Unit 1: Dynamic Planet

GCSE GEOGRAPHY REVISION GUIDE

EDEXCEL B

Produced by N.Garthwaite June 2010

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Topic 1: Restless Earth

What you need to know:

- Differences between oceanic and continental tectonic plates
- Different layers of the Earth and how they differ
- How convection currents drive plate tectonic movements
- The different types of plate boundaries and the hazards they create
- Explain the global pattern of earthquakes and volcanoes
- How hazards are measured using the VEI, Richter Scale and Mercalli scale
- Difference between primary and secondary impacts
- Differences between shield and composite volcanoes
- Detailed causes and effects of the Montserrat and Icelandic Eruptions
- Detailed causes and effects of the Loma Prieta and Kashmir Earthquakes
- How earthquakes and volcanoes can be planned for and predicted
- Different types of hazard response, both short and long term

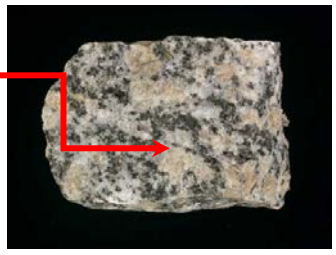
Key terms:

Atmosphere	The layers of gases/air around us.
Hydrosphere	The layer of water.
Biosphere	The very thin layer of living things on the crust.
Asthenosphere	The upper part of the Earth's mantle where the rocks are more fluid
Convection Currents	Circulating movements of the magma in the mantle caused by the heat of the core
Magnitude	The size of an earthquake
Oceanic Crust	Part of the crust made from dense basaltic rocks
Plate Margin	Boundary between 2 tectonic plates
Prediction	Forecasting future changes
Response	The way in which people react to a situation e.g. an earthquake
Tectonic Hazards	Threats posed by earthquakes, volcanoes etc
Core	Central part of the Earth consisting of a solid inner core made of iron and a more fluid outer core made of nickel
Continental Crust	Part of the crust made from less dense granitic rocks
Primary Effects	Immediate effects or impacts of a disaster e.g. mud flows, lava flows
Secondary Effects	The after effects of a disaster e.g. disease spreads due to dirty water, loss of economy due to destruction of businesses

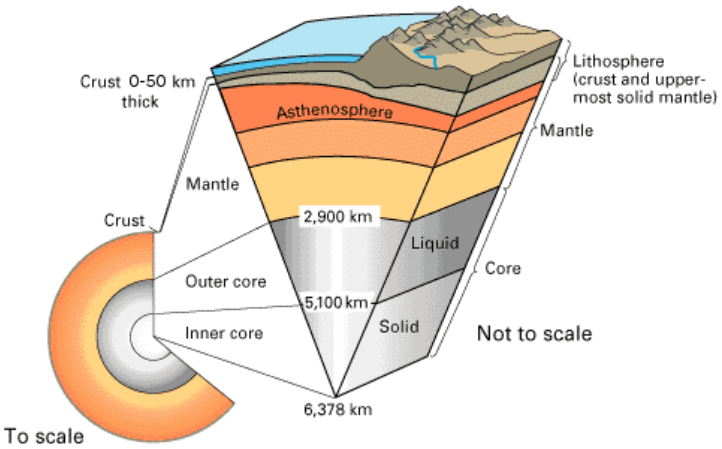
Differences between oceanic and continental tectonic plates

OCEANIC CRUST = found under the oceans and is thin and but dense as it is made out of basalt with no crystals in it as it cooled very quickly

CONTINENTAL CRUST = is the land and is thick but less dense as it is made out of granite which contains crystals as it cooled very slowly!



Different layers of the Earth and how they differ

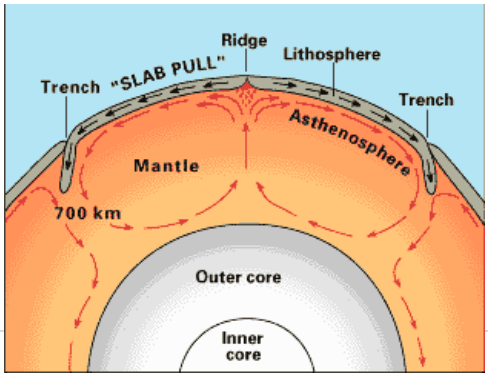


- The **lithosphere** (which is solid) is split into tectonic plates.
- These move slowly (2-5cm/yr) on top of a layer called the **asthenosphere** (which is like porridge)

Meteorites give us a clue as to what the core is like.

How do we know that the inside of the earth is hot?
→ lava from volcanoes
→ hot springs, geysers

How convection currents drive plate tectonic movements



- Convection currents occurred in the mantle and these are driven by the heat of the core. This heat is created due to both the pressure of the overlying material but also produced by the radioactive decay of uranium etc in the core and mantle.

- As heat rises from the core it creates **convection currents** in the liquid outer core and mantle. These convection currents move the tectonic plates on top of them.

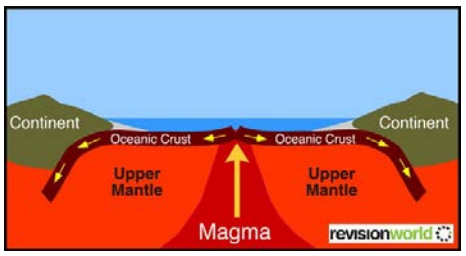
How do we know that the plates move?

Pangea…
The continents were once all joined together – **Pangea.** How do we know this? Identical fossils and rocks have been found in western Africa and Eastern South America for example.

Today the lithosphere is split into 15 tectonic plates. Where 2 plates meet together = **plate boundary**.

The different types of plate boundaries and the hazards they create

Constructive plate boundary…



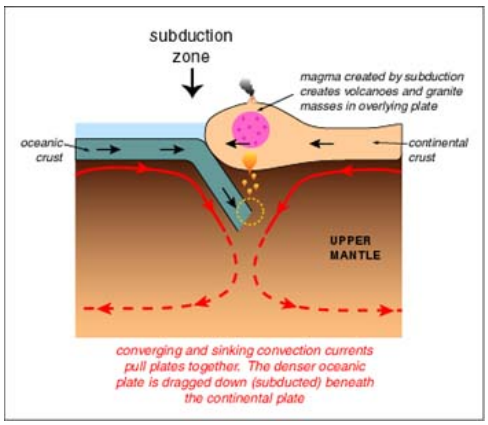
Convection currents from the mantle bring magma towards the surface. Magma is forced between the plates, cools and forms new oceanic crust.

- Where two oceanic plates are moving apart from each other.
- New oceanic crust is forming constantly in the gap created.
- The magma is injected between the two plates. As it cools it forms new oceanic crust.
- The magma is runny. Shallow sided volcanoes form.

HAZARDS:
→ Small earthquakes are formed by friction as the plates
→ Volcanoes that are not very explosive/dangerous.
Examples are Iceland – the Mid Atlantic Ridge

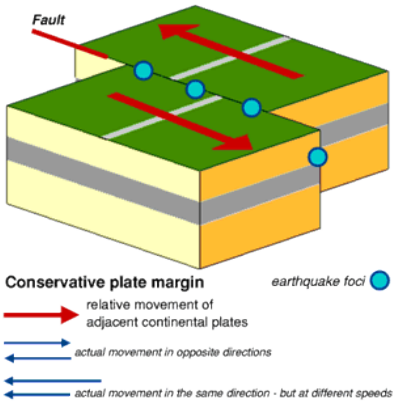
Destructive plate boundary…

- Where an oceanic plate meets a continental plate. They are moving towards each other.
- The denser oceanic plate is **subducted** beneath the less dense continental plate.



HAZARDS:
→ very destructive earthquakes
→ tsunami
→ very explosive, destructive volcanoes which cool to be steep sided.
Examples are Andes mountains, Peru, Chile.

Conservative plate boundary…



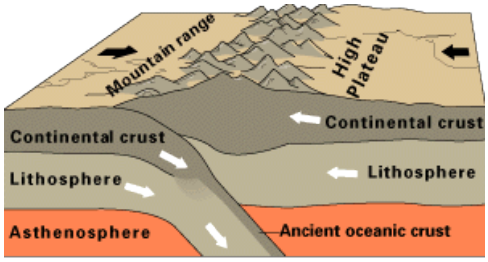
- Formed where two plates are sliding past each other.

HAZARDS:

→ destructive earthquakes
→ small earth tremors daily.
→ no volcanoes
Example is San Andreas Fault, California

Collision Zone

A type of destructive boundary where two continental plates move towards each other. As they meet they push upwards forming mountain ranges e.g. Himalayas.



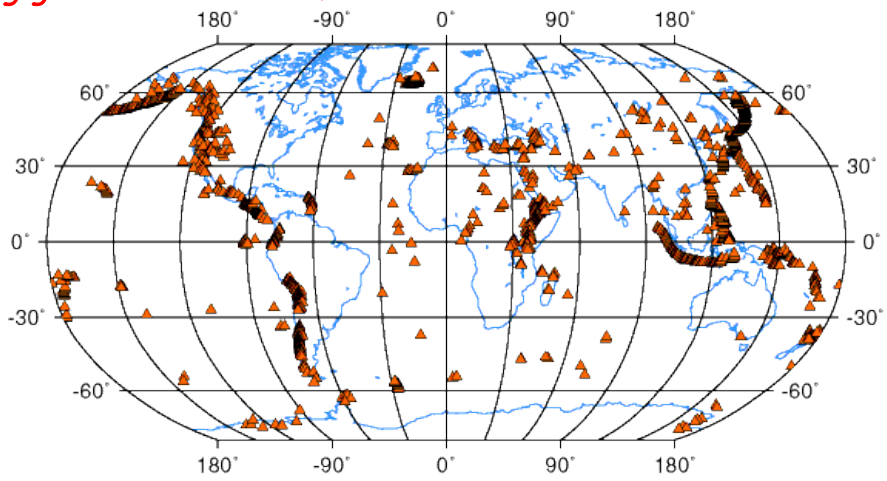
HAZARDS:

→ destructive earthquakes
→ landslides → volcanoes are rare

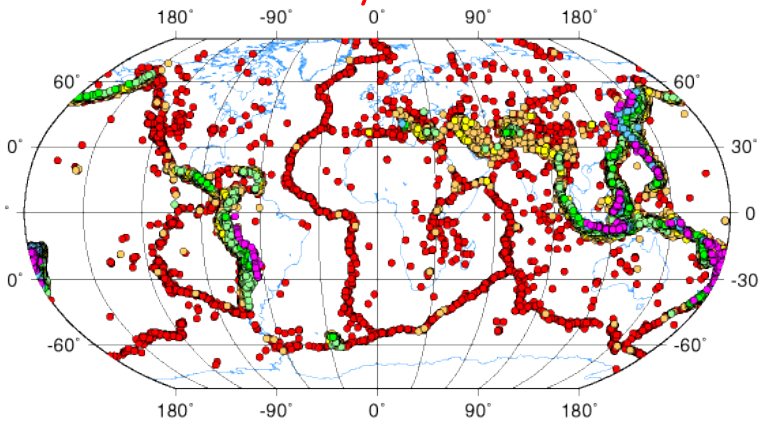
Explain the global pattern of earthquakes and volcanoes

There is a clear relationship between the distribution of earthquakes and volcanoes and the plate boundaries:

Map showing global distribution of volcanoes

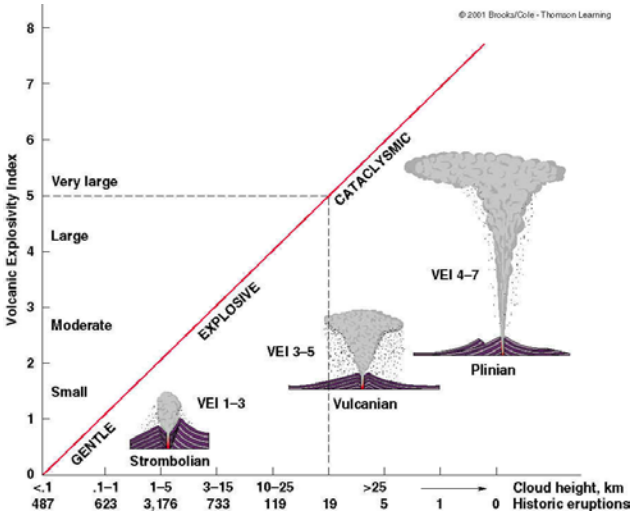


Map showing global distribution of Earthquakes



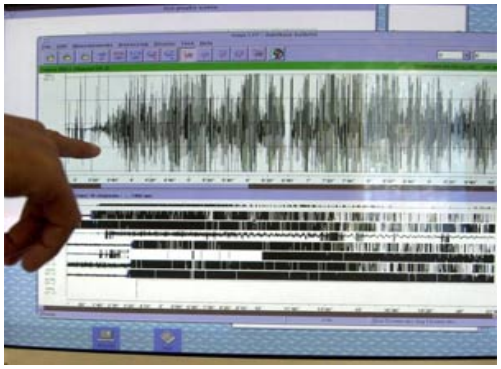
There are however, important exceptions for example the Hawaiian Islands have formed in the middle of the Pacific Ocean more than 3000km away from a plate boundary. This is explained via **'Hot-spot theory'** that there are fixed spots in the mantle where magma rises to the surface in the form of **PLUMES**.

How hazards are measured using the VEI, Richter Scale and Mercalli scale



Volcanic Explosivity Index (VEI)

Measures the destructive power of a volcano on a scale from 1 to 8.



Volcanoes are measured uses a **seismograph, or seismometer**, which is an instrument used to detect and record earthquakes.

Richter Scale – for example:

Descriptor	Richter magnitudes	Earthquake Effects	Frequency of Occurrence
Micro	Less than 2.0	Microearthquakes, not felt.	About 8,000 per day
Very minor	2.0-2.9	Generally not felt, but recorded.	About 1,000 per day

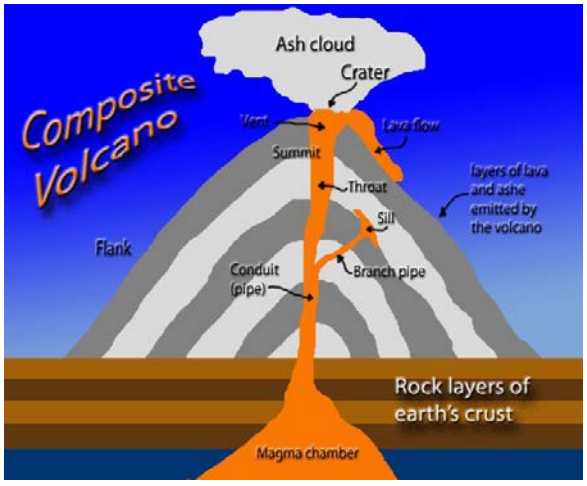
Mercalli Scale –for example:

Mercalli Intensity (at epicentre)	Magnitude	Witness Observations
I	1 to 2	Felt by very few people; barely noticeable.
II	2 to 3	Felt by a few people, especially on upper floors.

Predicting Volcanoes

- ✓ Aircraft used to measure the amount of gas the volcano gives off
- ✓ Tiltmeters detect when the volcano swells up as it fills with magma
- ✓ Seismometers monitor earth tremors which will increase as magma rises
- ✓ Boreholes to measure water temperature as magma heats up

Differences between shield and composite volcanoes



- Made from **andesitic lava** (lower temperatures, high silica and lots of dissolved gases). This means the magma is less fluid and more likely to explode when it reaches the surface
- They have steep sides with layers of ash and lava.
- The ash is formed out of the material destroyed in the explosive eruptions.
- Example: Mount Fuji

Shield Volcano

- Made from **basaltic lava** (high temperatures, very low in silica with low gas content) means it flows long distances on the earth's surface
- Creates very large, gently sloping shapes
- Example: Mauna Loa

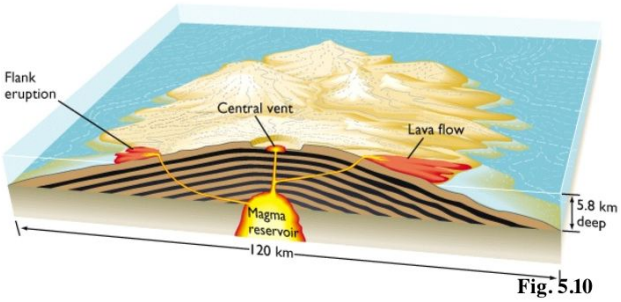


Fig. 5.10

Detailed causes and effects of the Montserrat and Laki Eruptions

Named Example: Montserrat Eruption 1995 (Composite Volcano)

Location: Montserrat is a small island is situated in the Caribbean and 12 miles long and 7 miles wide.

