.
- As you travel inland from the sea, the sand dunes get: taller, larger, darker, more vegetated.





The UK's coastline is at risk of erosion. For a section of coastline to be protected, the cost of the scheme must be less than the value of the land, property and infrastructure (e.g. roads) saved, and the scheme must have no negative 'knock-on' environmental effects, for example making erosion worse somewhere else. The British Government creates **shoreline management plans (SMPs)** that outline how our coastline will be protected. There are four strategies.

<b>Advance the line</b>	Build new defence structures (v. high land value)
<b>Hold the line</b>	Maintain/improve existing coastal defences (high land value)
<b>Managed retreat</b>	Allow the sea to flood the land and build new sea defences inland (low land value)
<b>Do nothing</b>	Leave land to erode/flood (v. low land value)

**Example: North Norfolk** is located on the east coast of England. Historic records show that between 1600 and 1850, >250m of land was eroded by the sea. This is due to soft rock (clay), large wave fetch (4000 miles from Arctic) and strong weather. Along the coastline they have a number of Shoreline Management Plans (SMPs).

<b>Happisburgh</b>	Very low land value. SMP: do nothing. ➤ Old sea defences are not repaired and the cliff is left to erode. Owners were given 40% of their homes full value (non-risk value) as compensation.
<b>Sea Palling</b>	Mid land value (homes, few shops, pub). SMP: hold the line. ➤ They have a concrete sea wall and offshore breakwaters.
<b>Sheringham</b>	High land value (lots of homes and businesses). SMP: hold the line. ➤ They have a sea wall, groynes, rock armour and beach nourishment.

<b>Managed retreat</b>	<b>A deliberate decision to allow the sea to floor an area of low-value land.</b> ➤ People are evacuated, buildings demolished and any existing sea defences removed. The sea floods the land and salt marshes develop which absorb the energy of future waves. New flood defences can be built in high-value land behind the salt marshes
------------------------	---

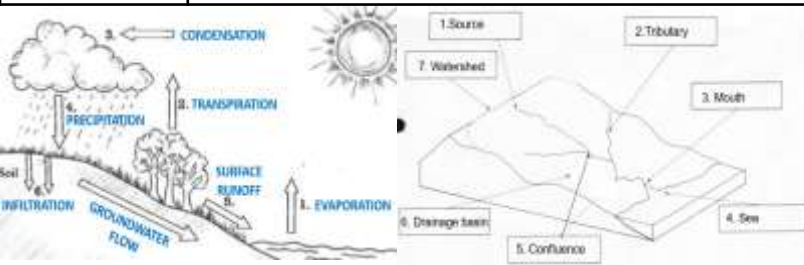
**Medmerry Managed Retreat, Chichester, South England.**  
The flat, low-lying land had a low value (used for farming and caravan parks). The sea wall that protected the area needed repairing, but the decision was to not repair it and allow the land to flood as it was cheaper than repairing the sea wall. The managed retreat took place in November 2013.

<b>Example of managed retreat</b>	<table> <tr> <th>ADVANTAGES</th><th>DISADVANTAGES</th></tr> <tr> <td>Created large saltmarsh that protected the most expensive inland areas from flooding. Created wildlife habitats Cheaper than repairing sea wall</td><td>People and businesses were flooded and relocated. It cost the government £28 million.  Large areas of agricultural land was lost.</td></tr> </table>	ADVANTAGES	DISADVANTAGES	Created large saltmarsh that protected the most expensive inland areas from flooding. Created wildlife habitats Cheaper than repairing sea wall	People and businesses were flooded and relocated. It cost the government £28 million.  Large areas of agricultural land was lost.
ADVANTAGES	DISADVANTAGES				
Created large saltmarsh that protected the most expensive inland areas from flooding. Created wildlife habitats Cheaper than repairing sea wall	People and businesses were flooded and relocated. It cost the government £28 million.  Large areas of agricultural land was lost.				

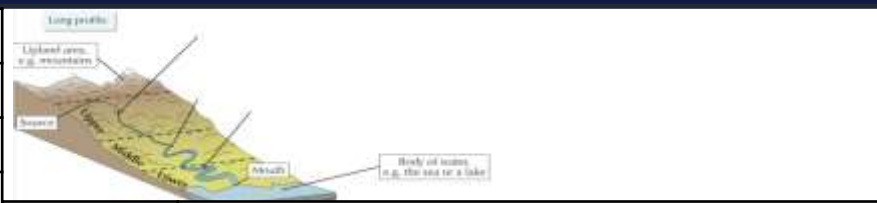
<b>Hard engineering</b>	<b>Using manmade, artificial structures to prevent erosion and flooding.</b> ➤ More effective, long lasting and need less maintaining than soft engineering, however more expensive and less natural/environmentally friendly.
<b>Sea Wall</b>	A strong concrete wall built in front of the cliff/settlement that absorbs the wave's energy. A curved sea wall reflects the wave back to sea. • Effective, long lifespan, tourists like to walk along it. • Expensive to build and maintain, looks unnatural.
<b>Rock Armour</b>	Large rocks placed in front of the cliff or settlement, that absorb the wave's energy. • Effective, long lifespan, cheaper, more natural and easier to build/maintain than a sea wall. • Expensive, access to the beach can be difficult, can become slippery and dangerous.
<b>Gabions</b>	A wire cage filled with rocks that are placed in front of the cliff or seaside settlement, that absorb the wave's energy. • Effective, long lifespan, cheaper and easier to build/maintain than rock armour/sea walls. • Wire cages have short lifespan (5-10 years). Sea water corrodes metal cages = broken gabions which can be dangerous to tourists. More expensive than soft engineering.
<b>Groynes</b>	Wood or rock fences built out into the sea. They trap sediment transported by longshore drift and make the beach larger. • Groynes - Beach becomes wider = waves lose energy as they rush up the beach = less erosion. Big beaches boosts tourism. • They prevent sediment reaching beaches further along the coastline = problem is shifted and not solved. More expensive than soft engineering.
<b>Off-shore Break-water</b>	Stone walls built up in the ocean parallel to the coastline. They reduce the energy of the waves and help deposition to occur = beach gets larger (e.g. Sea Palling), however they can also be very expensive and can interfere with boats.
<b>Soft engineering</b>	<b>Using natural, environmentally friendly methods to prevent flooding.</b> ➤ Often cheaper than hard engineering however need more maintaining and have a shorter lifespan
<b>Beach Nourishment</b>	Adds sediment to the beach to make it wider = acts as a barrier from the waves = reduces erosion and flooding. • Cheap and easy to maintain, natural looking, bigger beaches = more tourism • Short lifespan, constant maintenance, beach is closed due it is being done.
<b>Beach Reprofilling</b>	Material removed by longshore drift or destructive waves is returned to the beach = prevents the beach getting smaller. • Cheap and easy to maintain, natural appearance, bigger beach = more tourists • Short lifespan, constant maintenance, beach is closed due it is being done.
<b>Dune Regeneration</b>	Sand dunes are repaired and made larger using fences or marram grass = barrier from the waves. • Cheap, very natural, popular with wildlife (creates habitats). • While being repaired, dunes are closed = less tourists, constant maintenance as dunes are constantly changing.
<b>Dune Fencing</b>	Fences are built on sandy beaches to collect sand and create new sand dunes = act as a barrier from the waves • Cheap, natural, help make dunes larger, minimal impact on wildlife. • Can be dangerous if the fences break, need regular maintenance after storms



Evaporation	The sun heats up water. The water turns into a gas which rises up into the atmosphere (air).
Transpiration	The sun heats up water on the leaves of trees. The water turns into a gas which rises up into the atmosphere (air).
Condensation	As the water in the atmosphere rises, it cools and condenses to form clouds.
Precipitation	Water in the cloud falls to the earth's surface as rain, hail, sleet and snow.
Surface run-off	When the water runs off the surface of the ground as a river or stream.
Groundwater flow	When water flows through the rocks and soil underground.
Infiltration	When water enters a rock.



Drainage Basin	The area of land in which water drains into a specific river.
Watershed	The boundary of a drainage basin. It separates one drainage basin from another. It is usually high land.
Source	The point where the river begins.
Tributary	A stream or small river that joins a larger stream or big river.
Confluence	A point where two streams or rivers meet.
Mouth	The point where the river meets the sea or ocean.
Long Profile	Shows the gradient of a river from its source to mouth.
Cross Profile	Shows the shape of the river channel and valley. It is an imaginary 'slice' across a river channel/valley at a specific point.
Embankments	Raised river banks on either side of a river
Contour Line	Brown lines on an OS map that join up points of equal height. They allow us to determine slope gradient.
Flood	A flood occurs when there is too much water in the river channel. As a result water spills out onto the floodplain.
Flash Flood	Rapidly rising river levels leading to greater
Storm Hydrograph	Shows how a river changes after a storm and is used to predict floods
Lag time	The time (in hours) between the peak rainfall and peak discharge
Discharge	The volume of water in a river channel (measured in cumecs)



**Long profile** Shows the gradient of a river along its course (from its source to its mouth).

**Cross profile** Shows the shape of the river channel and valley. It shows a cross section of the river.

**Upper course:**

- Long profile: very steep gradient.
- Cross profile: Vertical erosion has created steep V shape valleys. Narrow and shallow river channel.
- Landforms: *V shape valleys, waterfalls, gorge.*

**Middle course:**

- Long profile: medium gradient.
- Cross profile: Gentle sloping valley sides – formed by lateral erosion. Wider and deeper river channel.

**Lower course:**

- Long profile: very steep gradient.
- Cross profile: Lateral erosion widens the river valley = very wide, almost flat valley. Widest and deepest river channel
- Landforms = *estuaries, floodplain, levees, meanders, ox bow lakes*

**Erosion** The removal of rock by the river

**Hydraulic Action** The force of water hits against the river channel and removes material. It is common with fast moving, high energy water.

**Abrasion** Sediment carried by the river hits the river channel and removes material.

**Corrosion** Chemicals in the water dissolve rocks (e.g. limestone)

**Attrition** Stones carried by the river hit into each other, gradually making the rocks smaller and smoother. Rocks in the upper course are large and more angular than rocks in the lower course.

**Weathering** The breakdown of rocks caused by the day-to-day changes in the atmosphere.

**Freeze-thaw** Water collects in cracks. At night this water freezes and expands. The cracks get larger. In the day the temperature rises and the ice melts (thaws). The repeated freezing and thawing weakens the rock = breaks apart.

**Transportation** Eroded material is carried by the river downstream.

**Traction** Large particles roll along the river bed.

**Saltation** Pebble-sized particles bounce along the river bed.




**Suspension** Small particles (silt and clay) are carried in the water.

**Solution** Soluble materials dissolve in the water and are carried along.


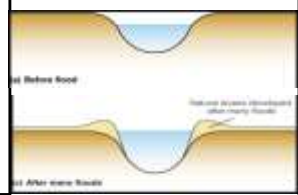

**Deposition** Deposition takes place where a river does not have enough energy to carry sediment (its load). As a result it is dropped.

Course	Cross profile
Upper	
Middle	
Lower	

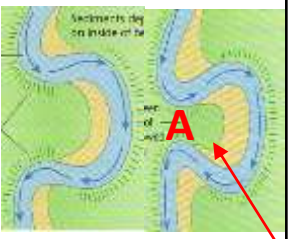
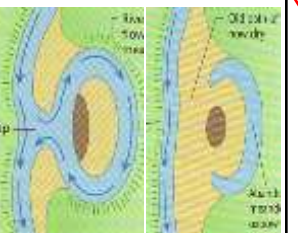
## LANDFORMS: EROSION AND WEATHERING

<b>Waterfall</b> 	<p><b>A steep fall of water in the upper course of a river.</b></p> <ul style="list-style-type: none"> <li>Waterfalls are formed when hard rock overlays softer rock.</li> <li>The softer rock is eroded more quickly than the harder rock = plunge pool and overhanging rock.</li> <li>Continued erosion makes the plunge pool deeper and overhanging rock unstable.</li> <li>The overhanging rock collapses and the waterfall retreats upstream.</li> </ul>
<b>Gorge</b> 	<p><b>A narrow steep sided valley that is usually found immediately downstream from a waterfall.</b></p> <p>It is formed by the gradual retreat of a waterfall over hundreds or thousands of years.</p>
<b>Interlocking Spurs</b> 	<ul style="list-style-type: none"> <li>In the upper course, the river erodes vertically (downwards) = steep valley sides.</li> <li>Weathering of the valley sides = deep V shape valleys.</li> <li>The river in the upper course does not have enough energy to erode laterally and so flows around bands of more resistant rock</li> <li>These resistant hard rock creates ridges with jut out = spurs. They overlap = interlocking spurs.</li> </ul>