Causes:

- Montserrat lies on a destructive plate boundary.
- As the Eurasian and the Caribbean plate merge the oceanic plate is forced down or sub ducted under the continental plate.
- As it is forced down pressure increases which triggers earthquakes and at the same time heat produced by friction melts

Primary Effects:

- 2/3 of the island was covered in ash
- 50% of the population were evacuated to the north of the island to live in makeshift shelters
- 23 people died in 1997
- Plymouth - the capital became a ghost town
- Floods as valleys were blocked with ash
- The airport and port were closed
- Farmland was destroyed
- Forest fires caused by pyroclastic flows
- Many schools and hospitals were destroyed

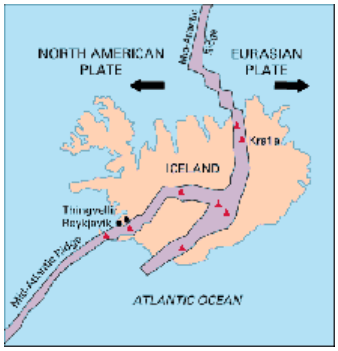
Secondary Effects:

- As most of the southern area was destroyed any remaining inhabitants have had to endure harsh living conditions in the North.
- Transport remains a problem for people travelling to the island as the port and airport remain closed.
- The tourist industry is still suffering with few visitors except for cruise ships looking at the volcano
- Over half the population left the island and have not returned

Responses:

- 41 million was given in aid by the British Government.
- Money was given to individuals to help them move to other countries.
- Riots occurred as locals complained that the British were not doing enough
- The MVO **(Montserrat Volcano Observatory)** was set up to study the volcano

Named Example: Icelandic Eruption 2010 (Shield Volcano)



Location: Iceland

Causes:

- A constructive plate boundary where the Eurasian plate and the North-American plate are moving apart
- This causes magma to rise to fill the void and magma is erupted onto the earth's surface. (Iceland itself was originally formed in the same way)

Primary Effects:

- Opening of a ground fissure (crack) of 150m
- Rivers saw a rise in the their temperature and water levels due to melting ice cap water = flooding
- Contamination of water sources and rivers due to ash
- Ash cloud reaches Europe within 2 day disrupting air flights
- Eruption cloud reached 8 km high

Secondary Effects:

- Long-term impacts on farming due to the thick layer of ash that has fallen on some Icelandic farms and pastures has become wet and compact, making it very difficult to continue farming
- Increase in short-term Volcano tourists who wanted to see the eruptions
- Global disruption of air flights leads to increase insurance claims and decline in profits for airline companies
- A possible chain reaction, leading to eruptions from other volcanoes in the area
- Possibly a shorter and colder summer in Europe

Responses:

- 800 farmers and their families evacuated from the local area
- Flights to and from Iceland were postponed

Why are people in developing countries at greater risk from tectonic hazards than people in developed countries?

- More live in risky conditions – no where else for them to live.
- Can't afford safe, well built houses → they collapse easily
- Don't have insurance
- Governments don't have the money to provide aid.
- Poor communications – no warning or evacuation.

Detailed causes and effects of the Loma Prieta and Kashmir Earthquakes

Named Example: Kashmir Earthquake 2005

Location: Mountainous region between Pakistan and India

Causes:

- A Collision plate boundary involving the Eurasian and Indian Plates
- Measured 7.6 on the Richter Scale

Primary Effects:

- Pakistan suffered approx 73,000 deaths
- Many of the dead were children as it was a Saturday morning – normal school day
- Many more died as it was Ramadan so people were sleeping after getting up early for the pre-dawn meal
- 2.8 Million homeless
- Property cost = $440 million

Secondary Effects

- Lack of food, clean water and shelter meant 120,000 people are at risk of death
- Secondary landslides are expected
- Winter snows were due to start making the relief effort very difficult

Response

- International Aid agencies used helicopters to fly in blankets, tents, basic provisions and medical supplies into the area

Named Example: Loma Prieta Earthquake 1989

Location: California

Causes:

- A conservative plate boundary involving the Pacific plate slipping past the North American plate
- Measured 6.9 on the Richter Scale

Primary Effects:

- 63 people died
- 3,757 injured
- 12,000 homeless
- Property cost= $10 billion

Secondary Effects

- Increased number of home insurance claims due to being an MEDC
- Decline in tourism income as people don't feel the area is same
- Collapse of overpasses means that emergency services have difficultly accessing certain areas

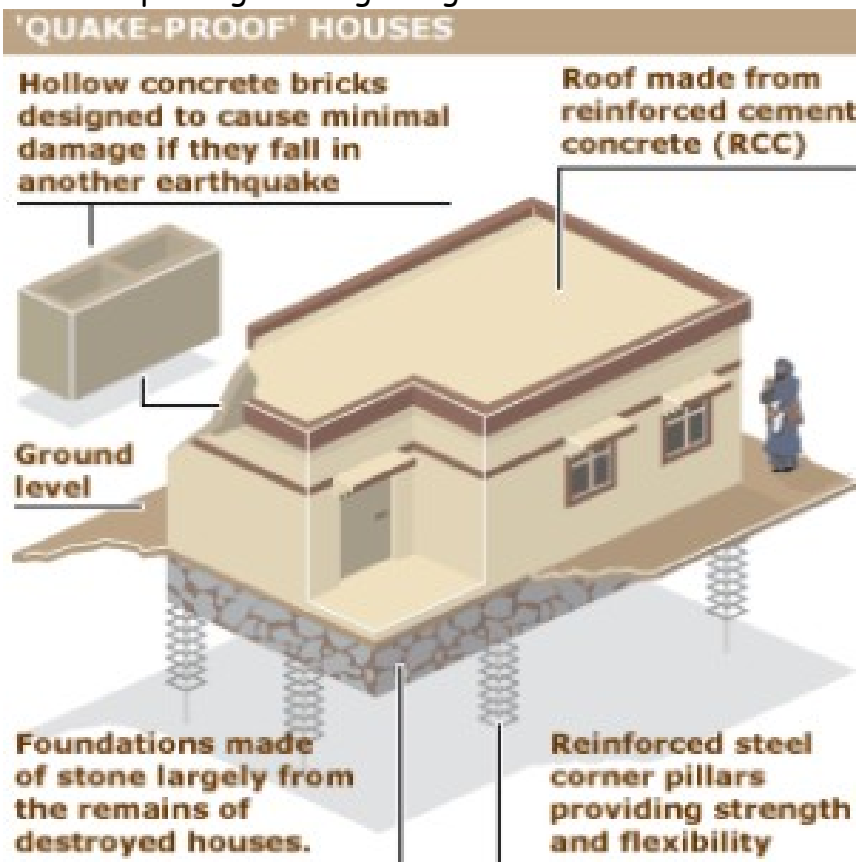
How earthquakes and volcanoes can be planned for and predicted

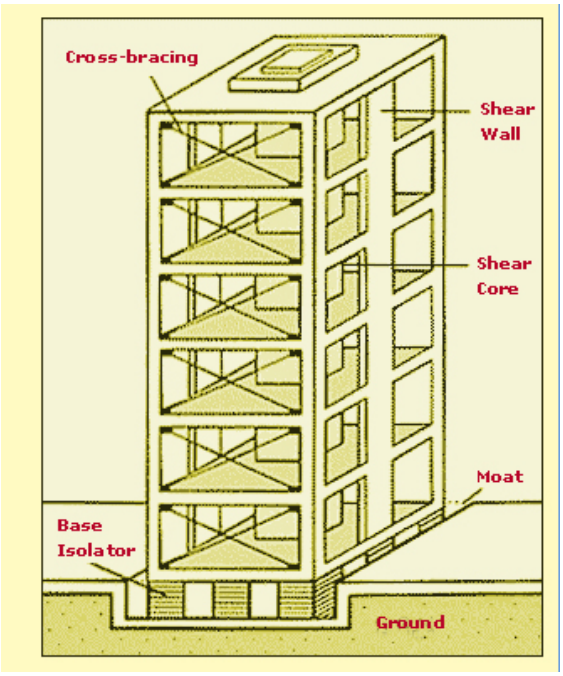
Being Prepared:

- Emergency plans
- Warning systems
- Training of people
- Evacuation plans

Reducing the impact:

1. Improving building design





Different types of hazard response, both short and long term

Short term:
- This includes mainly immediate aid to keep people alive e.g. tents, blankets and food

Long term:
- this looks to improve the preparedness of the people and reduce the impact of any future events

TOPIC 2: CLIMATE AND CHANGE

What do you need to know?

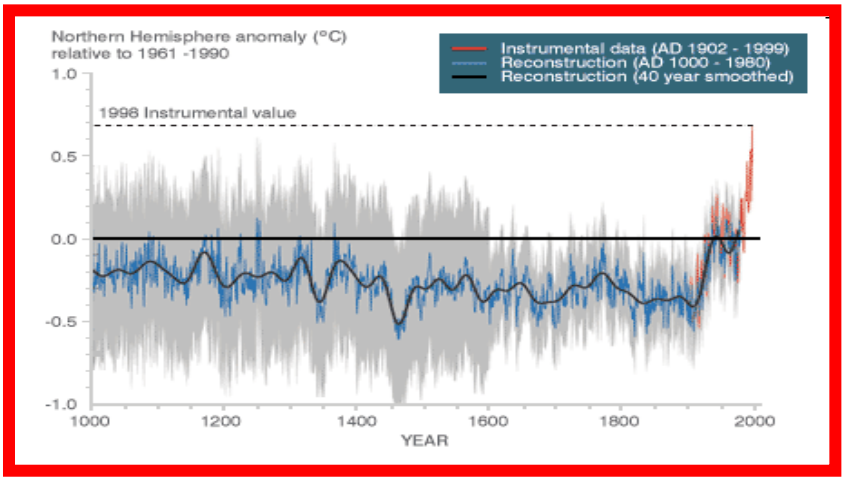
- How climate has changed in the past and how do we know it was different
- Natural causes of climate change
- How climate change affected people and the environment during the Little Ice age
- Geological Climate Events
- How the greenhouse effect works and the types of human activities increasing greenhouse gases
- How greenhouse gas levels have changed over time and who the main producers of greenhouse gases
- What scientists think might happen to climate and sea-levels in the future
- How the UK's climate could change in the future
- The challenges our changing climate might bring
- How climate change might affect people in the developing world

Key terms:

Climate Change	Long-term changes in temperature and precipitation
Deforestation	The chopping down and removal of trees to clear and area of forest
Ecosystems	A community of plants and animals that interact with each other and their physical environment
Enhanced Greenhouse Effect	The increased greenhouse effect resulting from human action (emission of greenhouse gases) and leading to global warming
Geological Climate Events	Climate changes that result from major geological events such as volcanic eruptions
Global Warming	A trend whereby global temperatures rise over time, linked in modern times with the human production of greenhouse gases
Greenhouse gases	Those gases in the atmosphere that absorb outgoing radiation, hence increasing the temperature of the atmosphere
Ice Age	A period in the earth's past when the polar ice caps were much larger than today
Little ice Age	A period of slight global cooling that lasted from around the mid-15th Century to the mid-19th Century
Megafauna	'big animals' which mostly weighed over 40kg e.g. Woolly mammoth and sabre-tooth cat
Natural causes	Processes and forces that are not controlled by humans
Orbital Changes	Changes in the pathway of the Earth around the sun and the tilt on its axis
Quaternary Period	The most recent geological period of the Earth's history
Solar Ouput	The energy emitted from the sun
Stratosphere	Layer of air 10-50km about the Earth's surface
Food Chains	Plants and animals are linked together and dependence on each other for food
Extinction	Species of plant or animal dying out completely, so none survive
Desertification	Gradual change of the land into desert

How climate has changed in the past and how do we know it was different

WEATHER = short term, day to day changes in the atmosphere.
CLIMATE = the average weather conditions over 30 years.



Graph shows that average temperatures in the past 2000 years have varied between 1-1.5°c colder or warmer than average temperatures today.

INTERGLACIALS = warm periods
GLACIALS = cold periods → ice ages → ice sheets 400-3000m thick extended across the northern hemisphere.

How do we know climate was different in the past?

- Fossils of animals and plants that no longer live in the UK.
- Landforms left by glaciers
- Samples from ice sheets in Antarctica. Ice sheets are made up of layers of ice, a layer for each year. Trapped in the ice sheets are air bubbles. Climatologists study the CO2 levels to reconstruct past climates.

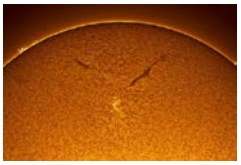
How do we know climate has changed in the more recent past?

- Old photos, paintings
- Diaries
- Newspapers
- Recorded dates of blossom and migration of birds.

Theories used to explain why climate has changed in the past (Natural events)....

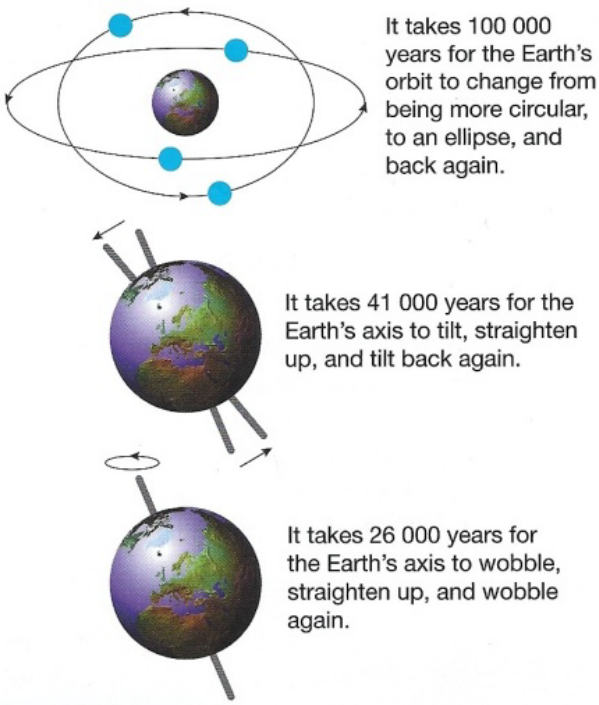
1. **ERUPTION THEORY** – very large and explosive volcanic eruptions change earth's climate. Ash and gas spread around the stratosphere and stop sunlight reaching the earth's surface → cools the earth. Example is Mt Pinatubo, 1991, Philippines – reduced global sunlight by 10% and cooled the earth 0.5 degrees for a year.

2. **SUNSPOT THEORY** – black areas on the sun's surface. Sometimes there are more then they disappear. Spots mean greater activity and more solar energy being sent towards the earth → warmer.



3. ORBITAL THEORY/MILANKOVITH CYCLES

- Changes in the way the earth orbits the sun from circular to ellipse alters the amount of sunlight the earth receives.
- The earth's axis also moves and wobbles about affecting how much sunlight is recieved



How climate change affected people and the environment during the Little Ice age

- The Little Ice Age was a period of unusually cool conditions between the years of 1300 and 1850 A.D.

Impacts:

ECONOMIC +VE	ECONOMIC - VE	HEALTH	ENVIRONMENT	FARMING
• English fisherman found herring normally located in the waters off Norway. • Increase in deep-sea fishing helped to build the maritime population	• Increasing grain prices and lower wine production • Many farmsteads were destroyed, resulting in less tax • Cod fishing greatly decreased, as the cod moved farther south. • Advancing glaciers closed the gold mines.	• Cool, wet summers led to outbreaks of St. Anthony's Fire illness • Malaria in several parts of England • Great Famine lasted 8 years • 10-20% of farmers died from hunger	• Beech trees, were replaced first by oak and then by pine. • Cold and rain occurred in the spring and summer of 1315 • In the Alps, valley glaciers grew in the colder climate	• Wheat and oats did not ripen so the harvests failed • Farms high on hillsides were abandoned • They had to change their crops from wheat to potatoes

Geological Climate Events

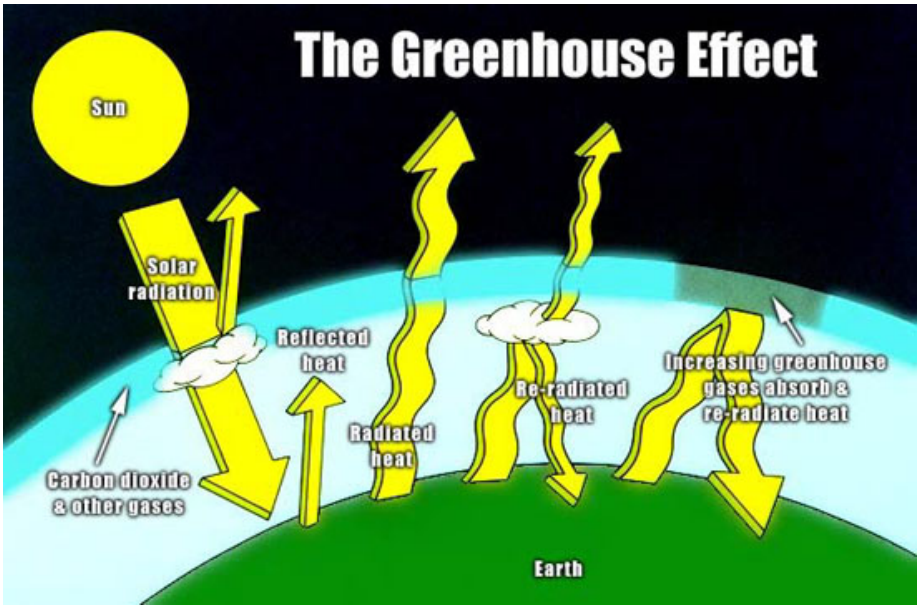
Ecosystems - where plants and animals interact with each other and their environment in order to survive. Can be small e.g. pond or large e.g. Tropical Rainforest.

How were ecosystems affected by climate change in the past?

- **The dinosaur extinction** was possibly caused by a massive asteroid hitting Mexico and a huge volcano in India combining → dust, ash, gas into the stratosphere → blocks the sun → cools the climate → plants don't grow → dinosaurs have no food……..knock on effect through the food chain.

- **Megafauna extinction** – big animals like the woolly mammoth. The climate was warming so they had to find new areas to live where the climate suited them. This disrupted food chains. Humans also hunted them to extinction.

How the greenhouse effect works and the types of human activities increasing greenhouse gases



Greenhouse gases (CO2 from the burning of fossil fuels, deforestation, Methane from paddy fields and cattle, Nitrous oxide from aircraft engines and fertilisers) trap heat from leaving the atmosphere and re-radiate that heat back down to earth. The greater the concentration of greenhouse gases, the more heat is trapped and the warmer earth becomes.

We need the NATURAL greenhouse effect – it makes the planet 16 degrees warmer. Without it the earth would be too cold for us to survive.

The extra greenhouse gases produces by humans → burning fossil fuels → power stations, transport, industry, homes.

GLOBAL WARMING = a warming of the earth's temperatures caused by the **ENHANCED** greenhouse effect (human's have polluted the atmosphere so it is working more strongly).

→ Global temperatures increase.
→ sea levels rise → THERMAL EXPANSION (water droplets expand as warm) and glaciers and ice sheets melt.

What evidence is there of Global Warming happening?