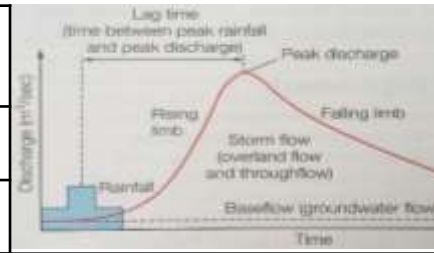
## LANDFORMS: TRANSPORTATION AND DEPOSITION



<b>Floodplain</b> 	<p><b>A wide, flat area of marshy land on either side of a river in the lower course of a river.</b></p> <ul style="list-style-type: none"> <li>Flooding is common in the lower course of a river. When a river floods, velocity decreases = energy decreases = deposition occurs.</li> <li>Layers of deposited fine sediment (e.g. silt/alluvium) build up.</li> <li>The floodplain is made wider due to large meanders that wind across the floodplain.</li> </ul>
<b>Levee</b> 	<p><b>A raised river bank found alongside a river in the lower course, caused by repeated flooding. They are natural embankments.</b></p> <p>Flooding is common in the lower course of a river. When a river floods, velocity decreases = energy decreases = deposition occurs.</p> <ul style="list-style-type: none"> <li>Heavier, larger material is deposited first, next to the river bank.</li> <li>Lighter silt/alluvium is deposited further across the floodplain.</li> <li>Over time the height of the banks are raised by a build up of coarser sand deposits = levees.</li> </ul>
<b>Estuary</b> 	<p><b>Is the wide part of a river, where the river meets the sea (mouth)</b></p> <p>Estuaries are the transitional zone between the river &amp; sea.</p> <ul style="list-style-type: none"> <li>The water flowing down the river meets water flowing up the river from the sea (during high tides) = velocity decreases = energy decreases = lots of deposition.</li> <li>Due to deposition, salt marshes form = habitats for wildlife.</li> </ul> <p>In some estuaries humans have made ports for industry.</p>

## LANDFORMS: EROSION AND DEPOSITION

<b>Meander</b> 	<p><b>A bend in the river on the valley floor.</b></p> <ol style="list-style-type: none"> <li>It starts with a slight bend.</li> <li>Water moves faster on the outside of the bend and slower on the inside.</li> <li>The fast water erodes the outside of the bend. The slower water deposits material on the inside of the bend.</li> <li>Continued erosion and deposition makes the bend bigger.</li> </ol>
<b>Ox bow lake</b> 	<p><b>U-shaped lakes formed when a meander is no longer connected to a river</b></p> <ol style="list-style-type: none"> <li>Continued erosion and deposition = meander bigger and the neck (A) narrows.</li> <li>Eventually the neck breaks through and the water takes the most direct route, avoiding the meander</li> <li>As less water is flowing through the meander, the energy is reduced = deposition. The meander is blocked off and an oxbow lake is created.</li> </ol>

## STORM HYDROGRAPH

<b>Storm Hydrograph</b>	A graph that Shows how a river changes after a storm and can be used to predict floods.	
<b>Lag time</b>	The time between the peak rainfall and peak discharge	
<b>Discharge</b>	The volume of water in a river channel (measured in cumecs)	

<b>NO FLOOD</b> 	<ul style="list-style-type: none"><li>• Trees in drainage basin that intercept rainfall = longer lag time.</li><li>• Gentle rain = more water infiltrated = takes longer to reach river channel</li><li>• Permeable rock = more water infiltrated = takes longer to reach river.</li><li>• Dry soils = more water can infiltrate = takes longer to reach river channel</li><li>• Large drainage basins = water has to travel further to reach river = slower</li></ul>
<b>FLOOD</b> 	<ul style="list-style-type: none"><li>• Deforestation – no trees to intercept rainfall = shorter lag time</li><li>• Intense rain = too fast to infiltrate = more surface runoff = quicker to river</li><li>• Impermeable rock = rain not infiltrated = more surface runoff = quicker to river. Impermeable surfaces created when areas are <b>urbanised</b> (concrete).</li><li>• Steep slopes = quick transfer of water to river channel = short lag time</li></ul>

<b>Hard engineering</b>	<b>Man-made structures built to control the flow or water and reduce flood risk.</b> <ul style="list-style-type: none"> <li>➤ More effective, long lasting and need less maintaining than soft engineering, however more expensive and less natural/environmentally friendly.</li> </ul>
<b>Dam &amp; Reservoir</b>	<p>A large wall is built across a river and a reservoir forms behind the dam. It is used to regulate river flow. The flow of water can be 'turned off' during periods of heavy rain.</p> <ul style="list-style-type: none"> <li>• <b>Effective, long lifespan, used for irrigation, water supply, recreation and HEP.</b></li> <li>• <b>Expensive, damage habitats, people have to relocate due to flooding.</b></li> </ul>
<b>Channel Straightening</b>	<p>Rivers are straightened by cutting through meanders to create a straight river channel. This speeds up the flow of water along the river.</p> <ul style="list-style-type: none"> <li>• <b>Effective as water does not have time to build up, long lifespan.</b></li> <li>• <b>Expensive, unnatural, damage habitats, result in flooding downstream.</b></li> </ul>
<b>Embankment</b>	<p>A raised riverbank (levee) which allows the river to channel to hold more water.</p> <ul style="list-style-type: none"> <li>• <b>Effective, long lifespan, can look natural if covered in vegetation</b></li> <li>• <b>Expensive, if concrete is used it is unnatural and unattractive.</b></li> </ul>
<b>Flood Relief Channel</b>	<p>A man-made river channel constructed to divert water in a river channel away from urban areas.</p> <ul style="list-style-type: none"> <li>• <b>Effective as regulate river discharge (in heavy rain, relief channels are opened)</b></li> <li>• <b>Expensive</b></li> </ul>
<b>Soft engineering</b>	<b>Using natural, environmentally friendly methods to prevent flooding.</b> It aims to reduce & slow down the transfer of water to the channel to prevent flooding. <ul style="list-style-type: none"> <li>➤ Often cheaper than hard engineering however need more maintaining and have a shorter lifespan</li> </ul>
<b>Afforestation</b>	<p>Planting trees to create a woodland/forest</p> <ul style="list-style-type: none"> <li>• <b>Trees slow down the movement of water into channels (longer lag time) = less likely to flood. Provides habitats. Cheap.</b></li> <li>• <b>Less effective than hard engineering.</b></li> </ul>
<b>Wetlands</b>	<p>Where land next to wetlands is left to flood.</p> <ul style="list-style-type: none"> <li>• <b>Cheap, easy to maintain, create habitats, stores water so less in river channel.</b></li> <li>• <b>Short lifespan, constant maintenance, beach is closed due it is being done.</b></li> </ul>
<b>Floodplain Zoning</b>	<p>Land is allocated for different uses according to its flood risk. Land closest to the river is used as parkland and land further from rivers is used for housing and industries.</p> <ul style="list-style-type: none"> <li>• <b>Doesn't stop the flood but reduces cost as infrastructure is not destroyed.</b></li> <li>• <b>Flood is not stopped, is difficult to if the land has already been built on.</b></li> </ul>
<b>River Restoration</b>	<p>Returns a river to its natural state (e.g. remove channel straightening or a dam).</p> <ul style="list-style-type: none"> <li>• <b>Cheap, easy to maintain, creates habitats, natural.</b></li> <li>• <b>Flooding still occurs, less effective.</b></li> </ul>
<b>Planning &amp; Preparation</b>	<p>Rivers are monitored to measure flood risk using satellites, instruments and computer models. The Environmental Agency issue alarms if a flood will happen.</p> <ul style="list-style-type: none"> <li>• <b>People can prepare – sandbags around home, move valuable upstairs, evacuate, create emergency kits,</b></li> <li>• <b>Flood still occurs, house prices can drop if deemed 'at risk'</b></li> </ul>

<b><u>BOSCASTLE FLOODS</u></b>		
<b>Where:</b> Boscastle, Cornwall <b>Physical landscape:</b> Boscastle is a village located in a steep V shaped valley. The river Valency flows through the centre of the village <b>When:</b> August, 2014		
Natural/Physical causes	Human causes	Social and economic effects
<p>There had been heavy rainfall in the previous week, saturating the drainage basin</p> <p><b>200 mm of rainfall fell in 4 hours</b>, saturating the drainage basin. Surface run-off and throughflow rapidly filled the river causing a flash flood.</p> <p>The village is in a steep V shaped valley so surface run-off filled the river rapidly</p> <p>The tide in the harbour was in, blocking the flow of river water out to sea</p>	<p>Boscastle is built on a narrow floodplain next to the river so is easily flooded</p> <p>Impermeable roads and surfaces rapidly channelled more water into the river</p> <p>Bridges over the river and culverts under the roads became blocked with cars and fallen trees, blocking the flow of the river</p>	<p><b>Economic</b>          £25 million lost in tourism business over the summer season          20 B&amp;B's closed for the whole tourist season          80 buildings severely flooded and damaged          Local jobs in tourism were lost          Price of building and contents insurance increased</p> <p><b>Social</b>          3 houses completely destroyed          Roads bridges and car park were destroyed          Road surfaces were ripped up by the floodwater          Electricity supplies cut off for several days          Repair and rebuilding took six months          Sewage pipes burst in the village          100 cars swept in to the harbour          150 people airlifted to safety</p>
<p><b>Boscastle flood prevention scheme. Cost £4.5 million</b></p> <p><b>Hard engineering</b></p> <ul style="list-style-type: none"> <li>• The river was channelized so that it would hold more discharge in the future</li> <li>• The car park was raised by 2 metres to stop it getting flooded again</li> <li>• Stone walls were built to strengthen the banks of the river to stop them eroding</li> <li>• Bridges over the river and culverts under roads were widened and strengthened to allow more discharge to pass through</li> <li>• The main sewage pipe was re-built under the river so it wouldn't be effected in a future flood</li> </ul> <p><b>Soft engineering</b></p> <ul style="list-style-type: none"> <li>• Old and unstable trees growing on the river banks were removed so that they would not be knocked over in a flood, blocking the river channel</li> </ul>		

## PAPER 2: HUMAN GEOGRAPHY

### Section A: Urban Issues and Challenges (Parts 1-5)

- *Case study of a major city in a LIC or NEE: **Rio de Janeiro***
- *An example of how urban planning improves the quality of life for the urban poor: **Favela Bairro Project***
- *Case study of a major city in the UK: **Bristol***
- *An example of an urban regeneration project: **Temple Quarter***

### Section B: The Changing Economic World (Parts 1-6)

- *An example of how tourism can reduce the development gap: **Jamaica***
- *A case study of an LIC or NEE: **Nigeria***
- *A case study of an HIC: the **UK***
- *An example of how modern industries can be environmentally sustainable: **Torr Quarry***

### Section C: The Challenge of Resource Management (27-29)


- *Example of a large scale water management scheme: **Lesotho***
- *Example of a local scheme in an LIC to increase water sustainability: **The Wakel river basin project***



## Section A: Urban Issues and Challenges (Parts 1-5)

- *Case study of a major city in a LIC or NEE: **Rio de Janeiro***
- *An example of how urban planning improves the quality of life for the urban poor: **Favela Bairro Project***
- *Case study of a major city in the UK: **Bristol***
- *An example of an urban regeneration project: **Temple Quarter***



Urbanisation is.....	The increase in people living in towns and cities		
More specifically.....	In 1950 33% of the world's population lived in urban areas, whereas in 2015 55% of the world's population lived in urban areas.		
By 2050.....	It is predicted 70% will be living in urban areas.		
Urban growth	The increase in land covered by cities	Three are currently 34 megacities in the world.	
Urban growth is caused by.....	Natural increase and rural to urban migration.	Most megacities are located... More specifically.....	In LICs and NEEs 65% of all megacities are located in LICs and NEEs.
Urbanisation results in the creation of....	Megacities	Urban growth is happening more in LICs/NEEs due to.... More specifically.....	Industrialisation  As a country develops their economy changes from agriculture (primary) to manufacturing (secondary) and services (tertiary). This occurs during the industrial revolution. Most of the secondary and tertiary jobs are in towns and cities. When this occurs, lots of people move from rural to urban areas = rapid urbanisation. HICs went through their industrial revolution a long time ago, whereas LICs and NEEs are going through their industrial revolution now. As a result more people in LICs and NEEs are currently moving to urban areas.
A megacity is...	An urban area with over 10 million people living in it. For example Mumbai, Tokyo and Mexico City.	Urban growth is happening more in LICs/NEEs due to.... More specifically.....	Natural increase  LICs and NEEs are in stages 2 and 3 of the demographic transition model. In these stages there is a high birth rate and lower death rate = more people are born than are dying = the population naturally increases. In HICs there is a low death rate and even lower birth rate = the population is declining.
Natural increase is.....	If a country has a higher birth rate than death rate, the population will naturally increase. This type of population is often found in stages 2 and 3 of the DTM where there is a high number of young adults (18-35 years) who are having lots of children and few older people who are dying due to improved healthcare. Therefore urban growth is common in NEEs.	Urban growth is happening more slowly in HICs due to... More specifically.....	Counter-urbanisation.  In HICs, people are deciding to leave cities and live in the surrounding countryside to get a better quality of life (less pollution, quieter, more space). They can commute to work due to improved transportation.
Rural to urban migration is...	The movement of people from the countryside to cities. It is caused by push factors (pushing people out of rural areas) and pull factors (pulling people to cities).	Case studies:	Rio de Janeiro and Bristol
Push factors are....	Factors that push people out of an area. Negative factors that make people want to leave an area.		
Pull factors are....	Factors that pull people out of an area. Negative factors that make people want to leave an area.		
Rural to urban migration push factors make people want to leave rural areas. Examples include.....	<ul style="list-style-type: none"> <li>Farming is hard and poorly paid</li> <li>Increased use of machinery in farming = less people needed to work = unemployment</li> <li>Dry land in rural areas caused by desertification = land cannot be farmed</li> <li>Fewer doctors, hospitals, schools and transportation routes</li> </ul>		
Rural to urban migration pull factors make people want to move to urban areas. Examples include.....	<ul style="list-style-type: none"> <li>More highly skilled, better paid jobs</li> <li>Range of entertainment opportunities</li> <li>More and better doctors and hospitals</li> <li>More schools and better education</li> <li>Better transportation routes/public transport</li> </ul>		

**RIO DE JANEIRO** is located in Guanabara Bay, on the south-east coast of Brazil. It lies next to the Atlantic Ocean. It is the cultural capital of Brazil and 2<sup>nd</sup> largest city, with a population of 12.5 million.