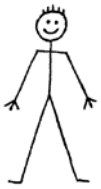
- 19 out of 20 warmest years on record since 1980.
- Sea ice in the Arctic shrank.
- 90% glaciers shrinking.

Scientists disagree – are human actions the main cause of global warming OR is it mostly natural??

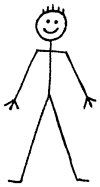
How greenhouse gas levels have changed over time and who the main producers of greenhouse gases

Since pre-industrial times, atmospheric concentrations of greenhouse gases have grown significantly as countries become more industrialised their people become consumers of energy and goods, as well as producers of air pollution through the burning of fossil fuels.

Most greenhouse gases are produced by developed countries – the EU, USA, Japan.



The average person in the developing world produces 1 tonne of CO2.



The average person in the developed world produces 10-25 tonnes of CO2.

The USA produce the largest amounts of Co2 each year and the world's current level of Co2 is increasing at a rate of 200x faster than at any time in the past million years.

Rates of methane have also doubled since the 1800s due to the growing world's population demanding an increasing amount of cows for meat.

Emerging powers such as China and India are now in line with older polluters such as USA and Europe due to the take off of their development. China is now the world's largest single polluter.

What scientists think might happen to climate and sea-levels in the future

Scientists do not know exactly how global warming might affect our planet but predictions include:
- Temperatures to rise between 1.1°c and 6.4°c by 2100
- Sea levels to rise between 30cm and 1 metre by 2100
- Floods, droughts and heat waves would become more common
- Storms and hurricanes would become stronger

Predicting future Global Warming is hard....as we don't know:

- What the future population will be.
- If we will continue to use fossil fuels or change to cleaner fuels e.g. solar, wind power…
- If we will change our lifestyles → recycle → use public transport etc.

How might a developed country be affected by Global Warming?

NAMED EXAMPLE of MEDC: UK

1. Likely to be **WARMER**:

COSTS	BENEFITS
▪ Summer drought and water shortages, especially in the south. ▪ More illnesses e.g. sunstroke, skin cancer. ▪ Roads melt, railway lines buckle. ▪ Farmers change crops to those that need less water and more sun. ▪ Extinctions of some plants and animals as it gets too hot. ▪ Scotland's skiing resorts could be gone by 2050 ▪ More cases of tropical diseases like malaria	▪ Winter heating costs and the costs of gritting the roads fall. ▪ Tourism increases – good for the economy. ▪ Fewer deaths in winter especially the elderly from the cold. ▪ More land can be farmed at higher altitudes. ▪ Growing seasons would be different so new crops could be grown e.g. vines for wine

2. **SEA LEVEL** rise
- Low lying coasts could flood
- Greater erosion e.g. Holderness
- Sea defences and flood barriers would cost £millions.

3. More **EXTREME WEATHER**
    - Heat waves
    - Floods
    - Storms

Extreme weather is hard to predict and costly.

The Stern Review 2005

We should spend 2% our GDP now, reducing pollution OR the effects of global warming could decrease our GDP by 20%. 'Spend now or pay later'.

What can we do?

- Decrease fossil fuel use.
- Switch to 'green energy' – wind, solar, tidal.
- Recycle more
- Use cars less and public transport more.

1997 Kyoto Protocol = international agreement to cut CO2 emissions.

Some countries e.g. UK have cut emissions, others e.g. China haven't. We need ALL countries to sign up.

How climate change might affect people in the developing world

NAMED EXAMPLE of LEDC: Egypt – the possible impacts of Global Warming

- A developing country
- Low greenhouse gas emissions – 2.6 tonnes per person per year (world average = 6.8)
- Produce less than 1% all green house gases.
- 99% of Egypt's people live in 5% land area as so much is desert.
- Average rainfall = less than 10mm/yr
- The River Nile is an important water supply.

With Global Warming…

- If sea levels rise 50cm, 1/3 of the city of Alexandria would be under water.
- 10% Nile Delta would flood → 7 million people would have to leave their homes. → farming would be hit. → there would be less food→ famine.
- Less and more unreliable rainfall → water shortages.
- Desertification
- Heatwaves → illness and death.
- Malaria increase.

Water Wars??

86% of the Nile's water starts it's journey in Ethiopia.
Uganda, Sudan and Ethiopia are all building huge dams for Hydro Electric Power (HEP).
This could have a serious impact on the amount of water reaching Egypt.
This could lead to conflict and war.

Egypt has a debt of $30 billion. It may not be able to cope with the impacts of global warming.

TOPIC 3: BATTLE FOR THE BIOSPHERE

What do you need to know?

- How to describe the distribution of biomes across the Earth's surface
- How climate (temperature and precipitation) influences the distribution and types of biomes
- How local factors, such as altitude, also influences biome distribution
- How the biosphere provides important services to humans
- How the biosphere provides goods (resources) that humans use
- How goods and services support human life on Earth
- How humans are directly degrading biomes by their actions, such as deforestation including a named example
- How climate change is affecting biomes
- Why humans need to conserve biomes and biodiversity
- How to define sustainable and unsustainable
- Why humans need to use biomes more sustainably in the future
- How global actions and agreements could help make this possible, including examples
- How local and national management can conserve biomes including examples

Key terms:

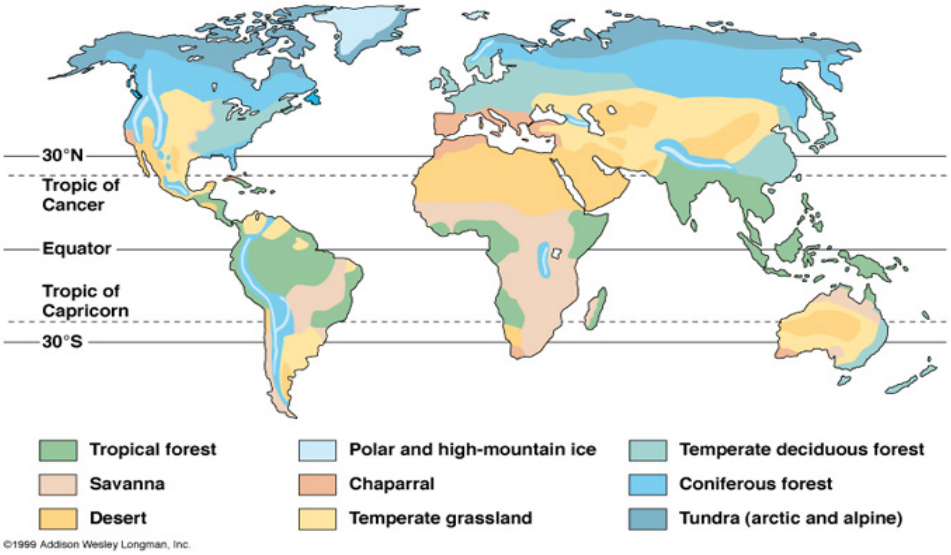
Biodiversity	The number and variety of living species found in a specific area
Bio fuels	Fuel sources derived from agricultural crops
Biome	A plant and animal community covering a large area of the Earth's surface
Biosphere	The living part – plants and animals – of the Earth
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora – an international agreement
Conservation	Managing the environment in order to preserve, protect or restore it
Deforestation	The chopping down and removal of trees to clear an area of forest
Degradation	The social, economic and environmental decline of an area, often through deindustrialisation
Gene pool	The genetic material contained by a specific population
Goods	Produced items and materials
Hydrological Cycle	The global stores of water and linking processes that connect them
Ramsar	The Ramsar Convention on Wetlands is an intergovernmental treaty for the conservation and wise use of wetlands
Services	Those things that are provided, bought and sold that are not tangible
Superpower Countries	The world's most powerful and influential nations- the USA and increasingly, China and India
Sustainability	The idea that the current generation of people should not damage the environment in ways that will threaten future generations environment
Unsustainable	Unable to be kept going at the same rate or level
Water Table	The level in the soil or bedrock below which water is usually present
Wilderness	Uncultivated, uninhabited and inhospitable regions

How to describe the distribution of biomes across the Earth's surface

BIOME = WORLD SCALE ECOSYSTEM

The world has 9 major biomes – determined by climate:

- Temperature – length of the growing season
- Precipitation
- Sunshine hours – precipitation
- Humidity



Tropical Rainforests: Mostly in a band either side of the Equator as the sun's rays are concentrated here and there is heavy rainfall.

Deserts – found close to the Tropic lines, sun's rays are concentrated but the air is dry

Deciduous – Grows in higher latitudes e.g. UK where the sun's rays are less concentrated and cooler winter temperatures encourage trees to loose their leaves.

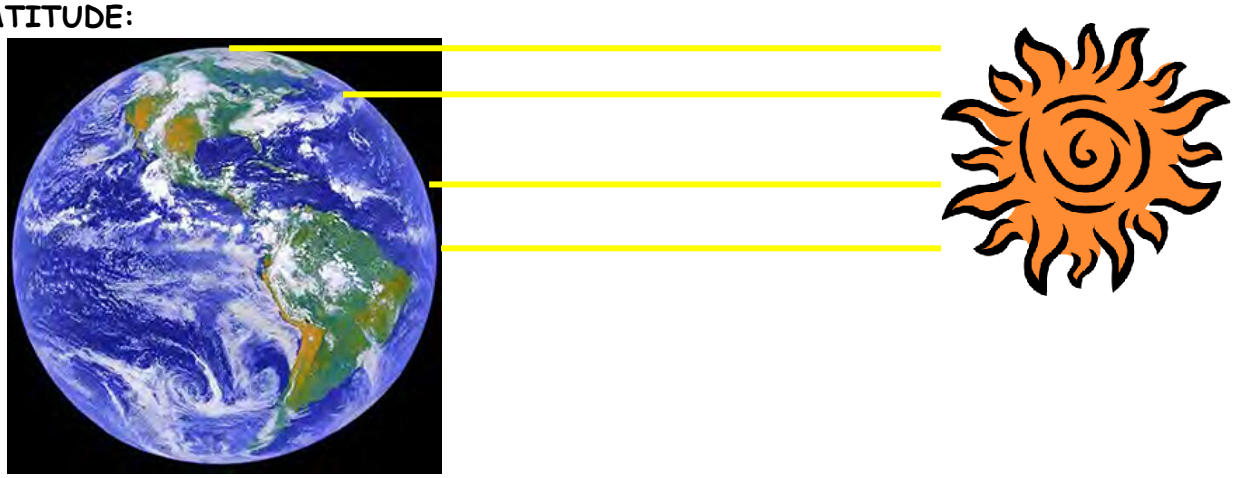
Coniferous – found 60° north where temperatures are so cold that trees have evolved pine needles to reduce moisture loss.

Tundra – found at the Arctic Circle where the sun's rays have little strength and temperatures remain mostly below freezing.

How climate (temperature and precipitation) influences the distribution and types of biomes

Average temperature is the main factor affecting plant growth. Temperature gradually decreases as you move away from the equator and as latitude increases, so temperature decreases.

LATITUDE:

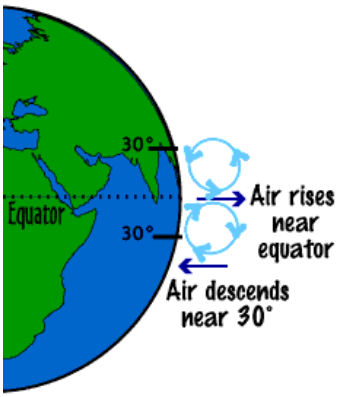


At the equator the sun's rays hit the earth at right angles, therefore concentrating the rays and making it very hot. At the poles the rays hit at a greater angle, so the rays are spread out over a greater area and is much less concentrated.

Lack of heat and light limits vegetation growth so plants become stunted and low growing.

Precipitation:

- Precipitation occurs in low-pressure belts, where air masses meet and air rises.
- At the equator the air is always rising = LOW pressure = clouds and rain = rainforests.
- At 30 degrees north and south of the equator the air is always sinking = HIGH pressure = no clouds and no rain = deserts.



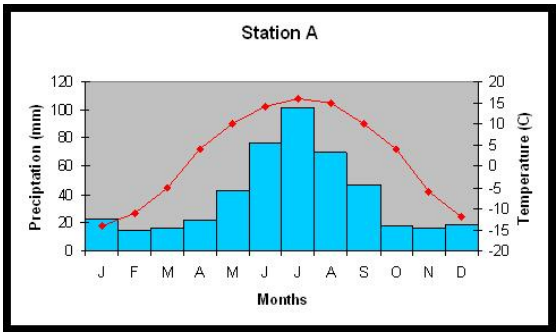
This means that in area such as UK and the Equator where year-round rainfall occurs, forests grow in these area. Whilst in polar and desert area, high-pressure zones occur causing dry conditions .

How local factors, such as altitude, also influences biome distribution

ALTITUDE: (height of the land) – as height increases so the climate gets increasingly cold and wet. Temperature decreases 1 degree for every 100m of height.
THE SEA: keeps places near the coast cooler in summer and warmer in winter (as water heats up and cools down more slowly than the land) this is called **continentality**.
PREVAILING WINDS: If the most common winds come from across the land, the climate = dry. If across the sea, the climate – wet. From the poles = cold, from the equator = warm.
GEOLOGY: Limestone bedrock creates dry soil conditions becomes rainwater can pass through it easily. So in the UK forests are rarely found in limestone area

A climate graph…

The RED line graph = average temperature for each month.
The BLUE bar graph = average rainfall for each month.
TEMPERAURE RANGE = difference between min and max temperatures.



How the biosphere provides important services to humans Goods and services

GOODS = things of value to us
SERVICES = things that satisfy our needs
The biosphere is a life-support system which provides many vital services such as:

1. Regulating the composition of the atmosphere – forests remove carbon dioxide from the atmosphere reducing global warming. Forests give out oxygen – purifying the atmosphere
2. Maintaining the health of the soil – forests provide leaf litter which forms humus. This makes the soil more fertile for growing crops
3. Regulating water within the hydrological cycle – forests protects watersheds from soil erosion and intercepts precipitation – preventing flash flooding. They also trap silt therefore keeping the water pure.
4. Protect against natural hazards such as storms and floods
5. 'Pollination' for food web/chains
6. Maintaining biodiversity

How the biosphere provides goods (resources) that humans use

1. **Food**
   - fish and meat
   - Sustainable harvesting of fruits, nuts and berries
   - Natural vegetation can be replaced with crops like wheat and rice
2. **Raw materials**
   - Timer
   - Bamboo – used in Hong Kong for scaffolding
   - Rubber comes from trees and makes tyres
   - wood pulp makes paper
   - Mangrove trees are a natural flood defence
3. **Medicine**
   - Vitamin C is found in oranges
   - St John's Wort is a plant used to help treat depression
   - the periwinkle plant is used to treat Hodgkin's disease

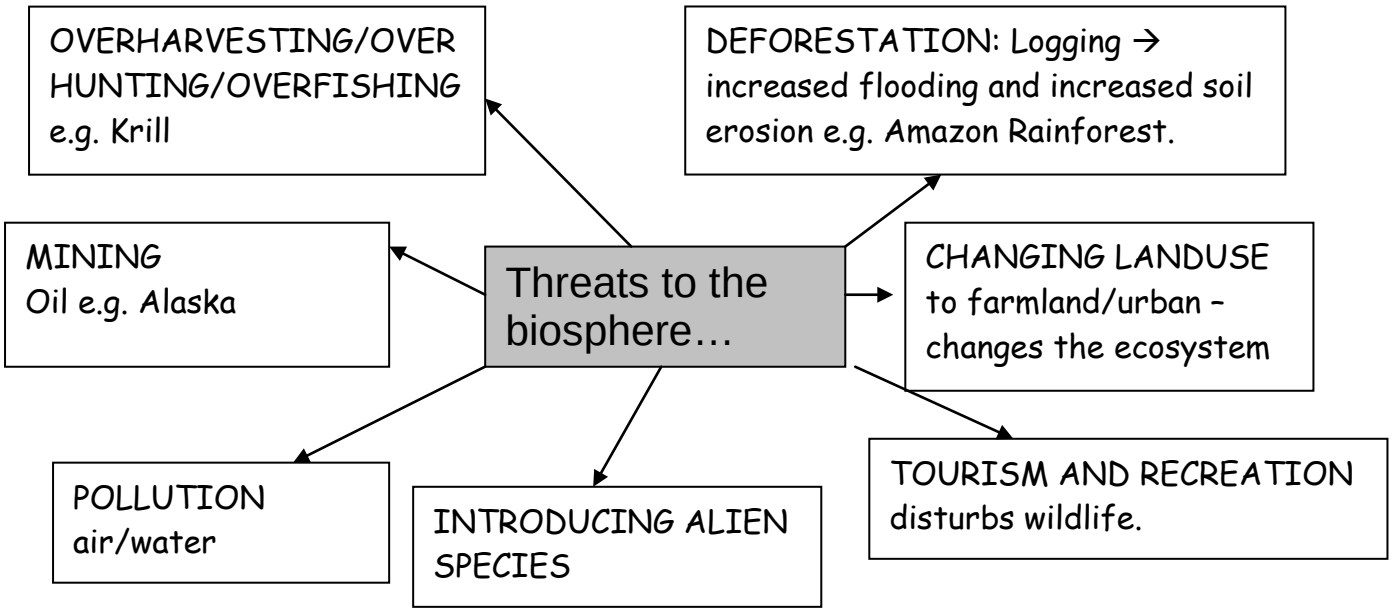
How goods and services support human life on Earth

- In Britain, deciduous forest wood helped make and fuel the factories that drove the industrial revolution
- Tropical rainforests are vital for poor countries in South America where wood is used in many ways to help build local incomes
- Coniferous forests in North America provide much of the world's softwood which is used to make paper

How humans are directly degrading biomes by their actions, such as deforestation, including a named example

Every year the 'red list' of endangered animals is produced.
Increasingly, habitats are being damaged and destroyed → this leads to increased threat of species survival.
Immediate causes = logging, overfishing, pollution
Root causes = increasing populations, economic development e.g. China, India → now = more money and therefore consuming more food and fuel etc.