It is globally important due to:

- Industrial businesses – produces 5% of Brazil's GDP.
- Financial centre – banking, finance and insurance.
- It hosted the 2014 World Cup, 2016 Olympics and annually the Rio Carnival.

These factors have attracted a multicultural population, with people from all over the world moving to Rio to live: *South Korea, China, UK, USA, Portugal, Argentina and Bolivia.*

Urban growth in Rio de Janeiro has created many **social** and **economic** opportunities:

Opportunity	Evidence in Rio
<b>JOBS</b>	<ul style="list-style-type: none"> <li>• Rio provides &gt;6% of all jobs in Brazil.</li> <li>• Rio is home to many manufacturing industries, (pharmaceuticals, clothing, furniture and processed foods) and service industries (banking, insurance).</li> <li>• As Rio grows there are many jobs in construction</li> </ul>
<b>BUSINESS OPPORTUNITIES</b>	<ul style="list-style-type: none"> <li>• The growth of urban industrial areas can increase economic development. It will attract businesses to the area.</li> </ul>
<b>EDUCATION</b>	<ul style="list-style-type: none"> <li>• Rio provide grants to poor families to encourage children to attend school.</li> <li>• Rio have many volunteers who help in schools.</li> <li>• There are adult classes to help adults gain skills = better jobs</li> </ul>
<b>SERVICES</b>	<ul style="list-style-type: none"> <li>• Rio has a new nuclear generator and hydro-electric power station = more energy produced.</li> <li>• 60km of new electricity lines = better access to energy</li> <li>• By 2014, 95% of Rio had access to a mains water supply. This was due to 7 new water treatment plants and 300km of new water pipes being laid.</li> <li>• 12 new sewage works have been built and 5km of sewage pipes installed in badly polluted areas.</li> </ul>
<b>HEALTHCARE</b>	<ul style="list-style-type: none"> <li>• Some areas in Brazil (Barra de Tijuana) have a life expectancy of 80 years old. Brazil (as a country) has an average life expectancy of 63 years.</li> <li>• Medical staff go into favelas and offer emergency medication to people's homes.</li> </ul>
<b>ENTERTAINMENT</b>	<ul style="list-style-type: none"> <li>• One of the world's top tourist destinations - The Statue of Christ the Redeemer, stunning natural surroundings and entertainment.</li> </ul>
<b>TRANSPORT</b>	<ul style="list-style-type: none"> <li>• It has two major airports and five shipping ports</li> <li>• Public transport, toll roads and one way systems to control traffic</li> </ul>

Urban growth in Rio has also created many **social**, **economic** & **environmental** challenges

Challenge	Evidence in Rio
<b>Lack of healthcare</b>	In 2013 only 55% of the city had a local family health clinic.
<b>Lack of education</b>	Not enough schools, teachers or funding for education.
<b>Lack of water supply</b>	Around 12% of Rio does not have access to running water.
<b>Lack of energy</b>	Due to illegal tapping onto electricity lines = blackouts.
<b>Unemployment and informal sector jobs</b>	Many people are unemployed or work in the informal sector (e.g. street vendor), which are poorly paid, no contract, no taxes paid.
<b>Air pollution</b>	caused by too many cars and growth of factories = 5000 deaths per year.
<b>Water pollution</b>	caused by sewage running into rivers (200 tonnes/day) and industrial waste from factories and oil spills.
<b>Waste pollution</b>	a lack of waste disposal = rubbish on streets.
<b>Creation of squatter settlements (favelas)</b>	<p><b>These are illegal settlements on the outskirts of cities</b></p> <p><b>Characteristics:</b></p> <ul style="list-style-type: none"> <li>• Poorly built homes using basic materials</li> <li>• Houses built on steep slopes = landslides (e.g. 2010: 224 killed and 13,000 lost their homes) and limited road access</li> <li>• 30% no electricity, 50% no sewage system and 12% no running water.</li> <li>• 20% are unemployed. Those who are, are employed in informal sector</li> <li>• Drug gangs are common &amp; police is rare (murder rate is 20 per 1000 ppl)</li> <li>• Infant mortality rate: 50 per 1000 people due to high population densities (37,000 per km<sup>2</sup>), lack of waste disposal, spread of disease and lack of health care.</li> </ul>

**URBAN PLANNING: improving quality of life in favelas.**

**Favela Bairro Project** is a site and service scheme that improves quality of life in **Complexo de Alemão (favela in north Rio).**

- Roads have been improved and paved
- Improved access to water pipes and sanitation
- Hillsides strengthened to prevent landslides
- New healthcare, leisure and education facilities
- Cable car has been installed that connects favela to centre of Ipanema (central Rio). Favela residents given free return daily ticket.
- 100% mortgages provided for locals to buy homes
- A Pacifying Police Unit (UPP) was set up = less crime



**Successful because: access/mobility is better = access to jobs in city centre, improved healthcare, education, access to services, 100% mortgages = more people can buy homes, less crime, fewer landslides.**

**Unsuccessful because: new infrastructure not maintained and residents did not have skills to fix it, area improved = increase in demand to live there = increase in rent = poorest had to move, budget of US\$1 billion could not help all favelas.**

# URBANISATION – BRISTOL – Part 3 Bristol's location and opportunities

Population Distribution	The way something is spread out over an area.
Industrialisation	Growth of secondary manufacturing
De-industrialisation	Decline of secondary manufacturing
Post industrial economy	Economy is mainly tertiary and quaternary industries
Brownfield site	Land that has previously been built on
Greenfield site	Land that has never previously been built on
International Migration	The movement of people across countries.
Urban Growth	The increase in the proportion of people living in urban areas.
Urban Sprawl	Unplanned growth of urban areas into the surrounding rural area
Urban Greening	Increasing the amount of green space in a city.
Social Inequalities	Some areas have more opportunities than others.
Rural-urban Fringe	The area on the edge of a city, where it meets the countryside.
Green Belt	Protected land at the rural-urban fringe where building is restricted.
Dereliction	Areas that are abandoned and become run down
Urban Regeneration	The reversal of urban decline through redevelopment, aiming to improve the local economy
Social Deprivation	When a person or area is deprived of services and amenities.

## The UK's population is unevenly distributed.

- 82% of people live in urban areas
- 32% live in London and the South East
- Sparse populations – Scotland and Wales

## Why do more people live in urban areas?

- Higher paid jobs and better working conditions in tertiary and quaternary sector, more entertainment options, better transport, more housing, better healthcare and education.

## Why do more people live in the south-east?

- Warmer, less rainfall, flatter land in the SE. In central Scotland and Wales it is colder, more rainfall and mountainous.

Bristol is located in the south-west of England. It's population is 440,500 people, which is expected to grow to 500,000 by 2029.

International migration has accounted for 50% of Bristol's population growth. There are 50 countries represented in its population.

They impact on the city by:

- Hard working workforce that bring new skills = contribute to local/national economy
- Enrich the culture of the city
- Young migrants balance aging population
- Pressure on housing, healthcare and education
- Language barrier and different religions = challenge to integrate into wider community

## Why do people migrate to Bristol?

- Culture/entertainment – sport venues, theatres, music venues, cathedrals
- Two cathedrals – religious importance
- Two universities – higher education
- Transport (M4, M5, rail) link Bristol to UK
- Transport (ports/airports) link Bristol to Europe and USA.
- Economic growth – in tertiary and quaternary industries = jobs (finance, technology, aerospace, media, defence)
- Economic growth due to inward investment from companies such as airbus (France) and BMW (Germany).

## OPPORTUNITIES IN BRISTOL

Bristol is constantly changing (*population, economy, industrialisation, de-industrialisation, regeneration*) . These changes create a number of social, economic & environmental opportunities.

### SOCIAL OPPORTUNITIES

- Increase in migration = diverse population = range of food, festivals and cultural experiences.
- Entertainment: new theatres and music venues (the Old Vic, Bristol Arena and Tobacco Factory)
- Recreation: lots of sport teams (rugby, cricket, football) are developing their opportunities for people in Bristol. *Bristol Rovers are building new football stadium on the outskirts of the city.*
- New shopping centres: Cabot's Circus in the city centre and Cribbs Causeway on the outskirts of the city offer residents shops, cinemas, restaurants, accommodation, jobs...etc.
- Improved transportation links (e.g. an integrated transport system, metrobus, electrification of the trains to London and improved public transport) = people can get around Bristol faster and the air is cleaner (due to less cars = less pollution).

### ECONOMIC OPPORTUNITIES

- Growth in tertiary and quaternary industries = employment opportunities (85% of jobs are in tertiary, 6% in quaternary, 8% in secondary and 1% in primary).
- Redevelopment of brownfield sites (e.g. the Temple Quarter) has attracted new tertiary and quaternary companies = jobs = higher disposable income = money spent in local area and therefore reinvested into the area = further economic development.
- Growth of high-tech industries due to *access to highly skilled university graduates, research facilities, clean non-polluted environment, cheaper land, superfast broadband speeds (the government gave £100million to create a super connected city).* Companies include: Hewlett-Packard, Toshiba, Aardman Animations (clay films), Defence Procurement Agency (DPA) (employs 10,000 people to make army and navy products) and aerospace (14 of the 15 main aircraft companies are in Bristol (e.g. Rolls Royce and Airbus) who produce aircraft parts and navigation/communication systems.

### ENVIRONMENTAL OPPORTUNITIES

As the city has grown, Bristol has created transport systems to reduce traffic congestion.

- Bristol's *Integrated Transport System* links different forms of public transport. (e.g. part of the ITS is the Rapid Transit Network which connects three bus routes, the Temple Meads railway station and park and ride network).
- They have also improved the rail links through electrification of the line to London = greener energy and faster connection to London.

As the city has grown and redeveloped, Bristol has focused on urban greening, to increase and preserve open green spaces.

- Urban Greening: Bristol has worked and its continuing to work very hard. Currently in Bristol:
  - ✓ 90% of people live within 350m of parkland with 300 parks in the city
  - ✓ 27% of the city is part of a wildlife network and 30% of the city is covered in trees
  - ✓ Brownfield sites are turned into green spaces (*Queen Square was a dual-carriageway*)

In 2015 Bristol became the first UK city to be awarded the status of: **European Green Capital.**

Their current goals and achievements include:

- To **reduce energy use by 30% and CO<sub>2</sub> emissions by 40%** by 2020; In 2015 **100 electric car** charging points were installed.
- Increase the use of **brownfield sites** for businesses and housing.
- In 2015 every primary pupil in Bristol **planted a tree** to increase Bristol's green coverage.
- Increase the use of **renewable energies** from 2%.



## CHALLENGES IN BRISTOL

Bristol is constantly growing. These changes have created a number of challenges in Bristol, such as urban sprawl, derelict buildings, waste disposal, air pollution, social inequalities and urban sprawl.