Certain species and places are particularly under threat.
There are 25 'hotspots' where there is greatest concentration of biodiversity (number of plants and animals).



NAMED EXAMPLE: THE TROPICAL RAINFORESTS - AMAZONIA

Location: Brazil – South America

Background:

TRF indigenous people (lived there for many generations) - almost everything provided by the rainforest:

- Wood for cooking and building
- herbs for medicine
- food – nuts, fruit, meat, fish
- grow crops – shifting cultivation (sustainable process)

Causes:

The tropical rainforest is currently being exploited for a number of purposes:

- TNC's exploit the TRF

→ logging for timber/paper (100,000sq km of forest cut down every year)

→ farming – soya – Growth in soya cultivation has grown due to increased global demand as cattle ranchers especially in Europe see soya as a safe and healthy food source for their animals. In 2003, the rate of deforestation in Brazil rose 40% due to the demands from soya consumers.

→ cattle ranches

→ mining for oil

→ governments building dams for HEP

→ roads e.g. Trans-Amazon highway

- Future population pressures – a growth rate of 1.5% per year means more land is needed each year for farming and housing.

This means…

- The soil is eroded and washed away → floods.
- Wildlife loses habitats
- Rivers become dirty and polluted

How have ecosystems changed over time?

MASS EXTINCTION = extinction of a large number of species in a short time.
Are we heading towards another mass extinction? We are threatening the ability of the biosphere to provide goods and services due to:

- Population growth
- Using more food, oil, water, minerals
- Human induced change (global warming)

How climate change is affecting biomes

- Habitats broken up
- Habitats change due to increasing temperatures, changing rainfall, rising sea levels
- Extreme weather = more common
- Oceans = more acidic as more freshwater is added. Kills coral reefs.
- Increased pests and diseases.
- Species face extinction
- Krill numbers falling
- Glaciers melting
- Emperor penguins decreased 50%

Why humans need to conserve biomes and biodiversity

It is important for humans to conserve biodiversity otherwise we face the issues of more species extinctions e.g. polar bears, as well as ecological environments such as Wetlands which support high levels of birds, mammals, reptiles and fish.

How can we conserve the biosphere?

- Should we save the hotspots or a representation of all of the biomes?
- Should we restore devastated areas?
- Should we conserve high profile animals or keystone species (have a large effect on other living things e.g. bees)

How global actions and agreements could help make this possible, including examples

GLOBAL ACTIONS… (Countries working together)

- RAMSAR → conserving wetlands
- CITES → stop ivory trade/crocodile skins
- Rainforest conservation →Introduced of 'debt-for-nature' swap agreements e.g. USA reduced the size of Guatemala's foreign debt repayments in exchange for less rainforest to be cut down
- World Heritage Sites → Over 800 important sites have been awarded recognition from the UN since 1972 due to their biosphere e.g. Galapagos Islands
- National Parks → Covering 13% of the land surface protecting areas of outstanding natural beauty

How local and national management can conserve biomes including examples

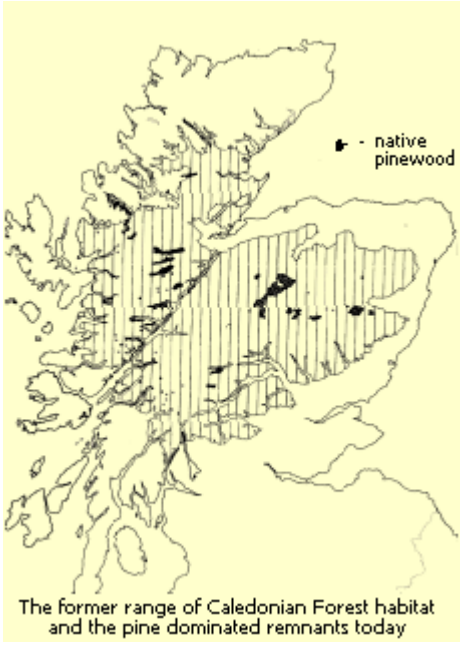
NATIONAL ACTIONS… (a particular country)

- National Parks England and Wales – protected areas e.g. The Peak District
- Community Forests – new areas of trees near cities
- Paying farmers to replace hedgerows

LOCAL ACTIONS… (local area)

- Biodversity action plans e.g Havering Wildlife Trust, Bedfords Park.

Named Example: Local Action in the Caledonian Forest



The former range of Caledonian Forest habitat and the pine dominated remnants today

This forest is all that remains from the original forest that existed in Scotland at the end of the last ice Age. The EU has provided funding for its restoration for the benefit of future generations:

- Bring back lost animal habitats and populations
- Restore biodiversity to its natural level by adopting a countryside management strategy known as **Environmental Stewardship**.
- Reintroduce wild boar which had been hunted to extinction – aim in the future to introduce wolves and brown bears! (very controversial)

SUSTAINABLE MANAGEMENT – meeting the needs of the present without compromising the needs of future generations.

Ways to do this…

- Zoning
- Educating local people
- Ecotourism
- Protected areas
- Only cut large trees

NAMED EXAMPLE: Klum, Cameroon Republic: Sustainable Forest Reserve

→ an area of selective logging
→ tree nurseries to replace trees cut down (afforestation)
→ ecotourism
→ protected areas
→ crops grown beneath the trees instead of cutting them down.

TOPIC 4: WATER WORLD

What do I need to know?

- How the hydrological cycle links to the biosphere, atmosphere and lithosphere
- Why the global hydrological cycle is called a system
- The key process, flows and stores of the hydrological cycle, and their names
- Why some area, like the Sahel, have unreliable water supply
- How too much or too little water can lead to problems in the UK, Asia and America
- How humans reduce water quality through pollution
- How future climate change might affect water supplies
- How human use of stores and flows can reduce water supply
- How large-scale water management can interfere with water supply using example of the Aswan Dam
- What intermediate technology is
- How intermediate technology might improve water supply in the developing world

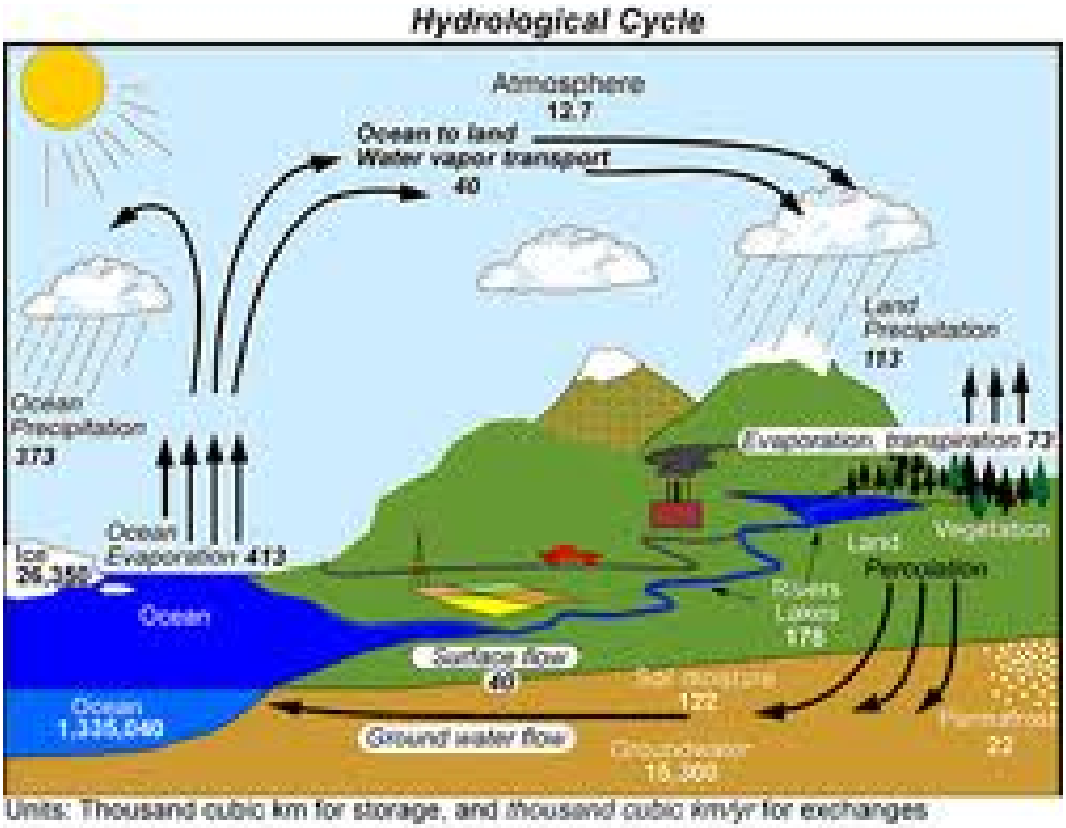
Key terms:

Aquifer	An underground store of water, formed when water-bearing (permeable) rocks lie on top of impermeable rocks
Groundwater	Water contained beneath the surface, as a reserve
Hydrological cycle	The global stores of water and linking process that connect them
Impermeable	Not allowing water to pass through
Infiltration	The process whereby water soaks into the soil and rock
Intermediate Technology	A technology that the local community is able to use relatively easily and without much cost
Joints	Lines of weakness in a rock that water can pass along
Over abstraction	When water is being used more quickly than it is being replaced
Permeable	Allowing water to pass through
Pollution	The presence of chemicals, noise, dirt or substances which have harmful or poisonous effects on an environment
Pores	Small air spaces round in a rock or other material that can also be filled with water
Precipitation	When moisture falls from the atmosphere – as rain, hail, sleet or snow
Regulated Flow	The steady movement of water through a drainage basin that will not bring flash flooding
River Pollution	The emission of harmful or poisonous substances into river water
Throughflow	Water that flows slowly through the soil until it reaches a river
Water harvesting	Storing rainwater or used water (grey water) for use in periods of drought
Water management schemes	Programmes to control rivers, generally organised by local or central government
Water store	A build-up of water that has collected on or below the ground, or in the atmosphere
Water Table	The level in the soil or bedrock below which water is usually present
Water stress	Occurs when the demand for water exceeds the amount available during a certain period, or when it is not good enough quality to use

Why the global hydrological cycle is called a system

The water is this cycle is a never-ending as it is a 'closed system' which means the water goes round and round, but none is added or lost from the systems. This means that the Earth gets neither wetter or drier.

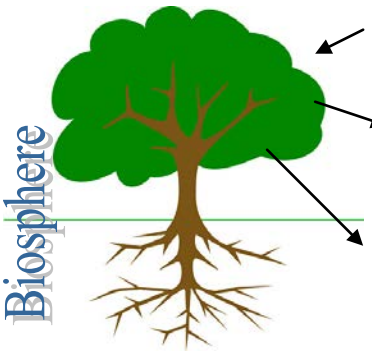
The key process, flows and stores of the hydrological cycle, and their names



STORES:

- rocks (can be stored for 100's yrs),
- soil, lakes, oceans (97% water stored BUT too salty to use)
- glaciers
- The soil, lakes and rocks hold relatively small amounts of fresh water – but are in high demand as sources of water.

TRANSFERS/FLOWS: Surface runoff, through flow, groundwater flow, infiltration, precipitation.



Intercepts precipitation

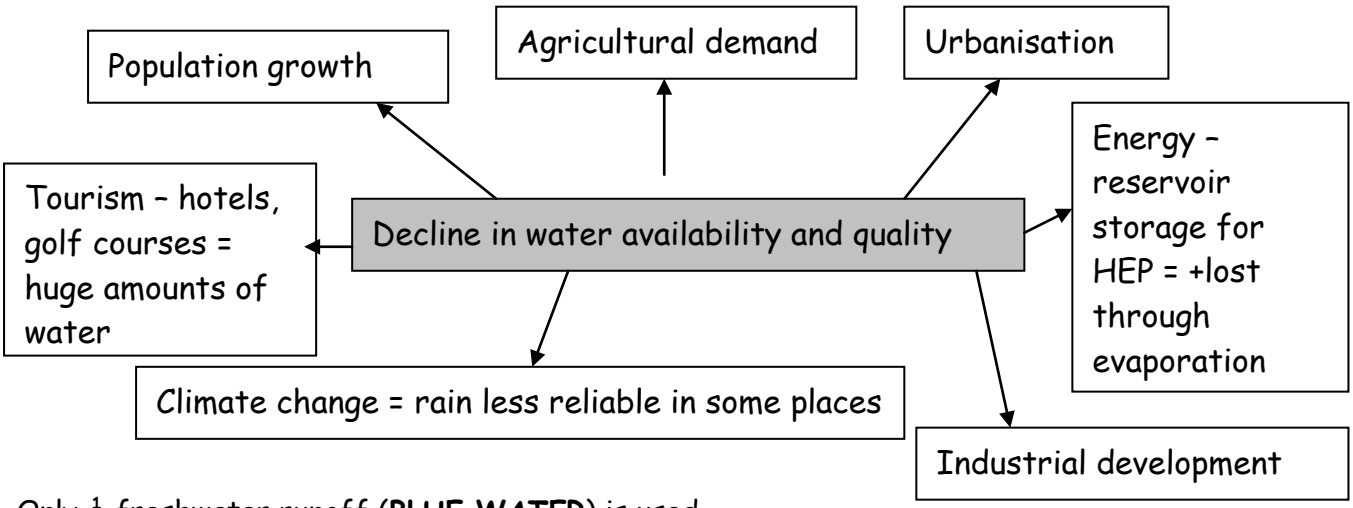
½ is Evapotranspiration without ever reaching the ground = GREEN WATER

Drips from leaves and infiltrates the soil

Why some area, like the Sahel, have unreliable water supply

Reasons for increasing demand for water and water stress

- Demand increases as population increases.
- Increased demand from agriculture – irrigating their crops uses huge amounts of water.
- Supplies are increasingly unpredictable
- Possibility of water wars – Middle East – fighting over water.
- Economic development – China, India – increased demand for water
- Rising living standards = use more water e.g. showers, washing machines etc.



Only ½ freshwater runoff (**BLUE WATER**) is used.
Most is inaccessible.

WATER STRESS = when demand is greater than supply or when it is not of good enough quality to use.

Turkmenistan and Uzbekistan are the most water stressed countries in the world → they use huge quantities for irrigating cotton crops.

SW USA, Central Asia = **PHYSICAL WATER SCARCITY** – Demand > availability
Sub Saharan Africa = **ECONOMIC WATER SCARCITY** – supply available but people can't afford to exploit them. Lack of money to build storage facilities or distribute water.

NAMED EXAMPLE: SAHEL

Location: Belt of semi-arid land south of the Sahara, Africa. The land covers 14.9 billion hectares of the Earth's Surface

Background:

- The countries comprising sub-Saharan Africa depend more on their natural resource base for economic and social needs than any other region in the world.
- Two-thirds of sub-Saharan Africa's people live in rural areas and rely on agriculture and other natural resources for income.
- Environmental problems of sub-Saharan Africa include air and water pollution, deforestation, loss of soil and soil fertility, and a dramatic decline in biodiversity throughout the region.

Causes:

- Rains usually 1 or 2 months a year. Total 250-450mm/yr.
- Since 1970 rainfall has been below average. Some years 25% less than average.
- Sometimes rainfall is so heavy when it does fall that most is lost as surface runoff leading to flooding.
- Other years there is no rain at all → rivers dry up → water table falls → farmers crops fail → animals die → desertification → decreased food supplies → famine.
- Rapidly growing population which puts increased pressure in drought years on failing food supplies

How too much or too little water can lead to problems in the UK, Asia and America

Global warming means...

- Less rain for some areas
- Increased rate of glacier melt
- More extreme weather events → floods and storms and droughts.

Richer countries e.g. Kuwait, Saudi Arabia (profit from oil) can buy their way out of trouble e.g. desalination → turning sea water into fresh water (very expensive). Developing countries rely on rainfall for their crops → + unstable → food insecurity and famine.

Impacts of climate change on water supplies:

	Social	Economic	Environmental
USA	- Huge populations e.g. Arizona rose 40% in 1990s, reliant on smaller water resources	- Authorities having to pay for solutions e.g. drought tolerant landscaping - Long-term decline in tourism in areas such as Las Vegas?	- Reduced rainfall to areas that are usually scarce e.g. SW - Drought conditions experienced in 2002, 2004 and 2007
Asia	- ½ world's population at risk - Billions of people could have reduced water supplies - Risk of starvation as subsistence farmers no longer able to supply water to crops	- Increased dependency on aid from other countries and the World Bank	- Major rivers fed by seasonal melting of glaciers ensure sustainable water supply – climate change could lead to permanent melting - Increase in extreme weather events e.g. Cyclones in Bangladesh - Increase sea level could flood low lying areas

Not all bad!

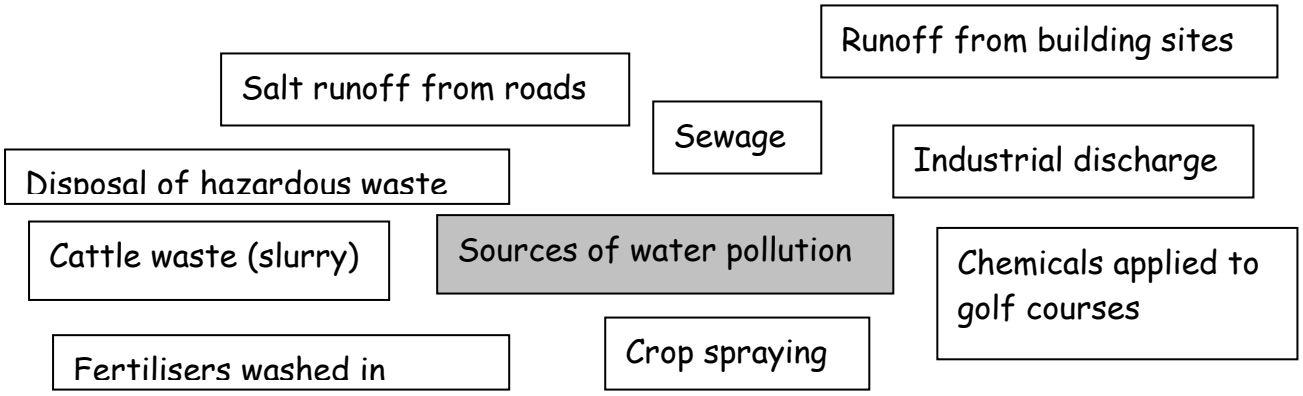
In the **UK** in the future it is predicted that:

- Longer, hotter summers especially in London and the South-East (enable growth of different crops e.g. grapes etc)
- Warmer, wetter winters with more rain bearing storms all over the UK (could fill reservoirs with more water for supplies)

How humans reduce water quality through pollution

Water quality…

People can suffer economic water stress if water isn't safe. Pollution can be: domestic, industrial, agricultural, transport related.