<p><b>CHALLENGE: RISE IN DERELICT AREAS:</b></p> <p>Industrial decline in the 20<sup>th</sup> century was caused due to an increase in manufacturing abroad, closure of many inner city ports and rise in tertiary and quaternary industries. As a result many inner city areas, such as Stokes Croft, became abandoned, run-down and deprived.</p> <p><i>Plans to fix the challenge of derelict areas.</i></p> <ul style="list-style-type: none"><li>• Lottery grants have helped improve the area of Stokes Croft. The money has been used to redevelop buildings, attract new businesses and create green spaces.</li><li>• Artists are used public to make the area more appealing</li><li>• New music venues, independent shops and nightclubs have opened in the area = improving the area's environment.</li></ul>	<p><b>CHALLENGE: URBAN SPRAWL</b></p> <p>Urban sprawl is caused by a rise in population and a lack of housing (4000 homes were damaged or destroyed in WW2).</p> <p>The demand for new housing has resulted in many people moving to the suburbs (outskirts of the city). This puts pressure on the rural-urban fringe for new housing = development of greenfield sites.</p> <p><i>e.g. Bradley Stokes and Harry Stokes are examples of new developments on greenfield sites. 1200 new homes have been built at Harry Stokes, with 2000 more planned.</i></p> <p>Building on greenfield sites is often cheaper and provides a clean environment, however it results in congestion, air pollution, loss of farmland and habitats, loss of green space and increases the risk of flooding (rise in impermeable surfaces)</p>	<p><i>Plans to reduce urban sprawl</i></p> <p><i>Focus on building new homes on brownfield sites. Between 2006 – 2013 only 6% of new housing developments were on greenfield sites. By 2026, over 30,000 new homes are planned on brownfield sites. Redeveloping brownfield sites is more expensive as land must be cleared and decontaminated from previous industrial use. However, it is the best option.</i></p> <ul style="list-style-type: none"><li>• Bristol's Harbourside was a derelict area in Bristol city centre. They have spent 40 years redeveloping the area, building flats and culture and leisure facilities.</li><li>• Finzels Reach is a 2 hectare brownfield site near the CBD. The abandoned factories and warehouses were redeveloped to create new offices, shops and 400 apartments.</li></ul>				
<p><b>CHALLENGE: WASTE DISPOSAL</b></p> <p>Bristol produces 500,000 tonnes of waste/year and is currently produces the most food waste in the UK.</p> <p><i>Plans to reduce issues with waste disposal:</i></p> <ul style="list-style-type: none"><li>• Reduce the waste sent to landfill sites. In 2004/05 88% of waste was sent to landfills. In 2012/13 it was only 27%.</li><li>• Increase recycling by making it easier to recycle by using roadside collections. In 2004/05 12% of waste was recycled. In 2012/13 it was 51%.</li><li>• Increase the amount of waste that is sent to waste treatment plants where the waste is used to generate energy. (e.g. Avonmouth treatment plant makes electricity for 25,000 homes).</li></ul>	<p><b>CHALLENGE: AIR POLLUTION</b></p> <p>Bristol is the most congested city in England = air pollution = 200 deaths per year.</p> <p>The prevailing winds from the south-west blow pollution from the industrial area at Avonmouth over the city.</p> <p><i>Plans to reduce air pollution:</i></p> <ul style="list-style-type: none"><li>• Integrated Transport Network</li><li>• Frome Gateway: a walking/cycling route to the city centre.</li><li>• Electrical vehicle charging points in 40 car parks</li><li>• Poo bus: buses between Bath and Bristol Airport will fun on bio-methane gas produced from human waste.</li></ul>	<p><b>CHALLENGE: SOCIAL INEQUALITY</b></p> <p>Some areas in Bristol are more deprived than others in Bristol. This is know as <b>social inequalities</b>. It is due to a lack of investment from the government.</p> <table><tr><th>FILWOOD</th><th>STOKE BISHOP</th></tr><tr><td><ul style="list-style-type: none"><li>➢ 1/3 of people live in low-income homes</li><li>➢ Over 1300 crimes per year</li><li>➢ 36% of students get top GCSEs</li><li>➢ Life expectancy is 78 years old</li><li>➢ 1/3 of people aged 16-24 are unemployed</li><li>➢ Poor access to fresh fruit &amp; veg.</li><li>➢ 62% of people feel unsafe at night</li></ul></td><td><ul style="list-style-type: none"><li>➢ Fewer than 4% live in poverty</li><li>➢ Less than 30 crimes per year</li><li>➢ 94% of students get top GCSEs and 50% have a degree</li><li>➢ Life expectancy is 83 years old</li><li>➢ 3% of people are unemployed</li><li>➢ Highest level of car ownership in the city</li></ul></td></tr></table>	FILWOOD	STOKE BISHOP	<ul style="list-style-type: none"><li>➢ 1/3 of people live in low-income homes</li><li>➢ Over 1300 crimes per year</li><li>➢ 36% of students get top GCSEs</li><li>➢ Life expectancy is 78 years old</li><li>➢ 1/3 of people aged 16-24 are unemployed</li><li>➢ Poor access to fresh fruit &amp; veg.</li><li>➢ 62% of people feel unsafe at night</li></ul>	<ul style="list-style-type: none"><li>➢ Fewer than 4% live in poverty</li><li>➢ Less than 30 crimes per year</li><li>➢ 94% of students get top GCSEs and 50% have a degree</li><li>➢ Life expectancy is 83 years old</li><li>➢ 3% of people are unemployed</li><li>➢ Highest level of car ownership in the city</li></ul>
FILWOOD	STOKE BISHOP					
<ul style="list-style-type: none"><li>➢ 1/3 of people live in low-income homes</li><li>➢ Over 1300 crimes per year</li><li>➢ 36% of students get top GCSEs</li><li>➢ Life expectancy is 78 years old</li><li>➢ 1/3 of people aged 16-24 are unemployed</li><li>➢ Poor access to fresh fruit &amp; veg.</li><li>➢ 62% of people feel unsafe at night</li></ul>	<ul style="list-style-type: none"><li>➢ Fewer than 4% live in poverty</li><li>➢ Less than 30 crimes per year</li><li>➢ 94% of students get top GCSEs and 50% have a degree</li><li>➢ Life expectancy is 83 years old</li><li>➢ 3% of people are unemployed</li><li>➢ Highest level of car ownership in the city</li></ul>					

### EXAMPLE OF REGENERATION: THE HARBOURSIDE, BRISTOL.

The Harbourside is located in central Bristol. It is one of the first parts of the city that visitors see when driving from the south/south-east or visiting the centre.

It was developed in the 18<sup>th</sup> century as a port area for international trade. In 1809 the floating Harbour was created to maintain the height of the water, as ships often got stuck in the River Avon when the tide went out

The Harbour finally closed in the 1970's when modern ships were too big to entre the lock gate. A new port was built in Avonmmouth. Many factories and port facilities closed and The area became rundown, abandoned and derelict, with high unemployment and social deprivation

The government decided to do something and began the largest **Urban Regeneration project in Europe**. Successful urban regeneration must improve an area socially economically and environmentally.

Redeveloping brownfield sites is often more expensive as the land must be cleared first and it might be contaminated from previous industrial use. However, it is always the preferred option.

### Social improvements:

- Tourist industries attracted to the area e.g. SS Great Britain, Industrial museum, We the Curious, Aquarium, M Shed, improving quality of life for Bristolians
- Area developed as a leisure and tourism centre attracting 500 000 tourists per year and creating 1.4 billion in income for the city. E.g. Harbourside festival
- Run-down historic buildings restored e.g. Anolfini and Industrial museum
- 1000 new apartments and homes built e.g. Wapping Warf, reducing housing shortage

### Economic improvements:

- Over 3000 jobs created reducing unemployment in the area
- New creative businesses attracted e.g. Ardman Animations
- Other major businesses attracted e.g. Lloyd's bank headquarters

### Environmental improvements:

- Improved public transport (ITS, RTN, improved Temple Meads station) = encourages people to use it and not drive = less air, noise and visual pollution.
- Area pedestrianised to allow for safe transport on foot and by bike.

## SUSTAINABLE URBAN PLANNING

**Sustainable cities are cities that meet the needs of the people who live in them today, without meaning that future generations do not have their needs met. Basically it means behaving in a way that does not irreversibly damage the environment or use up resources faster than they can be replaced. There are many things that cities can do to be more sustainable.**

## FREIBERG: A SUSTAINABLE CITY

## TRAFFIC MANAGEMENT STRATEGIES

Freiburg is located in the south-west of Germany. In 1970 is set a goal to become a sustainable urban area.

**Preventing the overuse of water: water conservation – collecting and recycling water to prevent overuse.**

**Collecting and recycling water:**

- Green roof gardens with water harvesting systems, which collect rainwater to reuse.
- Inhabitants are given incentives to use less water.
- Waste water systems allows rainwater to be retained, reused or to seep back into the ground (e.g. permeable pavements).
- Water in the River Dreisam, which flows through Freiburg, is managed using flood retention basins. These reduce the danger of flooding by storing excess water, which is used in the city.

**Prevent overuse of water:**

- Toilets installed that use less water to flush = people use less water.
- Water meters that remind residents how much water they are using = people use less water

**Preventing the overuse of energy and increasing the production of energy from renewable sources.**

Freiburg plans to be 100% powered by renewable energy by 2050. This will require many residents to half their current use of energy.

**Renewable energies**

- It is one of the sunniest cities in Germany so solar power is used. There are approximately 400 solar panels installations in the city, including at the railway station and football stadium. These produce 10 million kilowatts of electricity per year. *Freiburg's solar valley employs 1000 people in solar technology, in the production of solar panels, developing solar technology, such as solar cooling technology.*
- Other renewable energies that Freiburg uses include biomass and biogas.

**Prevent overuse of energy:**

- The government provide incentives to encourage people to become more energy efficient, by allowing homeowners to sell any excess energy to the national grid.

**Increasing the amount of green spaces. Green spaces are environmentally sustainable as they provide clean air, habitats and prevent flooding during intense rainfall. They are also socially sustainable as they create a calm, relaxing space for people to spend time and encourage exercise.**

- Afforestation – 75% of the deforested trees are re-grown every year.
- River Dreisam does not have any flood management strategies and provides natural habitats for animals and vegetation.
- 44,000 trees have been planted in the city = 40% of the city is forested. Of these areas, 56% are nature conservation areas.
- In the Riselfeld District, 78 hectares are built on and 240 hectares are open space.

Traffic congestion can lead to a number of problems:

*Air pollution, (climate change) health problems (e.g. asthma), accidents, increased journey times*

- 200 people die each year in Bristol from air pollution related causes
- Bristol is the most congested city in England
- Journeys take an average 31% longer in the rush hour in Bristol

**CYCLE ROUTES** are often provided alongside existing main roads, with some new cycle paths that exclude cars. There are many benefits of cycling.

- *Increase exercise, improve health, reduce air pollution, reduce stress, reduce congestion.*

The number of people cycling to work in Bristol is now 15%. To encourage even more people Bristol has: *made 20mph speed limits, increased cycle routes, installed cycle maps and signs and increased bike parking zones. You can hire a YoBike for £1 and leave it where you want*

**METROBUS** is a new express bus service in Bristol. It is made up of three routes that link key areas in Bristol. It will encourage more people to use public transport by improving the service it provides.

- *Faster and more reliable journeys than current buses, next stop announcements, bus stops with real time information and full accessibility.*

In Bristol the MetroBus is made up of 3 routes that link key areas of Bristol. They have priority over other transport = quicker journey times. *e.g. Long Ashton Park and Ride to Hengrove currently takes 50 minutes. The MetroBus will take 12 minutes.*

**PARK AND RIDE:** Free car parks are available on the outskirts of the city. People then take the bus into the city centre. One bus with 40 passengers causes less congestion than 20 cars with 2 people in each. A ticket costs £4.50 and is reduced if paying using an app or for a weekly pass.

They have social, economic and environmental impacts: *Less cars in the city = less congestions = less pollution (air, visual, noise), less time wasted in traffic, less accidents, less space needed in the city centre for car parks.*

Bristol has three Park and Ride Schemes around the city. Long Ashton, Portway and Brislington

**AN INTEGRATED TRANSPORT NETWORK** is a system that links different forms of public transport within the city and the surrounding area to make journeys smoother and easier. It is a sustainable transport system that reduces congestion as more people are travelling by public transport by making it easier and more convenient. *e.g. The MetroBus is a Rapid Transit Network and part of the ITS. It connects 3 bus routes, the Temple Meads railway station and all three Park and Ride stations.*

**Bio-methane buses.** Buses are the second most polluting form of transport in Bristol. In 2020 First bus introduced the first 27 of a new fleet of 77 Bio-methane buses. These buses produce 85% less pollution than diesel buses so are good for air pollution

## Section B: The Changing Economic World (Parts 1-6)

- *An example of how tourism can reduce the development gap: **Jamaica***
- *A case study of an LIC or NEE economy: **Nigeria***
- *A case study of an HIC economy: the **UK***
- *An example of how modern industries can be environmentally sustainable: **Torr Quarry***



# KS4 – The Geography Knowledge – THE CHANGING ECONOMIC WORLD (part 1) Measuring Development

**Development** is a process of change in countries that **improves people's lives**.

Developed countries are usually **wealthier** and peoples **incomes** are **higher** on average. This means they have a good **standard of living**.

You can compare the level of development between different countries using statistics called **indicators of development**.