Developing countries…

- The highest levels of pollution are found in rapidly developing countries like India and China – they put economic growth before environmental protection.
- Rapidly growing cities means slums → streams = badly polluted as no sewage systems in place.
- Chemicals added to crops = runoff….

Developed countries…

- E.g. UK, Japan – have taken big steps to control pollution.
- Tertiary and quaternary industries cause less pollution than primary and secondary.

NAMED EXAMPLE: River Rhine – Water Pollution

Location: The Rhine is one of the longest rivers in Europe. It runs for over 1,300 kilometres from its source in Switzerland.

Causes:

1. Many types of industries have established themselves along the banks of the rivers. The chemical industry disposes of waste containing heavy metals such like cadmium, lead and mercury. The paper-making, brewing and the detergents industries also dump their waste into the river. Although most of these emissions are properly authorised, some emissions are not and there is always the risk of accidental spill or leaks.

2. Households dispose of a variety of waste products: soap, detergents, leftovers and sewage. People often throw things directly into the river, from pieces of paper to rusting bed frames and old bicycles.

3. Many agriculture practices lead to organic waste, chemical fertilisers and other waste products reaching the river. Fertilisers contain various chemicals from phosphates and nitrates to poisonous hydrocarbons.

Impacts:

- Metals such as lead and cadmium pollute the river. These attach themselves to silt particles, and hence the polluted silt cannot be dumped in the North Sea.
- Public health would be seriously affected if the water is not purified. Phosphates, which are in high concentration, stimulate the growth of algae, eventually clogging the pipelines and filters. Silt also poses a similarly problem.
- The high salinity of the water not only gives the water a displeasant taste, but also helps to corrode the pipelines.
- Saline discharges from mines in Germany make the water in the Rhine unsuitable for market gardening in the Netherlands.
- Hence, Dutch market gardeners have to desalinate water before using it to water their crops. This is expensive.

How human use of stores and flows can reduce water supply

How people intervene in the water cycle:

1. CLOUD SEEDING: making it rain
2. DEFORESTATION: Decreased interception → increased flooding
3. URBANISATION: Increased impermeable surfaces
4. OVERABSTRACTION: taking too much water from rivers and lakes
5. BUILDING DAMS AND RESERVOIRS
6. GLOBAL WARMING: melting glaciers

OVERABSTRACTION: Too much water is being taken from the river/lake/water source.

NAMED EXAMPLE:
Thames Valley, South England

- Dramatic decrease in river flow
- Tributaries dried up
- Ecosystem damaged

Droughts and increased demand from more homes → increased use of groundwater supplies → falling water table so the store of water is not used sustainably.
→ Most water companies now have strict policies **CAMS (Catchment Abstraction Management Strategies)** for managing water levels.

RESERVOIR BUILDING: Adds a new store to the hydrological cycle.

But….brings **PROBLEMS**:
→ Loss of land – drowns villages, farmland
→ Disease – stagnant water → mosquitoes
→ Vegetation drowned releases methane = greenhouse gas

BENEFITS:

- Water supply
- Recreation – fishing, sailing, walking, wildlife

DEFORESTATION

- Fewer trees = less Evapotranspiration. Less green water recycled = less rain.
- Soil left exposed to the sun and rain
- Less nutrients in the soil
- Raindrops wash out the finer soil, leaving coarse, heavy surface.
- Less interception → greater flood risk

How large-scale water management can interfere with water supply e.g Dams

BENEFITS	DISADVANTAGES
▪ **Increased water supply** ▪ **Recreational use** ▪ **HEP – Industry** ▪ **Habitat for water birds** ▪ **Fishing**	▪ **loss of farmland/villages** ▪ **less navigation** ▪ **people have to be relocated** ▪ **disease – stagnant water** ▪ **loss of cultural sites** ▪ **interferes with fish migration**

Named Example: Aswan Dam, Africa

Location: Located on the Rhine Nine which runs through Egypt in Africa

Reasons for location of the dam:

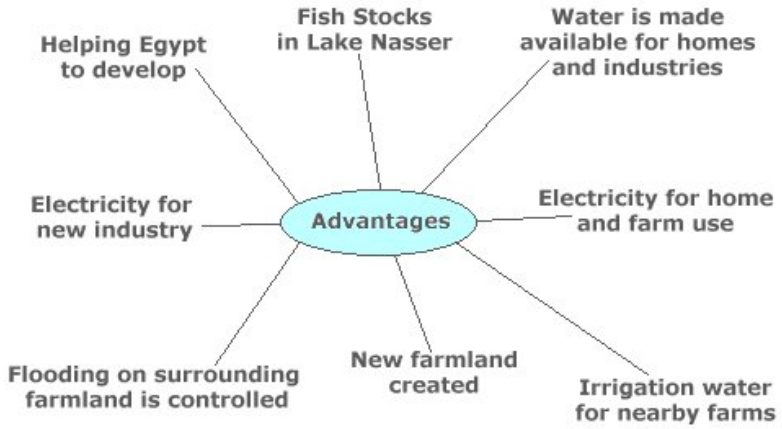
1. The valley is narrow and deep from where it enters Egypt to Aswan.
2. There were no major settlements around Aswan
3. The land around Aswan was of little agricultural value
4. Aswan granite could be used in the construction of the dam.

It was completed in 1970. The dam is built on the River Nile and provides:

- **Hydro-Electric Power (HEP)**
- **Irrigation water for surrounding farmland**
- **Water supply to the population**
- **Flood control.**

i.e. A MULTIPURPOSE SCHEME

Impacts:



What is intermediate technology ?

NGO's (Non Governmental Organisations) e.g. WaterAid develop small scale solutions. **APPROPRIATE/INTERMEDIATE SOLUTIONS:** Schemes that meet the needs of local people and the environment in which they live. Within their technical ability – they can operate and maintain the scheme themselves. They can continue to run it when the NGO has left e.g **RAINWATER HARVESTING** – using guttering to collect rainwater and divert it into a tank. **TUBE WELLS** – to pump up water. **LOW COST PIT/COMPOSTING TOILETS.**

NAMED EXAMPLE: DHAKA, BANGLADESH

- Old Zhimkhana – slum on disused railway station. No safe water or toilets.
- WaterAid constructed 6 tube wells and 2 new sanitation blocks

→ people are no longer continually ill
→they can run facilities themselves
→ moving out of poverty
In the past women had to walk long distances to get water. Now they have safe water for drinking, cooking, washing and personal hygiene.

Problems of small scale schemes...

- A huge number of people suffer from HIV/AIDS → too ill to operate.

In general, Intermediate technology is more sustainable than large scale schemes.

OPTIONAL TOPIC 5: CONTRASTING COASTS

What do I need to know?

- How rock types (geology) and structure influence coastal landforms
- How landforms such as cliffs and stacks form including key terms
- The difference between erosion, weathering and mass movement
- The different types of waves, constructive and destructive
- How sediment is transported and deposited on coasts
- How some coasts are threatened by rapid erosion and rising sea levels
- How erosion can cause conflict
- The range of management options for coasts
- The costs and benefits of different options for Holderness and Swanage

Key terms:

Backwash	the movement of a wave retreating back to sea, away from the beach
Bay	sheltered area of coastline made from soft rock
Coastal Flooding	When areas of land are flooded by the sea.
Coastal Management	The processes and plans applied to coastal areas by local authorities and agencies
Concordant Coast	layers of hard and soft rock which lay parallel against the coastline
Constructive Wave	wave which has a larger swash than backwash
Deposition	Placing sand and sediment in a certain place by a wave, erosion, transportation or humans.
Destructive Wave	wave which has a larger backwash than swash
Discordant coast	layers of hard and soft rock which run vertically against the coastline, forming headlands and bays.
Do Nothing	An approach that allows natural processes to take their course without any intervention
Erosion	breaking down of rock and sediment
Fetch	the distance a wave travels before hitting the coastline
Geological Structure	The way in which the rocks are arranged, both vertically and horizontally
Hard Engineering	a heavily managed area of the coastline, e.g. sea wall, groyne
Hard rock Coast	more resistant rock which is harder to erode or weather, e.g. granite
Headland	outcrop of land at sea made from hard rock
Holistic approach	An approach to environmental management that threats the whole area as an interrelated system
ICZM	A sustainable method of coastal management, managing the whole coastal area from the shoreline to several kilometres inland as one area.
Longshore Drift	Process of sediment moving along the coastline.
Mass Movement	The down slope movement, by gravity, of soil and/or rock by the processes of slumping, falling, sliding and flowing
Soft rock coast	less resistant rock which is easily eroded or weathered, e.g. limestone
Spit	sand and sediment which is attached to the coastline but sticks out at sea
Stack	A detached column of rock located just offshore
Strategic Realignment	The reorganisation of coastal defences that is often part of managed retreat
Stump	A stack that has collapsed, leaving a small area of rock above sea-level
Sub-aerial processes	the weathering of rock and the impacts of wind and rain
Swash	the movement of a wave onto the beach
Weathering	the weather breaking down rock

How rock types (geology) and structure influence coastal landforms

THE COASTAL ZONE = the zone between the land and sea.
Coasts are always changing.

Advantages of living by the coast:

- Fish
- Good agricultural land found next to the coast
- Access for trade
- Tourism opportunities
- Recreation

	Hard rock coast e.g. Granite at Land's end – Cornwall	**Soft Rock coast e.g. Scarborough – Yorkshire**
Shape of cliffs	High, steep and rugged	May be high but are less rugged and not so steep
On the cliff face	Cliff face often bare with no vegetation and little loose rock	May be piles of mud and clay which have slipped down the face of the cliff
At the foot of the cliff face	A few boulders and rocks have fallen from the cliff	Very few rocks, some mud and sand
		

EROSION: The process of wearing the cliffs away.

HYDRAULIC ACTION
The power of water/waves forced into cracks and forcing the rocks apart

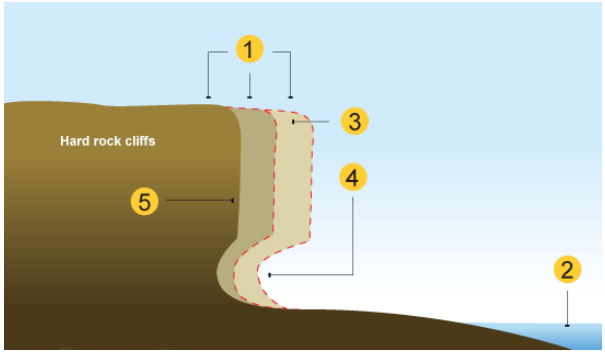
ABRASION
Rocks are hurled against the cliff. They scour away like sandpaper.

ATTRITION
Two rocks crash into each other and break down into smaller pieces

Some rocks are very resistant to erosion e.g. granite.
Some rocks are least resistant e.g. clays and will erode quickly.

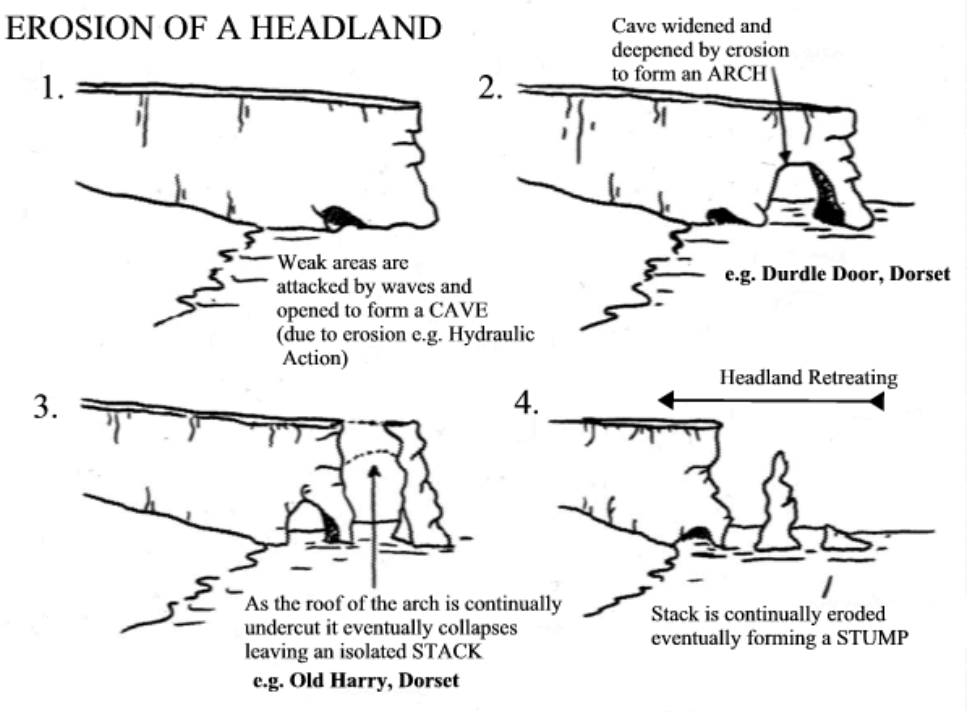
How landforms such as cliffs and stacks form including key terms

Wave Cut Notch/Platform



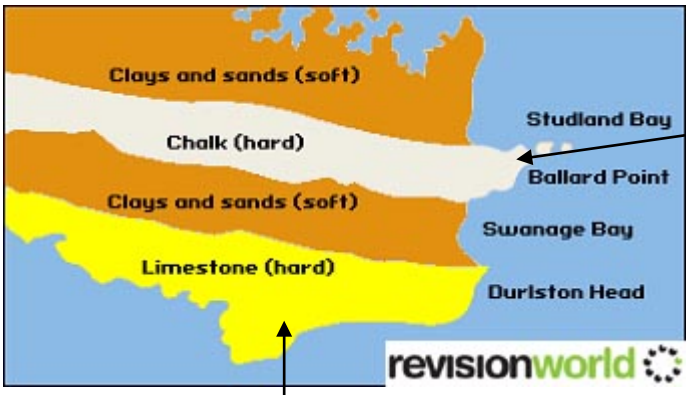
1. The sea attacks the base of the cliff forming a wave-cut notch.
2. The notch increases in size causing the cliff to collapse.
3. The process repeats and the cliff continues to retreat.
4. A wave cut platform is left at the bottom. Exposed at low tides.

Caves, Arches, Stacks and Stumps…



ROCK

STRUCTURE = the way rock types are arranged. Usually in layers (strata).
Concordant and Discordant coastlines:



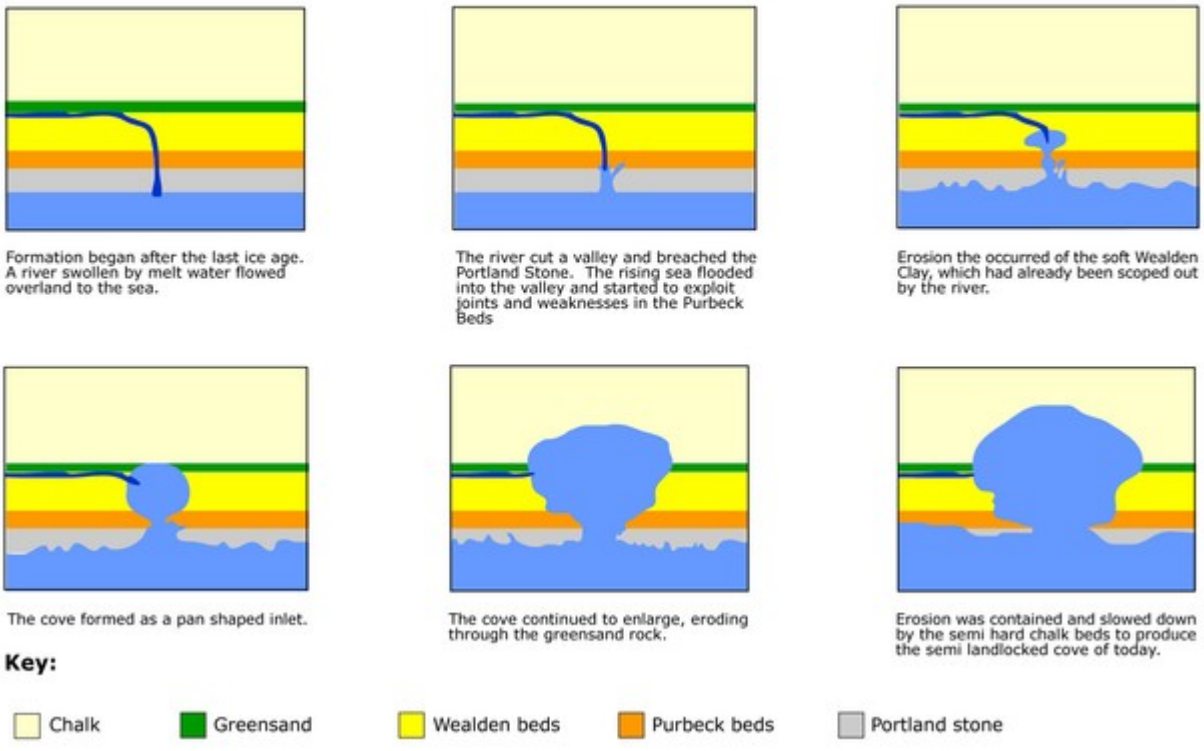
DISCORDANT coastline – different layers of rock at right angles to the coast.