There are three types of indicators of development – **social, economic and environmental**

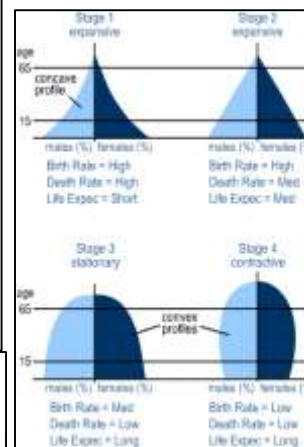
## Features of a developed country (HIC)

Better healthcare  
Less **poverty**  
Better education  
Fair police and courts  
Strong **economy**  
Equality of men and women  
Good access to services  
Higher wages  
Cleaner environment  
**Democratic Government**

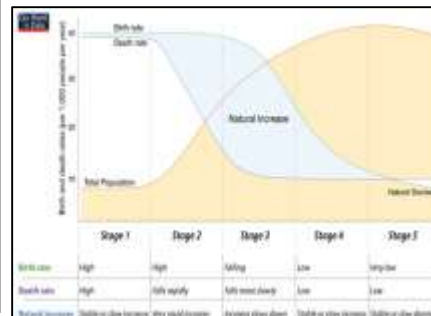
**Population pyramids** show the **population structure (male and female)** of countries at different stages of development. **(in 5 year intervals)**

**LIC's - Young populations** with **high birth rates** (wide base) **high death rates** (steeply sloping sides) and **low life expectancy** (narrow top)

**HIC's – Ageing populations** with **low birth rates** (narrow base) **low death rates** (straight sides) and **long life expectancies** (wide top)



The **Demographic transition model** shows the changes in population as a country develops over time. In the modern world different countries are at different stages on the **DTM**



## Economic Indicators of development

**GNI** - How much wealth is generated by the economy of a country

**GNI per capita** – A countries wealth divided by the population size – High = developed

## Social Indicators of development

**Life expectancy** – (years) A measure of how good health services are in a country

**Birth rate** – (per 100 people per year) Higher in LIC's where contraception is uncommon and children are needed for labour on farms

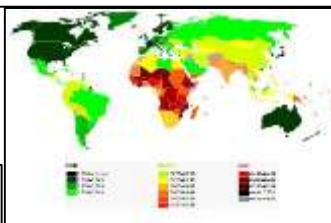
**Death rate** – (per 1000 people per year) – Shows how good health services are

**Infant mortality rate** – (per 1000 births per year) Shows how effective post natal care is

**Doctors per 1000 people** – Shows the quality and size of the health service

**Literacy rate** – (%) Shows the quality of education provision in a country

**Access to clean water or sanitation (%)** Show the quality of basic services in a country



The **Human Development Index (HDI)** combines **GNI per capita**, **years in schooling** and **life expectancy** to measure how people are benefitting from a countries **economic wealth**. (scored between 0 low and 1 high) Countries in Africa score worst and Europe, and North America

## Classifying countries

**HIC** - High Income Country  
(UK, USA, NORWAY)

**These have strong economies**

**NEE** – Newly Emerging Economy  
(BRAZIL, INDIA, CHINA)

**These are rapidly industrialising**

**LIC**- Low Income Country  
(GHANA, KENYA, HAITI)  
**These have little industry**

## Stages of the DTM

**Stage 1: (very few countries)** High birth rate, high death rate and slow population growth. Families are large but many people die due to dirty water, lack of healthcare, famine, and disease. **Little population growth**

**Stage 2: (LIC's)** Birth rate stays high, as people want children to help on farms, fetch water or earn income. **Death rate drops** due to more money being spent on healthcare, clean water and sanitation. **Population growth increases rapidly.**

**Stage 3: (NEE's)** Birth rate starts falling as people need less children as they are earning income in factories, contraception is used, and women work rather than have children. **Death rate continues to drop** as people are wealthier and healthier. **Population increase slows down.**

**Stage 4: (HIC's)** The country is now wealthy. Family planning is widespread. **Low birth rate** as women focus on careers and marry later. **Death rate is low** as healthcare is excellent. **Slow population growth.**

**Stage 5: (HIC's)** People have very few children. **The death rate is higher than the birth rate. Population starts to decline.**

## Causes of the development gap – The difference in Quality of life and standard of living between richer and poorer countries

Environmental/Natural	Economic	Historical
<b>Natural hazards</b> , extreme weather can damage regions and areas, this costs money to rebuild.	<b>Corrupt governments</b> treat the population badly, steal the countries money and resources and spend its money on weapons and war	<b>Colonial powers</b> like the UK took advantage of native people, ruled their countries and took their natural resources, leaving them less able to develop.
<b>Extreme climates</b> , droughts or flooding of land, can harm crops so people don't have enough food to eat or sell for income	Many countries are in <b>debt</b> . They have borrowed money for <b>development projects</b> . They end up paying off <b>loans</b> and not spending on improving development.	When European powers were forced out, they left <b>little industry</b> , low levels of education and social unrest.
<b>Landlocked countries</b> find it harder to trade, they do not have <b>access by sea</b> to other countries so find it hard to export goods	<b>Trade</b> - HICs buy cheap goods and sell expensive ones. LICs often <b>buy expensive goods</b> and have to sell cheap <b>raw materials</b> or <b>cash crops</b> so make little money	<b>Tribal and Cultural differences</b> between different groups create tension and <b>civil war</b> in a struggle for power after colonial powers have left their country



# KS4 – The Geography Knowledge – THE CHANGING ECONOMIC WORLD – (part 2) Reducing the development gap

## Key vocabulary

<b>HIC</b>	High Income Country
<b>NEE</b>	Newly Emerging Economy
<b>LIC</b>	Low Income Country
<b>Development</b>	The process of change for the better in a country
<b>Development Indicators</b>	A measure comparable measure of development between different countries.
<b>Birth Rate</b>	Number of births per 1000 people per year
<b>Death Rate</b>	Number of deaths per 1000 people per year
<b>Infant Mortality Rate</b>	The number of deaths of infants under the age of 1 per 1000 people per year
<b>Life expectancy</b>	The number of years an average person is expected to live
<b>Access to Clean Water</b>	Percentage of people with access to safe drinking water
<b>Literacy Rate</b>	Percentage of people with basic reading and writing skills
<b>Gross National Income</b>	Total value of goods and services produced by a country in a year (including money earned overseas).
<b>Gross Domestic Product</b>	Total value of goods and services produced in a country in a year (excluding money earned overseas).
<b>Number of Years in School</b>	The number of years an average person spends at school
<b>People per doctor</b>	The number of doctors per 1000 people
<b>Human Development Index</b>	Used by the UN to determine development. It uses literacy rate, GDP, life expectancy and number of years in school.

## Causes of the Development Gap

### • Social:

Education is poor in LICs so people do not develop skills, so stay poor.  
Infectious disease and illness spread easily because healthcare is poor and vaccination programs are not in place, so death rates are high  
Water supply and availability are poor so people struggle to farm or suffer health problems.

### • Economic:

LICs sell cheap primary goods and buy expensive secondary goods so stay poor.  
HICs sell expensive secondary goods and buy cheap primary goods so get richer.  
HICs have better trade links.  
LICs are in debt so do not have funds to pay for development projects

### • Physical:

More natural disasters occur in LICs so money is spent fixing instead of developing country. Extreme climates make food and water supplies unreliable so there are often food shortages  
Central African countries are landlocked so it is not easy to trade.

### • Historical:

Colonialism - LICs were exploited by HICs and became reliant on HICs. After LICs gained independence, corruption and civil wars occurred. Other countries and companies do not want to do business with countries experiencing corruption or civil war. Also the governments do not spend money on the things that matter (e.g. food, water, education).

## Effects of the Development Gap

### • Difference in wealth:

HICs are richer. The USA's share of global wealth is 35%. Africa's share of global wealth is just 1%.

### • Difference in health:

There is a higher death rate and lower life expectancy in LICs, where 4/10 children die before 15 years and only 2/10 live past 70 years.

The biggest killer in LICs is infectious disease whereas in HIC's it is chronic disease

### • Migration:

The movement of people from one place to another in search of a better life  
People leave voluntarily (e.g. for a job or family) or are forced (due to war). An **economic migrant** is someone who chooses to leave to search for work or better services  
A **refugee** is someone who is forced to leave for example to escape civil war

## Sustainable long

**term AID** aim's to improve the quality of life and standard of living of individuals and groups in a country over a long period.

## Intermediate

**technology** projects provide solutions that are appropriate to the skills and wealth of the population. Technology is usually designed to improve health, water or farming and to be easily repairable.

## Ways of reducing the development gap

<b>AID</b>	<b>TOURISM</b>	<b>FAIR TRADE</b>
A country receives help from another country or NGO, in the form of money, emergency supplies, food, technology, skills. <i>WaterAid (water pumps) or Oxfam's Goat Aid are examples of long term sustainable AID.</i>	LICs and NEEs can use tourism to generate income and improve their healthcare, food, water and education.  <i>Tourism brings Jamaica \$2 billion per year (45% of its GNI). Which it can spend on development.</i>	Ensures the farmers in LICs and NEEs get a fair price for their crops and invest money in local communities.  <i>Uganda coffee farmers get additional income from Fairtrade premium which improves their quality of life.</i>
<b>DEBT RELIEF</b>	<b>MICROFINANCE LOANS</b>	<b>INVESTMENT</b>
HICs reduce the amount of money LICs and NEEs have to pay back (reduce interest or invested money).  <i>By 2015, the International Monetary was giving debt relief to 36 LICs. The total debt relief was around US\$75 billion.</i>	Very small loans given to locals in LICs to start small businesses. They help the economy to grow and employment rates to rise.  <i>Grameen Bank in Bangladesh offer low interest loans of \$100 to develop small businesses.</i>	Countries & TNCs invest money and expertise in LICs to increase their profits. It helps LICs with employment, income and accessing resources.  <i>Shell and KFC in Nigeria. Also more than 2000 Chinese companies invest billions in Africa.</i>

NIGERIA IS A NEWLY EMERGING ECONOMY.		NIGERIA'S ECONOMY	
Location	North of the equator in west Africa. It borders four countries (Chad, Cameroon, Niger and Benin). The Atlantic Ocean is found along its southern coastline. Its two largest cities are Abuja and Lagos.	What does Nigeria import?	Telephones, cars, rice and wheat to China, EU, USA, India, Japan
Population	182 million. Since 1990 the number of people living in cities has increased to over 87 million people.	What does Nigeria export?	Oil, agriculture – rubber, cocoa, cotton to EU, USA, China, India, Indonesia, Brazil
Nigeria is considered important because...	<ol style="list-style-type: none"> <li>1. It has the fastest growing economy in Africa. In 2014 it became the world's 21<sup>st</sup> largest economy.</li> <li>2. It has the highest agricultural output in Africa, employing 70% of the population.</li> <li>3. It supplies 2.7% of the world's oil, making it the 12<sup>th</sup> largest producer.</li> <li>4. Political global links, working with the UN within peacekeeping.</li> <li>5. It is a role model for other African countries who hope to develop.</li> </ol>	What does Nigeria's economy look like?	Most people work in the primary sector, however the secondary and tertiary sectors are rapidly growing.
Nigeria's context		Why has Nigeria's economy changed?	<ul style="list-style-type: none"> <li>• Increased use of farm machinery and better pay/better working conditions in manufacturing industries = decline in primary sector.</li> <li>• A more stable government = rise in investment from HICs = rise in secondary manufacturing.</li> <li>• Improved trade links and increased number of people who speak English = increase in telecommunications, finance (tertiary sectors).</li> </ul>
Social	<ul style="list-style-type: none"> <li>➢ Multi-ethnic – there are many groups of people who identify with different cultures and traditions (e.g. Yoruba, Hausa and Fulani, Igbo)</li> <li>➢ Multi-faith – there are many religious groups (e.g. Christianity, Islam and traditional African religions).</li> </ul> <p>This social diversity has often resulted in conflicts between different groups.</p>	Multiplier effect	When one change = more changes.
Political	Prior to 1960 Nigeria was a British colony. In 1960 it gained independence. Until 1970 there were power struggles and civil wars as groups tried to gain power. Since 1999 it has had a stable government = lots of foreign investment.	How has Nigeria's economic change benefitted Nigeria?	<ul style="list-style-type: none"> <li>• Better and more regular wages = more disposable income = more money spent in local businesses = improved local economy.</li> <li>• Increase in employment and wages = increase in taxes = government has more money to develop healthcare, education, access to food.</li> <li>• Successful factories = increase in foreign investments who want to open factories in Nigeria = more jobs = further economic growth.</li> </ul>
Environmental	<p><b>North:</b> savannah and semi-desert. In the savannah lots of farming occurs (cattle, cotton, millet). Drier in the north.</p> <p><b>South:</b> rainforest. High rainfall and temperatures. Crops – rubber, cocoa, oil palm. It suffers from the tsetse fly so not many cattle.</p>	TRANSNATIONAL CORPORATIONS IN NIGERIA HAVE INCREASED DUE TO GLOBALISATION.	
Cultural	Rich culture with famous authors (Wole Soyinka), footballers, musicians (Fela Kuti) and film industry (Nollywood).	Globalisation	The increase in links between countries, made easier by improved communications (internet, smart phones) and transport (airplanes, ships).
Links with the wider world – Nigeria is linked with a number of African and global groups.		Transnational corporations (TNCs)	A company that has offices/factories in several countries. There are around 40 TNCs in Nigeria, such as KFC, Unilever and Shell Oil.
Commonwealth	It has equal status with all countries in the commonwealth, including the UK	Example of TNC in Nigeria	Shell Oil is an Anglo-Dutch company with its headquarters in the Netherlands. It has been extracting oil from the Niger delta since 1958.
African Union	Economic planning and peacekeeping group with Niger, Chad, Benin and Cameroon. It provides troops.	Advantages	<ul style="list-style-type: none"> <li>• Jobs. Shell provides 65,000 jobs and a further 250,000 jobs in related industries (e.g. companies who make parts for the oil rigs)</li> <li>• People have more money to spend in local shops = boosts local economy.</li> <li>• Country earns money from increased exported goods and increased taxes.</li> <li>• TNCs often invest in the local infrastructure and education.</li> </ul>
United Nations (the UN)	In 2013 Nigeria was the 5 <sup>th</sup> largest contributor of troops for peacekeeping.	Disadvantages	<ul style="list-style-type: none"> <li>• Working conditions/wages are bad.</li> <li>• Oil spills = water pollution = reducing crop production and fishing yields.</li> <li>• Much of the profits generated goes abroad to the country where the TNC has their headquarters.</li> <li>• Oil Theft and sabotage are big problems in the Niger delta.</li> </ul>
ECOWAS	Economic Community of West African States is a trading group		
CEN-SAD	Community of Sahel-Saharan States is a trading group.		