CONCORDANT coastline – the rock type is the same along the whole coastline.

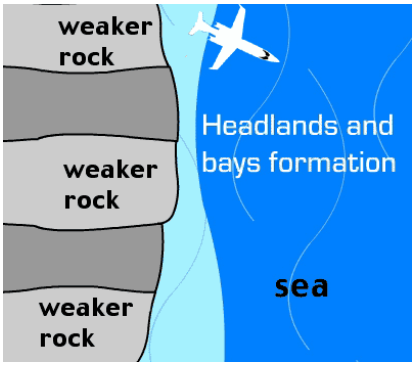
NAMED EXAMPLE: Concordant coast: lulworth cove

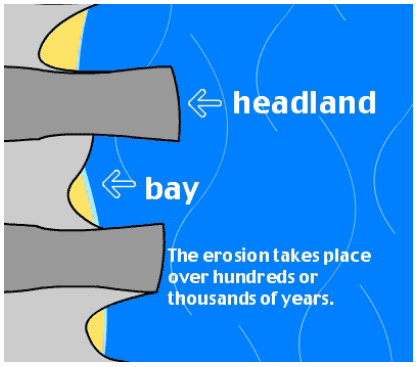
EROSION – EXAMPLE THE FORMATION OF LULWORTH COVE

Lulworth Cove is a natural harbour formed by the combined action of river and sea:



NAMED EXAMPLE: DISCORDANT COAST: HEADLANDS AND BAYS, S.W. IRELAND





The weaker rock here is limestone. The hard rock here is sandstone. The soft rock erodes much faster than the hard rock creating bays. The more resistant rock is left sticking out as headlands.

Weaknesses in the rock can be:

- JOINTS: small, natural cracks
- FAULTS: larger cracks caused in the past by tectonic movements

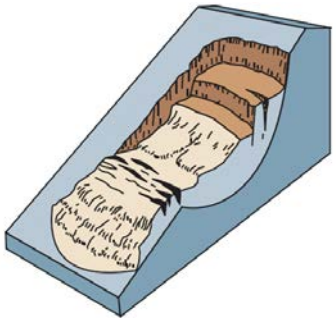
The difference between erosion, weathering and mass movement

Weathering /sub-aerial processes can occur in 3 main ways:

1. Mechanical weathering – salt crystal growth as sea water lands on rocks and the water is evaporated leaving the salt behind. The salt crystals grow and create stresses in the rock
2. Chemical weathering – All rain is slightly acidic causing rocks to decay
3. Biological weathering – roots of vegetation can grow in cracks in a rock and slit the rock apart

Mass movement:

- Rock fall – occur when fragments of rock weathered from a cliff face fall under gravity and collect at the base
- Slumping – occurs when the bottom of a cliff is eroded by the waves making the slope steeper. The cliff can then slide downwards due to rain saturation which lubricates the rocks and makes it heavier.

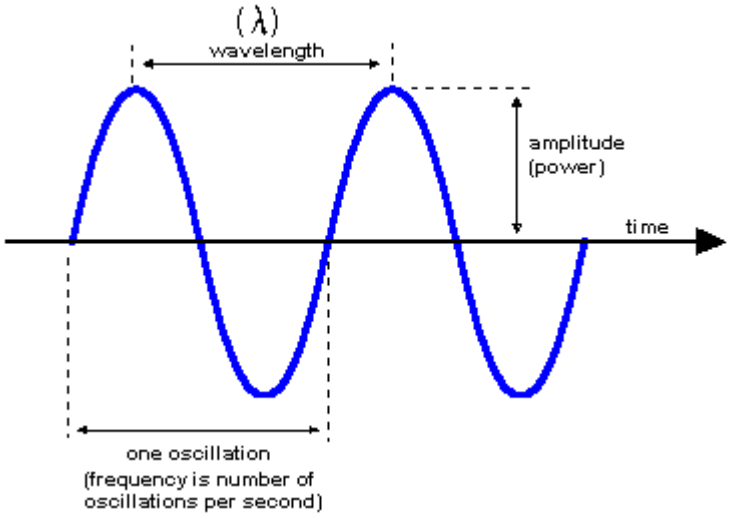


The different types of waves, constructive and destructive

The wind blows across the sea. Friction between the wind and water creates waves. The size of the waves depends on:

- The strength of the wind
- How long the wind blows for
- The length of water the wind flows over (the fetch). This is why Cornwall has the biggest waves in England.

Wave length and amplitude…

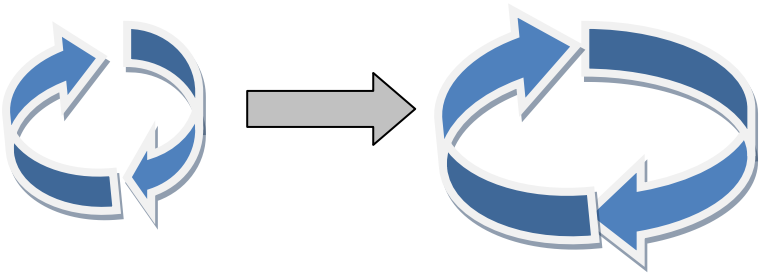


Wavelength is the distance from trough to trough or crest to crest

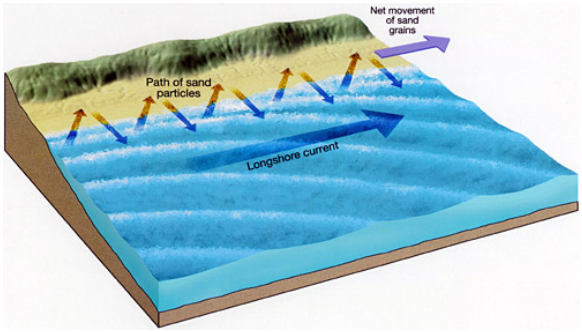
Wave Amplitude is the vertical height from the trough to the crest

How waves break…

1. Out at sea the wind creates a wave shape.
2. Within a wave each water particle moves in a circular movement and returns to the start. It is only energy and not the water itself that is moving forward.
3. When the wave reaches shallow water the wave is distorted from a circular shape to an ellipse shape until it becomes so top heavy that it 'breaks'.
4. It is now not only energy but also water that moves forwards.



Swash and backwash...



The waves come up the beach (swash) in the direction of the prevailing wind. The waves go back down the beach (backwash) at right angles due to gravity.

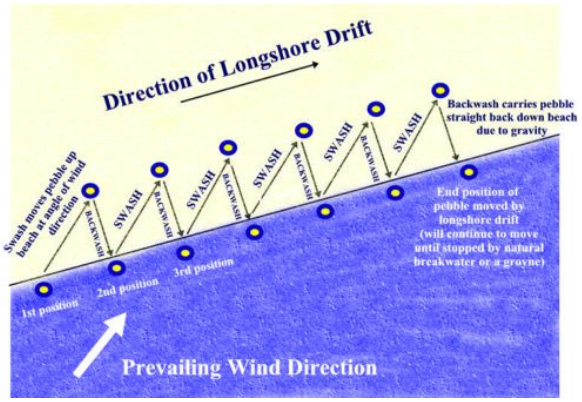
Summer waves = constructive waves:

- small
- long wavelengths
- low amplitudes
- Strong swash so transport sand up the beach and deposit it – builds up the beach.

Winter waves = destructive waves:

- taller (larger amplitude)
- closer together (shorter wavelength)
- Plunging waves = dangerous as are so quick the backwash has to flow under the incoming wave = rip current = dangerous to swimmers as can drag them out to sea.
- Strong backwash – erodes sand from the beach and carries it out to sea where it is deposited.
- Steep beach is formed

How sediment is transported and deposited on coasts

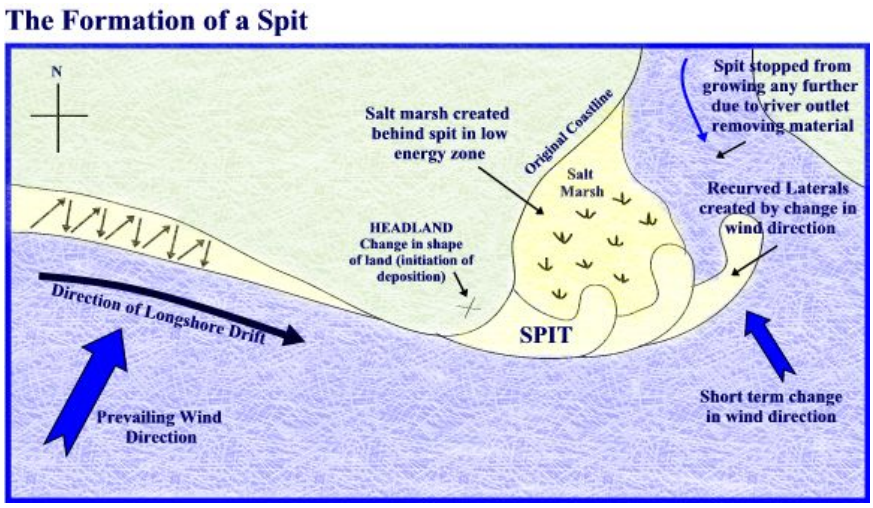


SEDIMENT = tiny clay particles, sand, silt, pebbles, boulders.

Longshore Drift...

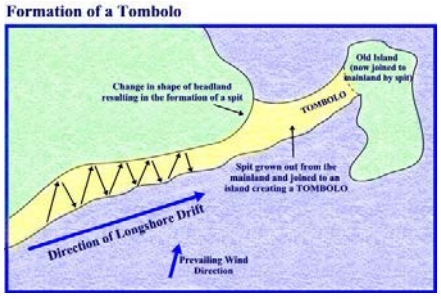
The particles of sand or shingle are transported along the beach in a zig zag movement, carried by the swash and backwash. As the prevailing wind is usually in the same direction so LSD usually is too.

Spits...

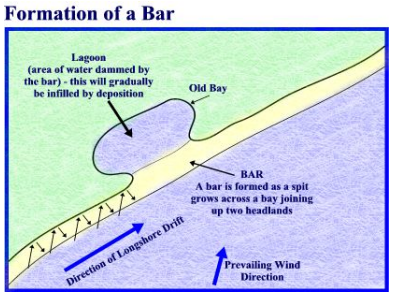


- At a corner in the coastline LSD continues to deposit out to sea forming a neck of sand and shingle.
- The end is curved round by the wind and waves.
- Salt marsh forms in the shelter of the spit.

Tombolo...



Bar...



A tombolo is where the sediment joins the mainland to an island.
A bar joins two sections of mainland.

Sand Dune Plants...

Plants that grow on the sand dunes need to be tough…

- Long roots to hold them in place during strong winds
- Tough, waxy leaves
- Can survive being sprayed with salt water
- E.g. marram grass

How some coasts are threatened by rapid erosion and rising sea levels

Coasts and the Changing Climate...

With increasing sea levels due to thermal expansion (water particles expand as they warm up) and the melting of the ice sheets. Low lying coastlines e.g. Bangladesh, Essex, Pacific islands = at risk.

STORM SURGES:

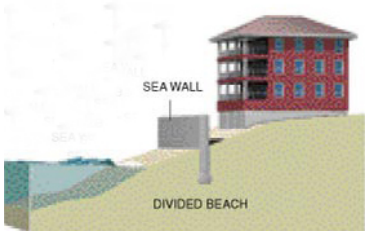
- The gravity of the moon creates tides. Twice a day we have high tides which gives raised sea levels.
- A few times a year we have 'spring tides' which are very high.
- If a spring tide and low air pressure coincide = a STORM SURGE = huge waves flooding the coast.
- Global warming could make depressions more powerful and therefore storm surges more common.

→ Higher sea levels and more storms would = faster erosion rates.
→ Current sea defences would be useless and we would have to spend a lot of money on new ones.

The range of management options for coasts

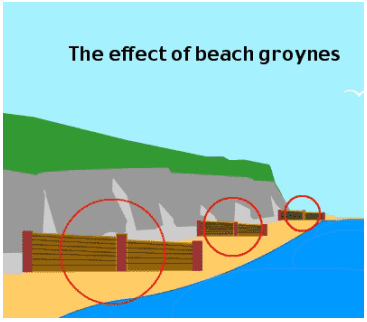
HARD ENGINEERING – traditional, building structures, costly, ugly.
SOFT ENGINEERING – working with nature. Cheaper, less intrusive.

SEA WALLS



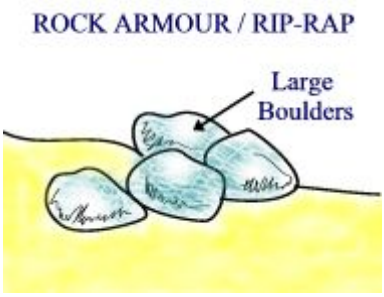
- reflect the waves back out to sea
- Costly
- Makes it hard to access the beach
- The wall itself erodes = high maintenance costs.

GROYNES



- Trap and stop the longshore drift from moving along. Builds up a nice big sandy beach. This is the best form of protection against erosion – the wave moves around every grain of sand, taking lots of energy out of the wave (energy is dissipated).
- Good for tourism
- Has a negative impact down the coast which is starved of sediment – here the beach becomes smaller and offers less protection so erosion rates increase greatly. This = conflict.

ROCK ARMOUR/RIP RAP



- Big boulders placed at the base of the cliff – dissipate the energy of the waves.
- Looks natural.
- Makes access to the beach difficult.
- Can be hard to transport the boulders into position.

REVETMENTS

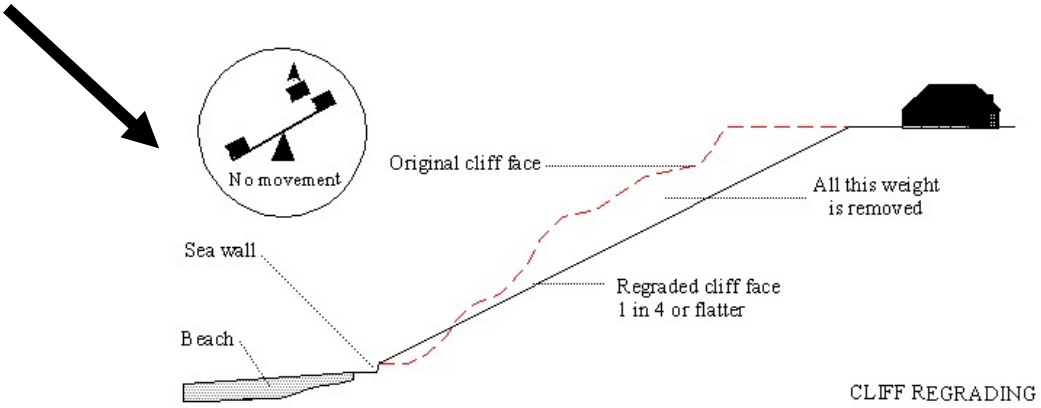
- Slatted wooden or concrete structures built at the base of the cliff
- Absorb and spread the wave energy through the slats
- Do not interfere with longshore drift
- Regular maintenance is needed
- Expensive

CONFLICT...

FOR HARD ENGINEERING	AGAINST HARD ENGINEERING
▪ Locals want hard engineering – it looks like something serious is being done to protect them. ▪ Local businesses e.g. caravan parks, hotels. ▪ Local politicians who want the residents support.	▪ Local taxpayers who don't live at the coast. ▪ Environmentalists – worry about habitats being destroyed. ▪ People who live down coast→ negative effects.

Soft engineering approaches:

- Planting vegetation – make the cliff more stable
- Beach nourishment – pump sand onto the beach, having dredged it from under the sea, to make a nice big sandy beach. Has to be maintained as LSD moves the sediment down the coast all the time.
- Offshore breakwaters – force the waves to break before they reach the beach.
- In cliff drainage to prevent saturation.
- Managed Retreat – people and activities are gradually moved back from the vulnerable areas of the coastline
- Cliff Regrading – making the cliff face longer, so that it is less steep



Some places are not protected as...

- Too expensive to
- The value of the land/buildings doesn't justify the cost
- Defences may cause erosion down coast
- May be impossible to soon due to global warming and sea level rise.

In some places defences are being abandoned and nature let take its course.
→ at the moment the government thinks it is too expensive to protect farmland/isolated houses.
→ conflict
→ hard to convince people who've lived there all their lives that protecting their property is not sustainable.
→ We don't know the impact rising sea levels will have so planning new defences is difficult.

Modern management...

Holistic management → managing the whole stretch of coast and not just one place. Holistic management takes into account:

- The needs of different groups of people
- Economic costs and benefits
- The environment of land and sea

ICZM – Integrated Coastal Zone Management
SMP – Shoreline Management Plans – for long stretches of coast. This should stop one place building groynes if it will effect down the coast.

Council choices...

Councils have 4 choices of how to manage the coast:

1. HOLD THE LINE: use defences to stop erosion and keep the coast where it is. Expensive.
2. ADVANCE THE LINE: move the coast further into the sea. Very expensive.
3. STRATEGIC RETREAT: gradually let the coast erode and move people/businesses away as necessary. Compensation has to be paid.
4. DO NOTHING: let nature take its course.

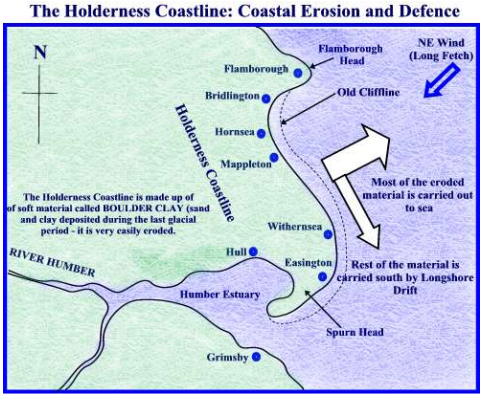
Councils would undertake a 'cost-benefit- analysis to identify whether the option is economically viable e.g. loss of houses if nothing is done, cost of building defences against the sea vs. people not losing their farms and land.

*****Named Case Study: Holderness Coastline*****

Question types: Area prone to erosion/

Management/ Conflict

Location: East Yorkshire – 60km long stretch of low cliffs



Why prone to erosion?

1. The **cliffs are made up of soft glacial material** (Boulder Clay - made up of sands and gravels). This is easily eroded by the waves and the cliffs are easily undermined.
2. The Holderness Coast is **very exposed**, **approaching waves have a long fetch** over the North Sea.
3. The **waves are mainly destructive** - eroding the base of the cliffs (hydraulic action etc.)
4. Most of the Material eroded from the cliffs is washed out to sea, the rest is moved by longshore drift - the **beaches are therefore narrow and do little to protect the coastline**. (If the beaches were wider, the waves would break on the beaches reducing their erosive power).
5. The coastline is threatened further by **sea-level rise**.

Attempts at Coastal Management along the Holderness Coast include:

- use of groynes to trap moving beach material and provide a protective beach in front of the cliff
- the construction of sea walls and revetments as wave-resistant structures at the base of the cliffs
- artificial off-shore breakwaters like tyres and concrete blocks, forcing waves to break off-shore.
- sea wall used to protect Easington Gas Station (cost £4.5 million)

Due to extensive costs - only the most valuable areas of land are protected. Much of the area is farmland which is not protected.

Example of the impacts of Coastal Management: Mappleton

The village of Mappleton is greatly under threat by coastal erosion along the coastline and by 1998, the main road running through the village was only 500m from the cliff top and in places it is now only 50m. The village is under threat due to the easily eroded boulder clay (glacial till) which makes up the cliff line. The area suffers from erosion rates of up to 2m per year.

Protecting Mappleton

To reduce the amount of erosion threatening Mappleton, 2 rock groynes were constructed in 1991 to encourage the build up of beach in front of Mappleton by trapping longshore drift. This meant that those waves would break on the beach rather than attacking the cliffs.

Problems for further down coast

- Those living south of Mappleton village have experienced the 'knock-on' effects of the coastal management.
- The groynes at Mappleton have disturbed the natural longshore drift movement, trapping the coastal material.
- Therefore whilst material is still being moved south of Mappleton, there is no fresh sediment to replace it.
- Beaches have become even narrower and the cliffs are unprotected.
- Estimates suggest that it has accelerated cliff erosion south of Mappleton to 10m / yr.

******Named Case Study: Swanage, Dorset ******

Question types: Different management options/ the need for coastal protection

Location: Dorset

Background:
- Rates of erosion in both Swanage Bay and Durlston Bay are around 40-50cm per year

Methods of protection

Swanage Bay

1) Sea Wall – built in 1920s and provided a promenade (walkway) as well as a barrier to wave attack
2) Cliff Regrading – series of steps made into the cliff to lower the slope angle
3) Groynes – series of timber groynes in 1930s to reduce longshore drift and make sure the beach remained to absorb the energy of the breaking waves
4) Beach replenishment – 90,000m3 of sand dredged from Studland Bay and pumped onto the beach

Cost of the recent new groynes and beach replenishment was £2.2 million

Durlston Bay

1) Regrading of the cliff – slope brought forward to make the slope longer and less steep
2) Installing drainage – removed excess moisture so the slope was not too heavy or lubricated after rainfall
3) Rip rap – large granite boulders placed at the base of the cliff to resist wave attack

Reasons for different choices

Swanage Bay	Durlston Bay
Erosion occurs along a large distance of the cliff rather than just one point Cliff top has houses and hotels which were in danger of collapsing Area is a tourist destination and therefore economically viable to protect the stretch of the cliff	Erosion occurs mainly in one particular point where there are major weaknesses in the cliff Cliff top has houses and apartments in that area Economically viable to protect that particular point due to the price of the houses on the top of the cliff

OPTIONAL UNIT 6: RIVER PROCESSES AND PRESSURES

What do I need to know?

☐ Key terms linked to river systems, such as drainage basin

☐ What the long profile of a river is

☐ How river characteristics change along the long profile

☐ How weathering, erosion, transport and deposition cause river landforms

☐ How to describe landforms of upper, mid and lower course rivers

☐ How the landforms are formed

☐ How sediment changes as it is moved along a river

☐ How flooding is caused

☐ How human and physical factors increase flood risk

☐ To describe and explain hydrological shape

☐ How climate change could increase flood risk

☐ The impacts of flooding in a named area

☐ How hard engineering schemes might prevent flooding

☐ How integrated approaches might reduce flood risk

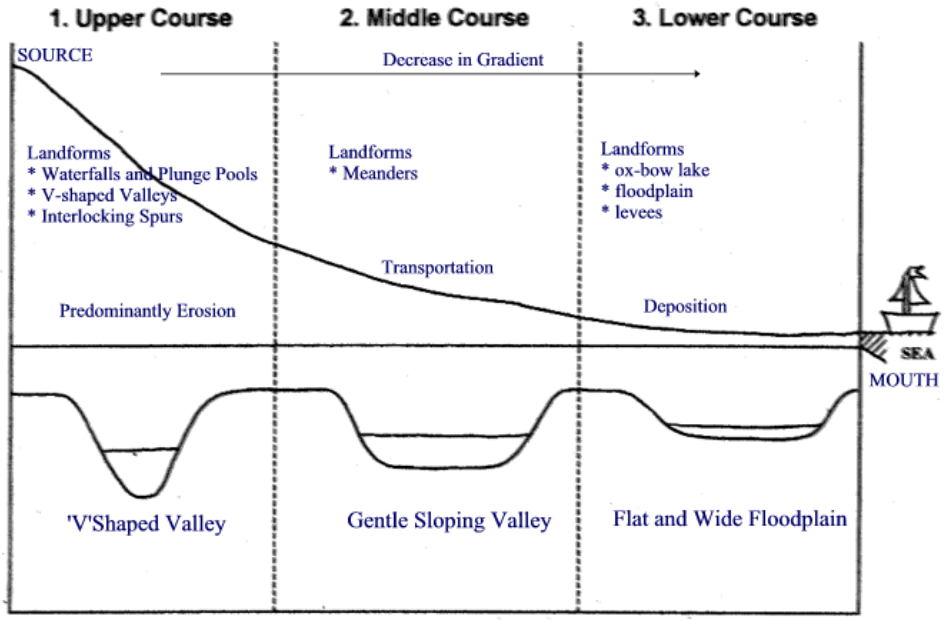
☐ How to evaluate different types of flood management schemes

Key terms:

Confluence	A point where two steams or rivers meet
Deforestation	The chopping down and removal of trees to clear an area of forest
Deposition	The dropping of sediment that was being carried by a moving force
Drainage Basin	The area of land drained by a river and its tributaries
Erosion	The wearing away and removal of material by a moving force
Flood plain	The relatively flat area forming the valley floor on either side of a river channel, which is sometimes flooded
Flood risk	The predicted frequency of floods in an area
Geology	The science and study of the earth's crust and its components
Hard engineering	Using solid structure to resist forces of erosion
Hydrograph	A graph which shows discharge of a river, related to rainfall, over a period of time
Impermeable	Not allowing water to pass through
Integrated river management	A holistic system of managing rivers that takes an overview of the whole river basin and the relationship between its different parts
Interlocking spurs	Areas of high land which stick out into a steep-sided valley
Levee	Natural embankments of sediment along the banks of a river
Long profile	The gradient of a river, from its source to mouth
Lower course	The part of a river system that is close to the mouth of the river
Meander	The bends in a river
Mid course	The central section of a river's course
Mouth	The point where the river enters a lake or sea
Ox-bow lake	An arc-shaped lake which has been cut off from a meandering river
River cliff	Steep outer edge of a meander where erosion is at its highest
Sediment	Usually sand, mud or pebbles deposited by a river
Slip-off slope	Inner gentle slope of a meander where deposition takes place
Tributary	A steam or small river that joins a larger steam or river
Upper course	The source area of a river, often in an upland or mountainous region
Urbanisation	The development and growth of towns or cities
Waterfall	Sudden descent of a river or steam over a vertical or very steep slope
Watershed	The boundary of a drainage basin
Weathering	The breakdown and decay of rock by natural processes

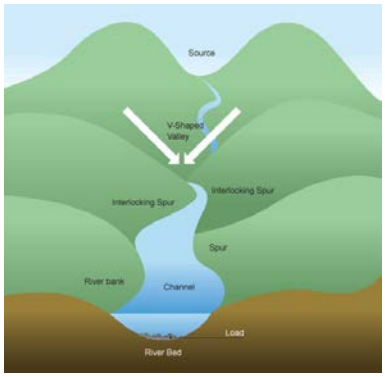
How river characteristics change along the long profile

There are a number of key changes as a river moves downstream. Width, depth, velocity and discharge of a river increases as it moves towards the mouth. Whilst the gradient of the river decreases towards the mouth.



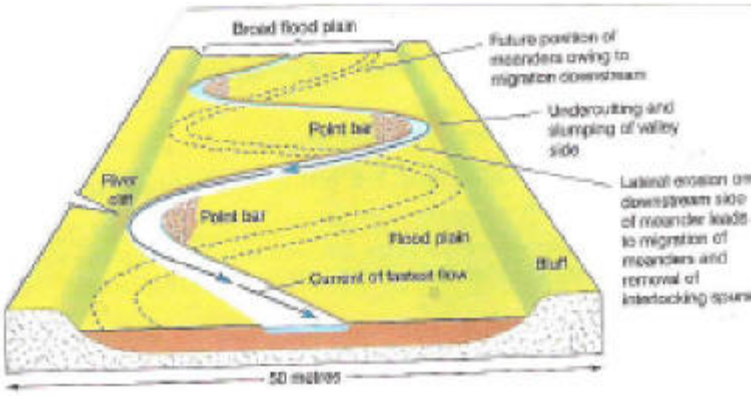
The long profile is a section along a river from its source to its mouth. The upper section is normally steep, whereas the lower section is usually flatter.

(Source: http://cgz.e2bn.net)

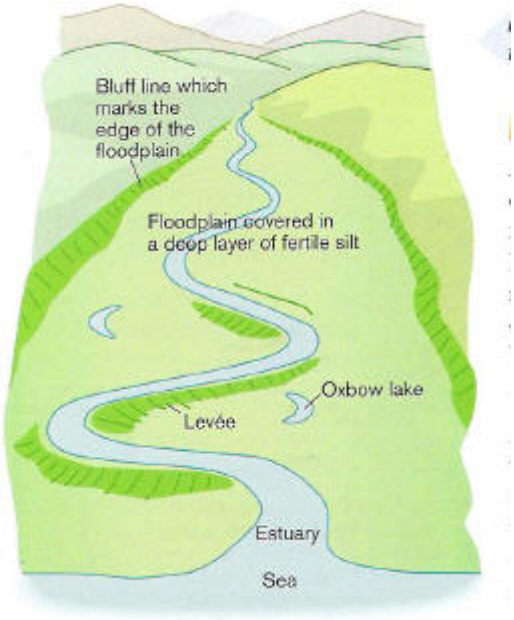


The UPPER course of a river is V-shaped. It has a steep gradient and the valley is relatively narrow. The river is often quite shallow and relatively fast flowing. There is lots of friction with the large boulders found on its bed and the river uses most of its energy to overcome friction.

- There is mainly vertical erosion
- Narrow valley
- Interlocking spurs
- V-shaped valley



In the MIDDLE Course the slopes are gentle. Lateral (sideways) erosion is beginning to form a flood plain. There is also a larger volume of water in the river due to tributaries. A larger river channel means there is less friction, so the water flows faster.



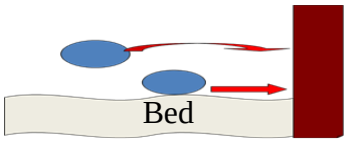
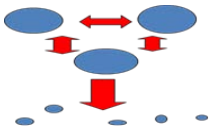
In the LOWER Course, the Valley sides are very gentle, almost flat. The river is now nearing the sea and deposition becomes the dominant process.

The main features of the river channel and river valley are:

- It is wide and deep with a more efficient shaped channel
- It is lined with sand and mud so this results in less friction
- The river carries a large load of alluvium
- There is a wide, flat flood plain either side of the river

How weathering, erosion, transport and deposition cause river landforms

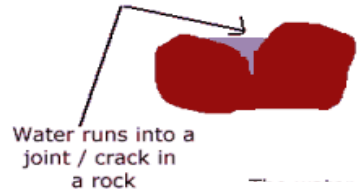
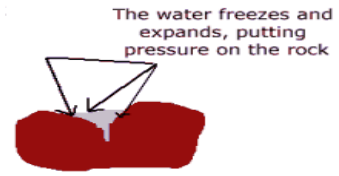
There are 4 main types of erosion:

Type of Erosion	Diagram	Explanation
Abrasion (or corasion)		This is when the river throws material against the channel
Attrition		This is caused when rocks and pebbles bump into each other and break into smaller pieces
Corrosion (or solution)		This is where salts and other acids in the salt water slowly dissolve away the coast
Hydraulic Pressure (or hydraulic action)		This is when air gets trapped in a crack in the river bank. The air gets compressed and expands, opening the crack

Rivers can erode:

- **Vertically** – erodes material from the river bed
- **Laterally** – erodes material from the river banks

Weathering is the breakdown of rocks *in situ*. The 4 main ways that rock is weathered are:

Freeze-Thaw Weathering		
		
Chemical Weathering		
Most rain contains a small amount of acid. When it falls on rock it slowly eats into it. It makes the rock rot and crumble away		
Onion-Skin Weathering		
The sun heats the rock and its outer layer expands. When it cools down at night it shrinks again. After this happens many times, the outside of the rock peels off like an onion.		
Biological Weathering		
A seed falls into a crack in a rock and it may start to grow. As the roots grow they force the crack to get wider. The rock breaks into pieces.		

Mass movements can occur once the rock on the valley sides is broken up. The fragments of rock can move in two main ways:

- Landslides (and mudflows) are relatively rapid movement of material.
- Soil creep is a slow process where slope material moves at about 2cm per year.

The shape of a river valley is affected by 3 things:

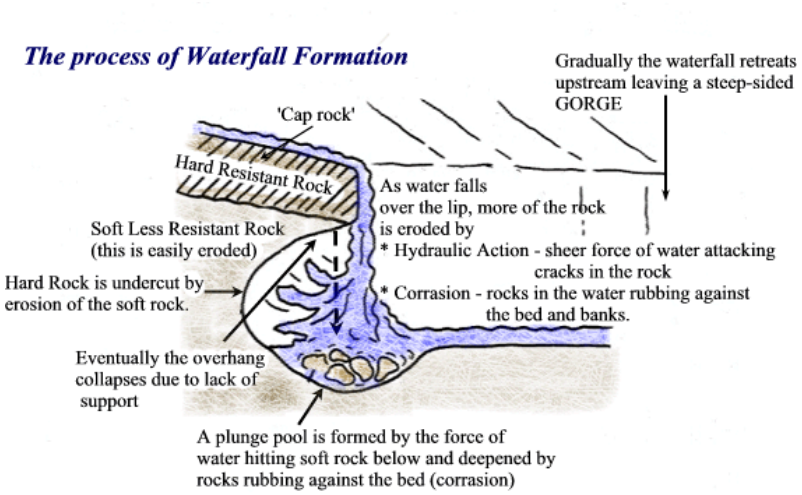
1. The speed of weathering
2. The speed of mass movements
3. How quickly the river can move material brought by mass movements

How to describe landforms of upper, mid and lower course rivers

Upper section of a river

Interlocking spurs

In the upper course steams are not strong enough to erode through the interlocking hills. Therefore they are forced to navigate around them

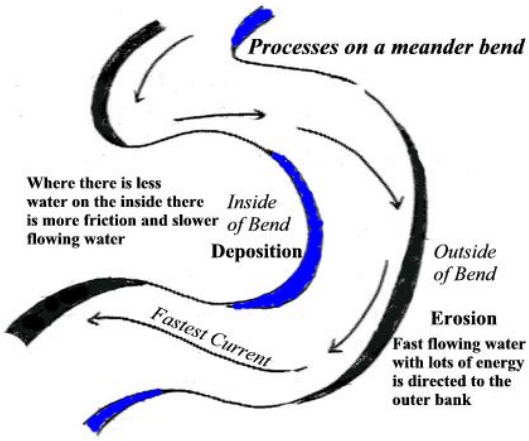


Waterfall Formation

Waterfalls frequently occur on horizontally bedded rocks. The soft rock is undercut by hydraulic action and abrasion. The weight of the water and the lack of support cause the waterfall to collapse and retreat. Over thousands of years the waterfall may retreat enough to form a gorge of recession. ***Gorges*** form through the retreat of waterfalls over thousands of years.

Mid section river landforms

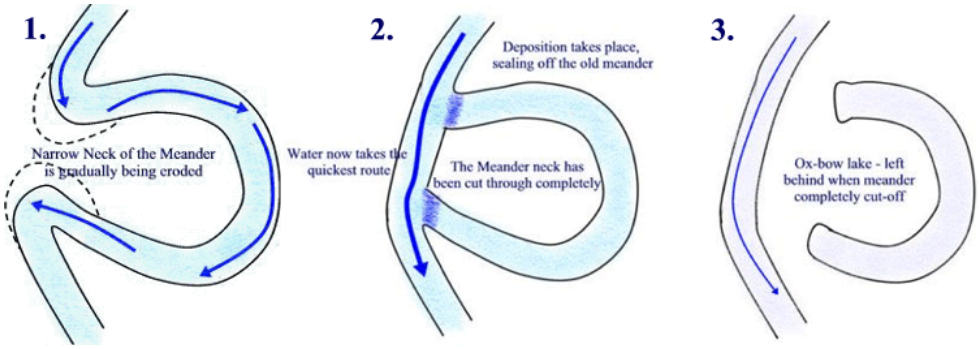
Meanders



1. **Water flows fastest on the outer bend** of the river where the **channel is deeper** and there is **less friction**. This is due to water being flung towards the outer bend as it flows around the meander; this **causes greater erosion** which deepens the channel, in turn the reduction in friction and increase in energy results in greater erosion. This results in undercutting of the river bank and the formation of a **steep sided river cliff**.