## Negative environmental impacts of rapid economic development

<b>Industrial Growth. More specifically.....</b>	An increase in factories and industrial plants due to industrialisation. As a result.....	<ul style="list-style-type: none"> <li>Water pollution caused by chemical waste from factories in Kaduna, Kano and Lagos.</li> <li>Air pollution caused by factories releasing harmful gases into the atmosphere.</li> </ul>
<b>Growth of oil extraction. More specifically.....</b>	TNCs, such as Shell Oil, drill for oil in the Niger Delta. It is Nigeria's main source of income. As a result.....	<ul style="list-style-type: none"> <li>Oil spills in Niger Delta = fires, air pollution, acid rain, water pollution...etc. For example <b>Bodo Oil Spill (2008-9)</b> Leaks in a pipeline = 11 million gallons of crude oil to spill over the land. Farmers and fishermen lost their livelihoods. In 2015 Shell agreed to pay £55 million in compensation to be spent on health clinics and schools.</li> </ul>
<b>Urban Growth. More specifically.....</b>	Increase of people moving to urban areas due to growth of secondary industries (factories) <i>industrialisation</i> . As a result.....	<ul style="list-style-type: none"> <li>Not enough houses = squatter settlements are formed.</li> <li>Not enough services or waste disposal = unhygienic rubbish on ground.</li> <li>Not enough roads = traffic congestion and pollution.</li> </ul>
<b>Growth of commercial farming. More specifically.....</b>	Large farms are created to grow crops to export. This is the main source of employment in Nigeria. As a result.....	<ul style="list-style-type: none"> <li>70-80% of Nigeria's forests have been deforested = many species have disappeared (<i>cheetahs and giraffes and nearly 500 types of plants</i>)</li> <li>Farming has caused land erosion and groundwater pollution due to harmful chemicals leaking into soil and river channels.</li> </ul>

## To what extent has development in Nigeria improved quality of life?

<b>On the one hand: Social benefits:</b> <ul style="list-style-type: none"> <li>Better paid jobs in manufacturing and service industries = more disposable income = more money spent on schooling, homes, food, clothes...etc.</li> <li>More taxes = more money spent on services (clean water, sanitation, electricity), infrastructure, health care = better transport, longer life expectancy, lower death rate...etc.</li> </ul>		<b>Aid in Nigeria</b>	
<b>More specifically, the HDI shows.....</b> <p>A steady increase since 2005 and it is expected to continue.</p> <ul style="list-style-type: none"> <li>2000 Nigeria was among the <i>least developed nations</i> in terms of wealth and education, where in 2011, Nigeria had one of the highest HDI improvements in the world over the last decade.</li> </ul>		<b>Types of aid</b>	<ul style="list-style-type: none"> <li>Emergency aid: aid given immediately after a disaster or war (e.g. food, shelter, medical supplies)</li> <li>Developmental long-term aid: aims at improving quality of life over a longer time (e.g. WaterAid, schools, roads, electrical supplies)</li> </ul>
<b>On the other hand: Social issues:</b>		<b>Aid can be given by....</b>	<ul style="list-style-type: none"> <li>Rich individuals, charities and non-governmental organisations (NGOs) (e.g. Oxfam, WaterAid)</li> <li>Governmental aid from countries (e.g. UK, USA) and International Organisations (e.g. World Bank, International Development Agency (IDA))</li> </ul>
<b>Environmental issues:</b>		<b>Why does Nigeria need aid?</b>	<ul style="list-style-type: none"> <li>60% of Nigerians (100 million) live on less than \$1/day (£0.63p/day).</li> <li>Nigerians live with limited access to clean water, sanitation and electricity.</li> <li>Birth rates and infant mortality rates are high and life expectancy is low.</li> </ul>
<b>Conclusion:</b>		<b>This is due to...</b>	<ul style="list-style-type: none"> <li>Corruption by individuals or the government = money is diverted by the government to other projects (e.g. the military or navy)</li> <li>People give aid but insist on where it is spent. This is not always in the best interest of the people.</li> </ul>
<b>Overall I believe.....</b>		<b>Examples of Aid in Nigeria:</b>	
<b>Most importantly.....</b>		<b>The World Bank</b>	Gave \$500 million to fund long term business loans in 2014.
<b>Additionally.....</b>		<b>Nets for Life</b>	Provide education and mosquito nets to help prevent malaria.
<b>Although.....</b>		<b>UK</b>	Provide a health and HIV programmes, providing health education in rural areas.
		<b>USA</b>	Provide education and protection against the spread of HIV/AIDS.
		<b>Aduwan Centre</b>	<p>In 2010, northern Nigeria, ActionAid and the World Bank, built a new health clinic. This supported people by:</p> <ul style="list-style-type: none"> <li>Local women were trained to educate mothers about the importance of immunising their children against polio and other diseases. <i>Develops skills and knowledge, long term, helps important problem, involves local community</i></li> <li>Tests for HIV and immunises children against polio. <i>Helps important problem.</i></li> </ul>

# KS4 – The Geography Knowledge – THE CHANGING ECONOMIC WORLD – (part 5) – UK economy

How has the UK's economy changed?	<ul style="list-style-type: none"><li>➤ 1700s: 75% primary (farming) before the invention of factories</li><li>➤ Late 18<sup>th</sup> century: industrialisation resulted in the rise of secondary industry (manufacturing 55%). Largely in the North near coal fields</li><li>➤ 1950-70s: de-industrialisation a decline in manufacturing, e.g. Heavy industry - Iron and steel and shipbuilding and coal mining</li><li>➤ 1970s: A post industrial economy. Most people work in tertiary and quaternary sectors, especially in the South and East</li></ul>	Primary	Extraction of raw materials (agriculture, mining, fishing)
		Secondary	Manufacturing of raw materials (food processing, clothes, oil refinery)
		Tertiary	Selling of services and skills (education, health service, transportation)
		Quaternary	Information and research services (ICT, computing, research, consultancy)
Rural Populations in the UK - 18% of the UK's population live in rural areas. This is constantly changing.			
Why did de-industrialization occur?	<p>Factories closed or moved abroad because:</p> <ul style="list-style-type: none"><li>➤ Competition as it is cheaper to produce goods abroad e.g. China</li><li>➤ Improved trade links and transport links makes it easy to trade between countries so companies are international.</li><li>➤ Improved communications and IT. (The internet) people can store information online which can be accessed anywhere in the world so offices communicate and share information internationally.</li></ul>	South Cambridgeshire  Negative impact	<p>Rising population due to counter-urbanisation (urban to rural migration), made possible by improved transport links so people are able to commute to work on London/Cambridge. Also an increase in retired people looking for better quality of life</p> <p>Increase in congestion from commuters. Petrol prices rise due to higher demand. House prices increase due to higher demand forcing young locals to leave. Loss of farmland due to new developments. Local shops and bus routes shut as new residents shop in supermarkets or travel by car.</p>
The UK's Tertiary sector		Outer Hebrides  Negative impact	<p>Declining population. Their population is 27,400 and has declined by 50% since 1901. Due to outward migration as younger people leave to look for better paid jobs and entertainment. Farming and fishing are the only main jobs here.</p> <ul style="list-style-type: none"><li>• Lack of customers so local shops close down. Lack of students means schools close down</li><li>Younger people move away leaving an elderly population with less people to look after them.</li></ul>
		Improvements in transport in the UK	
How much money does the tertiary sector earn the UK?	<ul style="list-style-type: none"><li>• 1948: 46% of the UK's GDP</li><li>• Today: 79% of the UK's GDP</li></ul>	ROADS  Positive impact: Negative impact:	<p>Added 100 new roads and 1300 miles of new lanes They have also created smart motorways (e.g. M4), which have varying speed limits &amp; extra lanes to reduce congestion</p> <p>Reduces congestion and reduces journey time for people and business transport</p> <p>Encourages people to drive causing more pollution. Extra lanes on motorways are built on green land causing loss of habitats.</p>
The UK is the world's leading centre for...	Financial services (finance, insurance). This accounts for 10% of the UK's GDP and employs 2 million people.	RAIL  Positive impact:  Negative impact:	<p>Electrification of rail lines : e.g. Bristol to London and Manchester to York</p> <p>It will speed up travel times between major cities for commuters and reduce air pollution caused by diesel trains. It will create many construction jobs.</p> <p>Extremely expensive to upgrade all the lines and trains</p>
The UK's Quaternary sector			
How much does the quaternary sector earn?	£3 billion each year and employs 60,000 highly qualified people.		
Science Park	A site on which high-tech industries carry out scientific research.		
Bristol and Bath science park is located...	On the outskirts of North West Bristol near the countryside, M4 and A4174 ring roads and Bristol Parkway train station. It opened in 2011 and is home to 40 high tech firms		
Advantages	<ul style="list-style-type: none"><li>• Good transport (M4 and rail links to Bath and London)</li><li>• Highly skilled graduates from UWE and University of Bristol</li><li>• Close to rural open spaces – nice environment for workers</li><li>• Edge of city so less traffic congestion for workers and deliveries</li><li>• Edge of the city so more space and cheaper land to rent.</li></ul>		
Disadvantages	<ul style="list-style-type: none"><li>• Traffic can become quite congested on the A4174 ring road</li><li>• House prices are becoming expensive in Bristol for workers</li></ul>		
		AIRPORTS  Positive impact: Negative impact:	<p>Plans to build a 3<sup>rd</sup> runway at Heathrow Airport.</p> <p>Boost economy by over £200 billion, improve UK's global links, provide jobs.</p> <p>It will cost £18.6 billion, cause pollution (air, visual, noise) &amp; villages will be relocated</p>
		PORTS  Positive impact: Negative impact:	<p>Liverpool 2 Deep water Container Port. It can accommodate the largest ships (up to 400m long and will be able to deal with 600 000 shipping containers a year</p> <p>It will employ thousands of people in the port and next door logistics park.</p> <p>It will help to reduce the North South divide</p> <p>It will increase congestion in the surrounding area.</p>



EXAMPLE OF A MODERN INDUSTRY: Torr Quarry in the Mendip hills Somerset		THE NORTH – SOUTH DIVIDE	
There are hundreds of quarries in the UK producing million’s of tonnes of stone for building, roads and construction. There are many quarries in Somerset as the limestone found in the area is ideal for construction		The cultural and economic differences between the north and south of England.	
How does quarrying harm the environment?		Examples of the north – south divide	<ul style="list-style-type: none"><li>• <b>North:</b> lower standard of living, shorter life expectancy, less jobs, lower wages, lower house prices</li><li>• <b>South:</b> higher standard of living, longer life expectancy, more jobs, higher wages, higher house prices.</li></ul>
Visual pollution	<ul style="list-style-type: none"><li>• Quarries create huge holes in the ground in rural areas, spoiling the countryside</li></ul>		
Habitat destruction	<ul style="list-style-type: none"><li>• Quarries damage the natural landscape, and also cause noise and air pollution that damages <b>habitats</b> and affects local <b>bio-diversity</b></li></ul>		
Noise pollution	<ul style="list-style-type: none"><li>• <b>Explosives</b> are used to beak up the rock before it can be transported away. This frightens wildlife and the noise is a real problem for people living nearby.</li></ul>	Why does the divide exist?	<ul style="list-style-type: none"><li>• Lack of employment in the north due to <b>de-industrialisation</b>. There were more <b>factories and coal</b> fields in the north. When these closed down this caused unemployment.</li><li>• More jobs &amp; higher wages in the south due to the creation of <b>a post industrial economy</b>. <b>Tertiary jobs</b>, with high wages are in urban areas, there are more urban areas in the south with more wealth.</li><li>• Much <b>high tech industry</b> is in the South due to better accessibility</li></ul>
Air pollution	<ul style="list-style-type: none"><li>• <b>Dust</b> from explosions travels in the air and covers roads, fields and peoples homes</li></ul>		
Transport	Heavy lorries damage local roads and exhausts create <b>air pollution</b>		
How is Torr quarry more sustainable?		How are they reducing the divide?	<ul style="list-style-type: none"><li>• <b>Better transportation</b> to connect north with south and the wider world (HS2, new ports, smart motorways) so better transport links for businesses which increasing profits for companies in the North</li><li>• <b>The Northern Powerhouse strategy</b>, where government encourages business to locate in Northern cities like Manchester and Liverpool</li><li>• <b>Enterprise Zones</b> are created by Government to attract new business to area with little existing business, e.g. financial help with factory start up, cheaper business taxes and the addition of high speed internet. This creates jobs in the North.</li></ul>
Visual pollution and habitat destruction	Used parts of the quarry are <b>restored</b> and a lake created with trees and vegetation planting. This creates <b>habitats</b> for wildlife and can be used by locals for recreation such as walking and water sports		
Noise pollution	<b>Blasting</b> only takes place between 9 and 5 Monday to Friday when most people are at work		
Air pollution	<b>Dust</b> is monitored carefully and water jets used to keep it from spreading into the surrounding area		
Transport	The quarry uses its own local <b>railway station</b> to transport most of the rock rather than lorries		

HOW IS THE UK LINKED WITH THE WIDER WORLD?				
<b>Commonwealth</b>	<p>The <b>British Empire</b> once covered 1/3<sup>rd</sup> of the world. During the late 20<sup>th</sup> century, most countries gained independence leading to the creation of the <b>COMMONWEALTH</b>: a group of 53 countries, including India and Canada.</p>	<b>European Union</b>	<p>In 1973 the UK joined the <b>European Union</b>. The EU allows the free movement of <b>people, goods and services</b> between the member countries. It is an important <b>trading group</b> with a total of 28 countries, such as France, Italy, Spain, Germany and Belgium. However we are now leaving because of <b>BREXIT</b>.</p> <ol style="list-style-type: none"><li>Financial support for farmers. In 2015, £18 million of EU money was used to support dairy farmers in the UK.</li><li>Since the early 20<sup>th</sup> century, 10 Eastern European countries have joined the EU. Since, many people from these countries have migrated to the UK looking for better paid work.</li><li>The UK support poorer members by paying more money into the EU.</li></ol>	
<b>How does this link the UK with the wider world?</b>	<ul style="list-style-type: none"><li>Countries meet every 2 years to discuss current issues.</li><li>The UK trades with other Commonwealth countries.</li><li>Many people of British descent now live in Australia and Canada.</li><li>The Commonwealth Games is held every 4 years.</li><li>All countries share common values, such as democracy and human rights.</li></ul>			
<b>Transport</b>	<ul style="list-style-type: none"><li>Airports connect the UK with many countries: <i>Canada, USA, South Africa, Singapore and India.</i></li><li>The Channel Tunnel is a railway line that connects the UK &amp; mainland Europe.</li></ul>	<b>Trade within the EU</b>	<p>Most of the UK's trading partners are within the EU. This is because:</p> <ul style="list-style-type: none"><li>➤ The UK is part of the EU, which encourages trade between EU countries.</li><li>➤ EU countries are closer to the UK and therefore it's easy to transport goods</li><li>➤ European countries are wealthy, which means they can afford more expensive goods.</li></ul> <p>The top countries the UK exports to: USA, Germany, Netherlands, France, Switzerland The top countries the UK imports from: USA, Germany, Netherlands, France and China.</p>	
<b>Communication</b>	<p>The internet is the biggest contributor to the UK connecting with other countries. It has had a huge impact on businesses and our economy.</p> <ul style="list-style-type: none"><li>➤ In 2013, on average 183 billion e-mails were sent and received each day. This is 2.1 million every second.</li><li>➤ In 2014 90% of people in the UK used the internet, compared to just 27% in 2000.</li></ul>			

## Section C: The Challenge of Resource Management (Parts 1 -2)

- *Example of a large scale water management scheme: **Lesotho***
- *Example of a local scheme in an LIC to increase water sustainability: **The Waket river basin project***



## WORLD'S ESSENTIAL RESOURCES

Food		Water		Energy	
<p>Food is important because it affects your health. The World Health Organisation says we need 2000-2400 calories per day to be healthy. If you do not have sufficient food you become malnourished or suffer from undernutrition.</p> <ul style="list-style-type: none"> <li>Food surplus: North America, Europe, Australia, Russia, UK, USA</li> <li>Food deficit: Africa (e.g. Chad, Congo, Ethiopia)</li> </ul>		<p>Water is important as we need it for our health and for economic development (agriculture, manufacturing, cleaning, drinking).</p> <ul style="list-style-type: none"> <li>Water surplus: areas where there is high rainfall and water storage (aquifers/reservoirs). E.g. USA, Canada, Europe, Russia</li> <li>Water deficit: areas where there is low rainfall and a lack of water storage. E.g. Africa, Brazil, Argentina, Australia, China.</li> </ul>		<p>Energy is important because it is used to build homes, heat homes, power machinery, make food...etc. It is also traded between countries and so helps a country develop.</p> <p>HICs consume (use) far more energy than LICs and NEEs.</p> <ul style="list-style-type: none"> <li>LICs – use very little energy (few machines, lack of processed foods, few families use power in their homes).</li> <li>NEEs – use more energy (increase in factories = increased use of machines = more energy used).</li> <li>HICs – use the most energy (lots of energy used in industries and homes, people eat a lot of processed foods).</li> </ul>	
FOOD in the UK		WATER in the UK		ENERGY in the UK	
<b>40% OF FOOD IN THE UK IS IMPORTED.</b>		Water surplus	Areas with high rainfall and low population ( <i>Wales &amp; Scotland</i> )	<i>The UK's energy mix is...</i>	<ul style="list-style-type: none"> <li>52.6% fossil fuels, 21% nuclear energy,</li> <li>24.7 renewable energies</li> </ul>
Why?	<ul style="list-style-type: none"> <li>Food is cheaper to make food in LICs.</li> <li>Demand for exotic foods (mangoes, bananas)</li> <li>Demand for seasonal foods all year round.</li> <li>Some foods cannot be grown in the UK.</li> </ul>	Water deficit	Low rainfall and high population ( <i>south east England and parts of central England</i> ).	<i>Fossil fuels will be used less because...</i>	a) 75% of oil and gas reserves are gone b) 100% of coalfields are closed down c) The EU fines companies who release too many greenhouse gases
Problem:	Increase in food miles (distance travelled by food to our plate) = increase in carbon footprint (the amount of CO2 a country produces).	Water transfer scheme	Water is moved from areas of surplus to areas of deficit. The government proposed a UK wide water grid in 2006, however it was not built due to high costs and impact on ecosystems. Some water transfer schemes do exist.	<i>Renewable energies will be used more because...</i>	The government has been investing in these sources.
SOLUTION		The demand for water in the UK has increased in recent years. In fact households use 70% more water. This is because:		<i>Fossil fuels will continue to be used because...</i>	a) Coal is cheap to import b) New nuclear stations and renewable energy infrastructure is expensive
Organic Farming	<p>Small scale farming that produce local, seasonal food without the use of chemicals.</p> <ul style="list-style-type: none"> <li>Uses natural predators instead of pesticides</li> <li>Crop rotation is used instead of fertilisers</li> <li>Grows seasonal food locally.</li> </ul>	<ul style="list-style-type: none"> <li>More wealth = more household appliances that use water</li> <li>Population increase &amp; people wash more often</li> </ul>		Economic and Environmental impact of each energy type	
Disadvantage	It is usually more expensive because yields are low (less food is produced) and more people are employed, due to lack of machinery used. This means they need to charge a lot to make a profit.	Causes	<ul style="list-style-type: none"> <li>Fertilizers in farming go into rivers</li> <li>Chemical waste from factories pollutes rivers</li> <li>Sewage is pumped into the sea</li> <li>Oil from cars and boats goes into rivers/sea</li> </ul>	Fossil Fuels	<ul style="list-style-type: none"> <li>Ec. Coal must now be imported from South Africa.</li> <li>Ec. Fossil fuels release greenhouse gases = global warming. The impacts of global warming are expensive to fix</li> <li>En. Greenhouse gases = global warming.</li> <li>En. Coal mines need land to be cleared = loss of habitats</li> <li>En. Waste from mines = visual and noise pollution</li> </ul>
Agribusiness	<p>Large scale intensive farms that use lots of machinery and chemicals to increase food production.</p> <ul style="list-style-type: none"> <li>Hedges are cut down = large fields</li> <li>Machinery (combine harvester, tractors)</li> <li>Fertilizers used to add nutrients to the soil</li> <li>Technology – GM crops, hydroponics, high yielding varieties</li> </ul>	Impacts	<ul style="list-style-type: none"> <li>Waste from factories = toxic water = harm wildlife &amp; humans</li> <li>Fertilizers get into water = growth of algae = lack of oxygen and light in the pond = wildlife die (eutrophication)</li> <li>Bacteria from sewage plants = diseases in river</li> </ul>	Renewable Energies	<ul style="list-style-type: none"> <li>Ec. New infrastructure is expensive to build</li> <li>Ec. They are unreliable</li> <li>En. Wind turbines and solar panels = visual and noise pollution and affect ecosystems.</li> </ul>
Advantage	More food can be produced = less needs to be imported. Use of machinery = fewer people employed = cheap food.	Management	<ul style="list-style-type: none"> <li>UK has strict laws to control waste production and disposal</li> <li>Chlorine added to water to remove bacteria.</li> <li>Water treatment plants remove bacteria, algae and chemicals</li> <li>Sewage systems are improved (e.g. the Tideway project in London)</li> </ul>	Nuclear Power	<ul style="list-style-type: none"> <li>Ec. Nuclear power stations are expensive to build (£18 billion)</li> <li>Ec. Radioactive waste must be carefully stored = expensive.</li> <li>En. Warm water waste can harm local ecosystems</li> <li>En. Radioactive leaks harm people and wildlife (e.g. cancer)</li> </ul>
Disadvantage	It can harm the ecosystem due to use of chemicals = water pollution.				

<b>Water Surplus and deficit</b>	Areas of water surplus have plentiful supplies of water that exceeds their demand e.g. North America, Europe and parts of Asia. Many areas such as large parts of Africa have a water deficit where demand exceeds supply. This causes problems for people, industry and agriculture
<b>Water Consumption</b>	Water consumption is the amount of water people use. This is increasing globally as world population grows, people need to grow more food, to use for industrial development and for more energy. All energy production requires water.
<b>Water insecurity</b>	This is when a place does not have enough water for good well-being, health and economic development
<b>Water stress</b>	Water stress is when places come close to using up all their available water

CAUSES OF Water surplus or deficit	
<b>Climate</b>	<ul style="list-style-type: none"> <li>Regions with high rainfall usually have a water surplus whereas desert areas usually have a water deficit</li> </ul>
<b>Geology</b>	<ul style="list-style-type: none"> <li>Areas with permeable rocks at the surface and impermeable rocks underground can store rainwater water in underground aquifers so it doesn't evaporate away. 15% of Bristol's water comes from underground stores</li> </ul>
<b>Limited infrastructure</b>	<ul style="list-style-type: none"> <li>Poorer countries have limited water storage and transfer infrastructure as it is expensive to build so even though some countries have enough rainfall they cannot get it to the people who need it</li> </ul>
<b>Poverty</b>	<ul style="list-style-type: none"> <li>Many villages in poorer countries have no mains water connection so they much collect water from rivers and wells</li> </ul>
<b>Over abstraction</b>	Where water is stored in the ground, if you use more than is being replaced by rainfall the underground water table falls (the level at which the soil underground is saturated with water) This causes wells and rivers to dry up

IMPACTS OF Water insecurity	
<b>Waterborn disease</b>	Poorer countries often pollute their water supplies with sewage as there is little sanitation. Water shortage means people have to drink polluted water supplies causing disease like Cholera and dysentery. 1 billion litres of raw sewage enters the River Ganges in India each day
<b>Food shortages</b>	Farming uses 70% of global water supply for irrigating crops. Water shortages can lead to a drop in food production. In poor countries most people are poor subsistence farmers, growing food to survive, this leads to malnutrition and starvation
<b>Industrial output</b>	Industry uses huge amounts of water. By 2033 30% of all China's water will be used for industry. In times of water shortage factories shut down. This has cost China \$40 billion in lost output
<b>Water conflict</b>	Large rivers e.g. the Nile and Ganges run through several countries. If one country takes out too much water it can affect water supply in another country. There is conflict between Egypt and other African countries over use of the river Nile.

STRATEGIES TO INCREASE Water SUPPLY	
<b>Dams and reservoirs</b> <i>Advantages</i>	<ul style="list-style-type: none"> <li>✓ Dams control the flow of rivers and water can be stored in huge man made reservoirs. This water can be released downstream when needed and extracted for use by towns and cities.</li> <li>✓ Dams help to control rivers and prevent flooding</li> </ul>
<i>Disadvantages</i>	<ul style="list-style-type: none"> <li>X Dams are extremely expensive to construct and maintain</li> <li>X Reservoirs flood large areas of land where people live, forcing them to move</li> <li>X Dams flood large areas of land destroying habitats and bio-diversity</li> <li>X In hot countries, much of the water stored in reservoirs is lost through evaporation</li> </ul>
<b>Water transfer</b> <i>Advantages</i>	<ul style="list-style-type: none"> <li>✓ Water transfers redistribute water from areas of surplus to areas of deficit using canals, pipes and river systems. This increased their water supply.</li> </ul> <p>The Kielder water transfer scheme transfers water from the wetter North to the drier South East of the UK.</p> <p>Several schemes transfer water from central Wales to large cities like Birmingham and Liverpool</p>
<i>Disadvantages</i>	<ul style="list-style-type: none"> <li>X The same disadvantages occur as for dams and reservoirs as these usually need to be built to store water</li> </ul>
<b>Desalination</b> <i>Advantages</i>	<ul style="list-style-type: none"> <li>✓ This involves removing salt water from seawater by boiling and distilling it to produce fresh water. This increases fresh water supplies</li> </ul> <p>Saudi Arabia has the most desalination plants in the world, followed by the USA and UAE.</p>
<i>Disadvantages</i>	<ul style="list-style-type: none"> <li>X The process is extremely expensive so only happens in richer countries</li> <li>X Removed salt is dumped back into the sea, increasing salt levels which kill marine bio-diversity</li> <li>X Huge amounts of energy are used which produced greenhouse gases contributing to climate change</li> <li>X The huge cost of transferring water to inland areas that need it</li> </ul>



### STRATEGIES TO INCREASE FOOD SUPPLY SUSTAINABLY (increase food supply without harming the environment)

<b>Organic Farming/ Permaculture</b>	<ul style="list-style-type: none"> <li>✓ No chemicals are used.</li> <li>✓ Rainwater is collected and recycled using water harvesting tanks.</li> <li>✓ Natural predators are used instead of pesticides.</li> <li>✓ Soil is kept fertile using manure/compost instead of fertilizers.</li> <li>❖ <i>It is more expensive than mass produced food.</i></li> </ul>
<b>Urban Farming</b>	<p>Gardens are created on unused land in urban areas (allotments). These gardens are used to grow food.</p> <ul style="list-style-type: none"> <li>✓ Economic – people can sell their produce.</li> <li>✓ Environmental – food does not travel far &amp; brownfield sites are used.</li> <li>❖ <i>It is small scale. Not a lot of food is produced.</i></li> </ul>
<b>Seasonal Food</b>	<p>Food is only grown in the season it naturally grows in (e.g. strawberries in the summer and apples in the autumn).</p> <ul style="list-style-type: none"> <li>✓ Food miles are reduced as food does not travel as far = fewer carbon emissions (reduced carbon footprint).</li> <li>✓ Boosts local economy as local food is brought.</li> <li>✓ Less energy is used to grow the food (no additional heat or light is needed).</li> <li>❖ <i>There is still a demand for exotic food and seasonal food all year.</i></li> </ul>
<b>Reduce Food Waste</b>	<p>If less food is thrown away, less food needs to be grown as less is wasted.</p>
<b>Promote Sustainably sourced food</b>	<ul style="list-style-type: none"> <li>✓ Buy meat from small scale (free range and organic) that use less energy</li> <li>❖ <i>Do not buy meat from large scale intensive farms that use chemicals, lots of energy (in heating large indoor spaces) and produce lots of greenhouse gases.</i></li> <li>✓ Buy fish from fish farms that do not use chemicals, that use a pole and line, that use divers to catch shellfish, that only take the fish/shellfish they need, that meet EU requirements to only fish a certain amount.</li> <li>❖ <i>Do not buy fish from large scale intensive fish farms that use chemicals, large nets (that catch all species rather than what they want) or that use seabed dredging to collect shellfish. This process lifts up the entire of the seafloor = ecosystems destroyed.</i></li> </ul>

### THANET EARTH: A LARGE SCALE AGRICULTURAL DEVELOPMENT


Thanet Earth is located in east Kent, in the south east of England.

#### What?

- **5 greenhouses** grow seasonal food all year using **hydroponics**.
- Large lights give **artificial sunlight** = longer growing seasons = crops can be grown all year round.
- **Rainwater is collected** into 7 onsite reservoirs for irrigation
- Each greenhouse has its own power station providing its heat & lighting. The energy produced is sold and the waste produced (*carbon dioxide and heat*) is recycled. It is pumped back into the greenhouses to help the plants grow.

ADVANTAGES	DISADVANTAGES
<ul style="list-style-type: none"> <li>➤ 500 jobs.</li> <li>➤ More food grown in UK, therefore less food imported = better food security.</li> <li>➤ Less imported food = less food miles = less carbon emissions.</li> <li>➤ Natural predators are used = less chemicals (pesticides) used.</li> <li>➤ Hydroponics system reduces waste. The exact amount of water, nutrients, fertilisers are used.</li> </ul>	<ul style="list-style-type: none"> <li>➤ A large area of green farmland was built on = habitats lost/ecosystem disrupted.</li> <li>➤ Money goes to large companies rather than local communities.</li> <li>➤ Greenhouses use artificial lights = very bright = visual pollution.</li> <li>➤ Energy is used to power the greenhouses, package the food and transport it to the supermarkets = release of greenhouse gases.</li> </ul>

### THE MAKUENI FOOD & WATER SECURITY PROGRAMME: A LOCAL SCHEME IN AN LIC/NIC TO INCREASE FOOD SUPPLY SUSTAINABLY

<b>Where?</b>	Makueni is located in south Kenya (east Africa), 200km south east from Nairobi. I has a population size of 885,000 and receives 500mm of rain per year. They grow crops to feed their population (maize, sweat potatoes, millet), however due to a lack of rainfall, poverty, pests and lack of technology they cannot have food insecurity.
<b>What?</b>	<p><b>In April, 2004, the charity 'Just a Drop' joined forces with the African Sand Dam Foundation and:</b></p> <ul style="list-style-type: none"> <li>➤ Built a water harvesting tank on the roof of the school</li> <li>➤ Built a sand dam.</li> </ul>
<b>What is a sand dam?</b> 	<p><i>A concrete wall is built across a river channel. During Kenya's rainy season, rain rushes down the slopes and picks up lots of sand/sediment. The concrete wall stops the water as it flows down the river. The energy of the river reduces = deposition of sand. Over the rainy season, more and more sediment is deposited, until eventually the river behind the dam is filled with sand. The sand is porous/permeable and so allows water to pass through. Eventually the sand river is full of water and acts as a aquifer. It benefits the community as they have access to water for drinking, irrigation, cleaning. Also none of the water is lost due to evaporation in the hot climate. It is sustainable because it is cheap, easy and does not require skills.</i></p>
<b>How did it help?</b>	<ul style="list-style-type: none"> <li>✓ Crop yields increased as there was a reliable water supply.</li> <li>✓ Waterborne diseases decreased as the sand filtered the water.</li> <li>✓ Less time was wasted collecting water from far away streams = more time to study/work.</li> <li>✓ Children at the schools in Makueni (e.g. Kanyenyoni Primary School (463 students) have access to a clean and safe water supply.</li> </ul>

## Example Wakel River Basin Project

The exam paper will refer to this case study in an exam question as;  
*'Using an example of a **small scale Water Management Scheme** that you have studied...'*

**Example exam question:** To what extent has a local scheme for increasing sustainable water supplies been successful?

**Key idea:** The **Wakel River Basin** is located in the south of **Rajasthan (North-West India)**. It is the **driest** and **poorest** part of India & largely covered by the **Thar Desert**. **Water Management in the region has been poor**, but an **NGO** (non-government organisation) has been **working with locals** to **increase water supply & storage using appropriate local solutions**. They've also **raised awareness in local communities of effective water management**. Therefore this is a **sustainable** project.

### Water Supply Issues:

**Climate.** Summer temperatures can reach **53°C**. Rainfall is less than 250mm per year with 96% of this between June and September. There's **little surface water** as **rain quickly soaks away or evaporates**.

**Poor Water Management.** **Over-use of water** for **irrigation** and taking too much water from **pumps** has **reduced the water table & some wells have dried up**. This had led water shortage leading to **water stress** and **water insecurity**.

### Increasing Water Supply:

The project has encouraged greater use of **rainwater harvesting** techniques to **collect & store water**. This benefits villages & families. Methods include:

**Taankas** - **Underground storage** systems about 3m in diameter & 3-4m deep. They collect water from roofs holding up to 20,000 litres.

**Johed** - **Small earth dams** capture rainwater which sinks into the ground and **raises the water table**. Wells can then collect this water. Five rivers that used to dry up once the Monsoon passed now flow all year!

**Pats** - **Irrigation channels** that **transfer water** to the fields to water crops. The villager whose turn it is to receive water makes sure the channels are repaired and working properly.

### Increasing Public Awareness:

**Education.** Communities are **educated** to **conserve** (protect) **water**. By working together they can conserve water and **water security is increased**. This means that problems such as soil erosion, desertification & groundwater pollution are reduced.

**Funding & the NGO.** The Wakel River Basin Project was **funded** by The **Global Water for Sustainability Program** between 2007-2014. This NGO was created as part of the USA's International Development Agency. This NGO has worked with local people to **increase water security & to develop sustainable solutions**. Local people have been involved in the decision-making process to make this water management scheme successful.

**A Johed –**  
During the dry season in Rajasthan.



**Example:  
Lesotho Highland  
water project**

The exam paper will refer to this case study in an exam question as;  
*'Using an example of a large scale water transfer scheme'*

**Example question :** Evaluate the sustainability of a large scale water transfer scheme

**Key idea:** Water transfer schemes move water from areas of **water surplus** (plenty of water) to areas of **water deficit** (water shortages) **Reservoirs store water**, and **rivers and pipes** are used to transfer it. It provides **water for farming** (irrigation) **power for industry** (HEP) and **water for drinking, sanitation and domestic use**. Dams also **control flooding**. Transfer **relieves water stress** but can cause both **social, (S) economic (E) and environmental (EN) advantages and problems**.

**Key features of the scheme**

**Background** – Lesotho is a small highland country in Southern Africa. It has few resources and high levels of poverty and food insecurity. It is a **LIC**. However it has **high rainfall** and a **water surplus**. It is completely surrounded by South Africa on which it depends economically.

**What is the Highland water project** – The scheme will transfer **2000 million cubic meters** of water per year from **Lesotho to South Africa**, to solve problems of water stress in drier regions. It will take **30 years to complete** and cost **\$4 billion**.

**Key features of the scheme:**

**5 huge dams** and reservoirs to store water  
**200km of tunnels** to transfer water to South Africa

**Roads, bridges and infrastructure**

**Pumping stations** to pump water

**A Hydroelectric power plant** to generate electricity

**Advantages - Lethoso**

**E/S - Wealth.** Provides **75% of Lethoso's GDP** which can be used for development projects.

**E/S - Power.** Hydroelectricity will supply Lesotho with **all its energy needs**.

**S - Water supply and sanitation.** Water supply will reach **90% of people in the capital Meseru** and **sanitation will be improved** from 15-20%

**E/S - Transport.** New roads will improve transport boosting travel, **trade and industry**.

**Advantages – South Africa**

**E/S - Water supply.** Will provide water to regions suffering **uneven rainfall and drought**.

**S - Safe water.** Will provide water to **10% of the population** without access to safe water.

**EN - Pollution.** Extra fresh water will **reduce problems of industrial and sewage pollution** in South Africa's Vall river reservoir, which was destroying the local ecosystem.

**Disadvantages - Lesotho**

**E/S - Loss of homes and livelihoods.** **30000 people were forced to move** from their land due to flooding from the first two dams

**E/S - Loss of homes and livelihoods.** A further **17 villages** will be flooded and **71 villages will loose farmland** when the next dam is constructed

**EN - Habitat destruction.** Habitats are lost due to flooding. Flood control on rivers downstream of dams have **destroyed a wetland ecosystem**.

**Disadvantages – South Africa**

**E - Cost.** The scheme will cost South Africa **\$4 billion**, putting strain on South Africa's finances.

**E - Leakage.** **40% of water is lost** through leakage, wasting huge amounts of water

**E/S - Water bills.** **Water bills** in South Africa to help pay for the scheme are too high for the poorest people who need the water most.

**E - Corruption.** **Corruption** has increased costs.