2. In contrast, **on the inner bend water is slow flowing**, due to it being a **low energy zone**, deposition occurs resulting in a **shallower channel**. This increased friction further reduces the velocity (thus further reducing energy), encouraging further deposition. Over time a small beach of material builds up on the inner bend; this is called a **slip-off slope**.

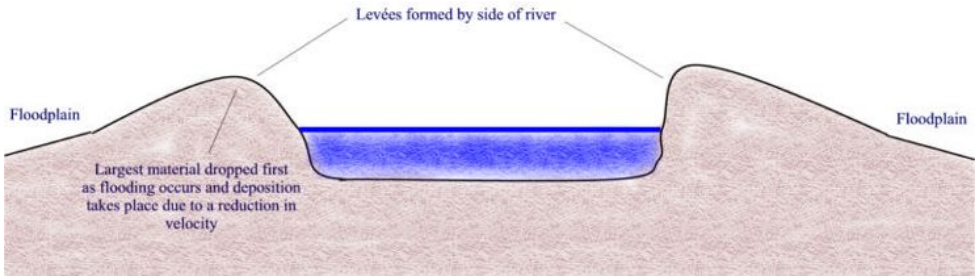
Ox-Bow Lake formation



1. As the outer banks of a meander continue to be eroded through processes such as hydraulic action the neck of the meander becomes narrow and narrower.
2. Eventually due to the narrowing of the neck, the two outer bends meet and the river cuts through the neck of the meander. The water now takes its shortest route rather than flowing around the bend.
3. Deposition gradually seals off the old meander bend forming a new straighter river channel.
4. Due to deposition the old meander bend is left isolated from the main channel as an ox-bow lake.

Lower section river landforms

When the river floods over the surrounding land it loses energy and deposition of its suspended load occurs. Regular flooding results in the building up of layers of nutrient rich alluvium which forms a flat and fertile floodplain.



When the river water bursts its bank, this results in the loss of energy and therefore deposition occurs. The heaviest materials are deposited first as these require the most energy to be transported and therefore build up around the sides of the river forming raised banks known as ***Levées.*** Finer material such as silt and fine clays continuing to flow further over the floodplain before they are deposited.

Delta

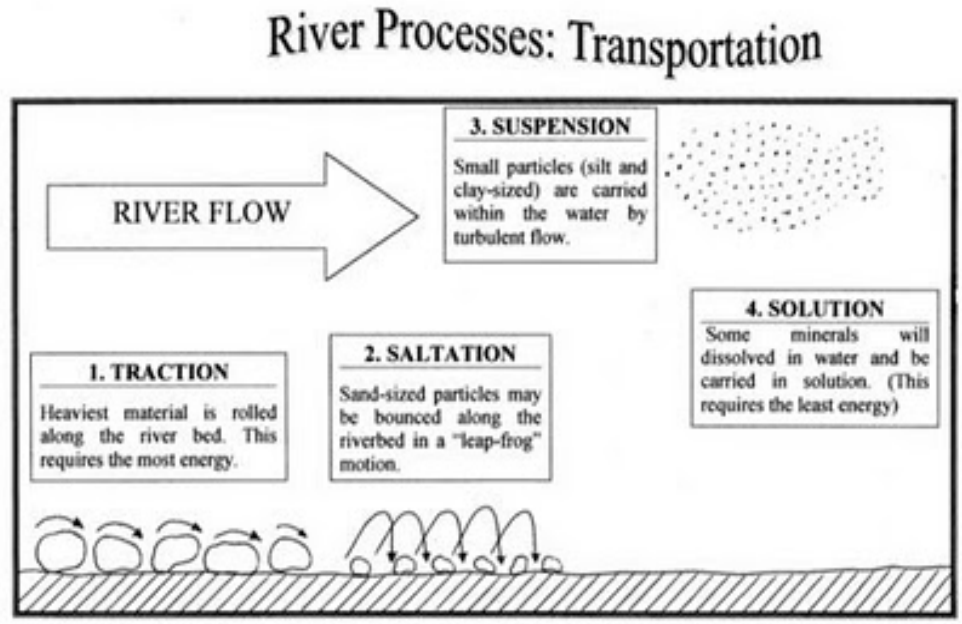
For deltas to be formed a river needs to:

- Carry a large volume of sediment
- Enter a still body of water

The coarser material is deposited first, and the finest material last, and furthest away.

How sediment changes as it is moved along a river

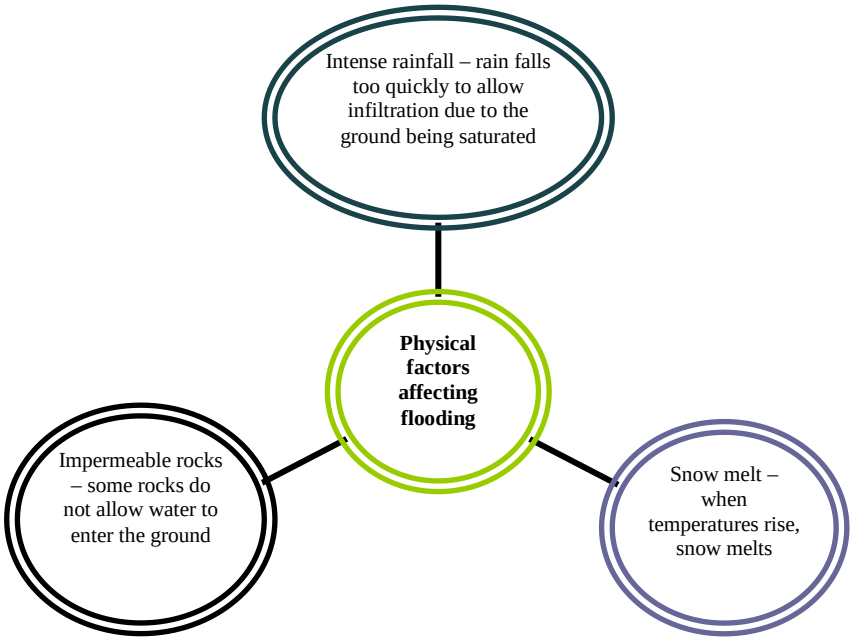
How much load a river can carry depends on the energy or power the river has.
Transportation is how the load is carried within the river

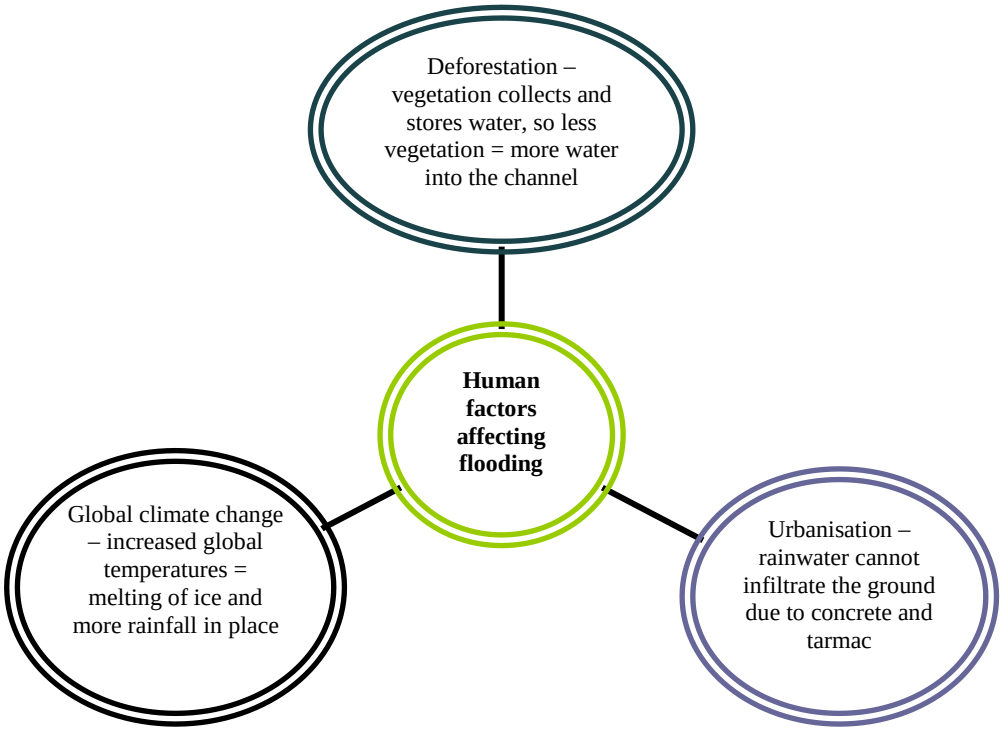


Deposition occurs when the river's load is too big to carry and it can create some interesting and unique features.

How flooding is caused

How human and physical factors increase flood risk

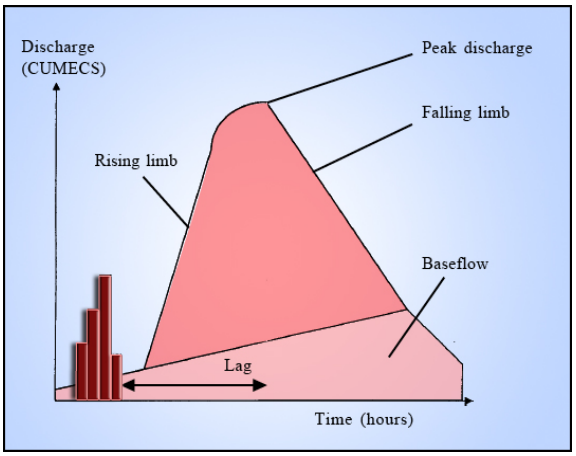




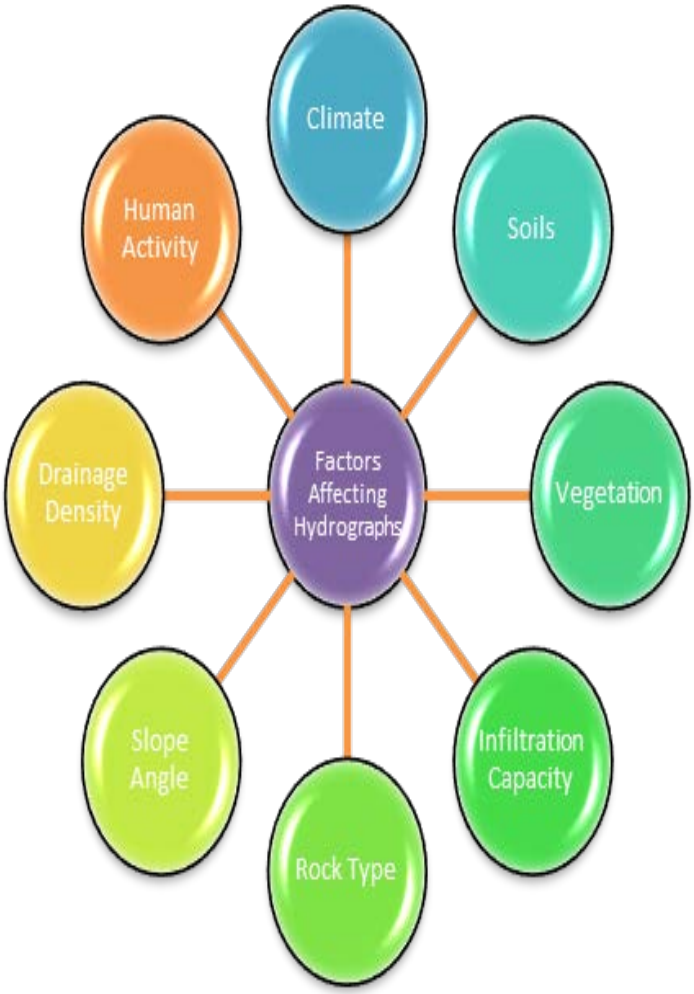
To describe and explain hydrological shape

A **river regime** is the annual variation in the flow of a river. In Britain, river flows are higher in winter because:

- higher rainfall
- lower temperatures and hence lower evapotranspiration
- less interception by deciduous vegetation



A storm hydrograph (or flood hydrograph) shows how a river changes in response to a storm or period of heavy rainfall.
The rising limb shows how quickly the flood waters begin to rise.
The peak flow is the maximum discharge of the river.
The lag time is the time between the height of the storm and the maximum flow in the river.
The recessional limb is the speed with which the water level in the river declines after the peak.
Baseflow is the normal level of the river, which is fed by groundwater.



The impacts of flooding in a named area

Named Case Study **LEDC FLOOD: Bangladesh floods 1998**

BANGLADESH FLOODS

CAUSES OF FLOODING IN BANGLADESH

Physical (Natural) causes of flooding in Bangladesh

1. Bangladesh is a very low lying country, with 70% of its land area being less than 1m above sea level and 80% of it being floodplain.
2. Bangladesh receives large amounts of water passing through it with two major rivers (the Ganges and Brahmaputra)
3. Bangladesh has a monsoon climate and the annual rains which result often result in the rivers exceeding their capacity and flooding;
4. In the spring, melting snow from the Himalayas further increases the flood risks as torrents of melt water enter the rivers at their source.

Human causes of flooding in Bangladesh

1. Increasing population pressure in the foothills has resulted in intense deforestation.
2. Deforestation is also believed to be responsible for the increased soil erosion which has led to large amount of silt being washed into the rivers, reducing its channel capacity and increasing the likelihood of flooding.
3. Increasing population pressure in Bangladesh itself has resulted in the sinking of many new wells resulting in the lowering of the water table
4. Bangladesh is an LEDC and its lack of money and heavy national debt means that little money is available to spend on flood protection methods / defences and many existing defences lack upkeep and are of questionable use.

EFFECTS OF FLOODING IN BANGLADESH

POSITIVE EFFECTS OF FLOODING

As well as providing water for crops, when flooding occurs, there is a loss of energy which results in the deposition of rich fertile soil resulting in the providing important nutrients enabling people to grow crops;

NEGATIVE EFFECTS OF FLOODING

- Over two thirds of the land area was covered by water and the capital, Dhaka, was 2m underwater.
- 30 million people were made homeless in the floods with many losing all their belongings.
- 1,070 people died – due to drowning in the flood waters, contamination of water by waste and dead bodies / animals, and the lack of a clean water supply resulted in the spread of disease such as cholera and typhoid.

- Food supplies were severely affected as flooding destroyed the rice stocks with a total of 668,529ha of crops being destroyed;
- Communications became difficult, with shopping impossible in the main port, as well as roads and railways having been swept away making the distribution of aid and the rescue operation very difficult;

FLOOD RELIEF / MANAGEMENT IN BANGLADESH

Following the 1998 floods a number of **short term flood relief measures** were put in place to try minimise loss of life - these included:

- international food aid programmes
- the distribution of free seed to farmers by the Bangladesh government to try and reduce the impact of food shortages
- volunteers / aid workers worked to try and repair flood damage

In the **long term** a number of flood prevention measure are possible:

- **the creation of embankments (artificial levees)** along the river to increase channel capacity and restrict flood waters - however since 1957, 7,500km of flood embankments have been constructed and yet many were breached in the 1998 floods;
- **constructing flood protection shelters** (large buildings raised above the ground) to shelter both people and animals
- **emergency flood warning systems and plans** made for organising rescue and relief services;
- providing **emergency medical stores in villages**
- **building flood proof storage sheds for grain and other food supplies**
- **Dam construction upstream and major embankments around Dhaka** have been suggested however lack of money has meant that these suggestions have not been taken further.

Named Case Study **MEDC FLOOD: Morpeth, 2008**

Location: Morpeth, market town in Northumberland, UK. On the banks of the River Wansbeck.
When: 6th September 2008, the River Wansbeck breached its banks. The narrow steep topography of the Wansbeck Valley and increased urbanization caused exaggerated surface run-off and a lag time of only 8 hours.

Causes:
~ River Wansbeck has tributaries in the uplands of rural Northumberland and flows through many small villages and towns along its course.
~ 150mm (6in) fell between Friday 5th and Saturday 6th October 2008
~ 24 hours of prolonged heavy rainfall filled river channels and saturated the catchment area
~ Highest ever peak discharge recorded by the Environmental Agency
~ Narrow steep drainage basin which encourages overland flow
~ 8 hour lag time
~ Confluence just north of Morpeth

Effects:
~ 2000 homes flooded
~ 1000 people evacuated
~ Major roadways in Durham and Northumberland were closed; with rural villages such as Powburn and Rothbury completely cut off and isolated.
~ Damage estimated to cost £10 million
~ Many homes and business are still unoccupied today

Response:
~ Fire crews using inflatable dingies ferried families to safety
~ Morpeth Lions coordinate a Flood Victims Appeal and collect donations from Newcastle to Alnwick.
~ Immediate needs were addressed by the Red Cross
~ Red Cross fire and emergency support vehicles are stations in streets as a focal point for information.
~ Local Authorities help with the clean up and re-house residents in social housing

How hard engineering schemes might prevent flooding

	Advantages	Disadvantages
Embankments (Levees) 	Stop water from spreading into areas such as housing. They can be made of earth so blend into the environment	Floodwater can go over the top and they can burst under pressure
Channelisation	This allows more water to run through the channel more quickly	More water is taken downstream where it could put another place at risk. Unnatural
Dams 	Water is held back during times of heavy rain or snow-melt. Can be used to supply HEP	Can be an eyesore and are very expensive. If they burst they cause wide scale damage
Flood relief channels 	Can accommodate extra water from the river so that it doesn't overflow	An eyesore and costs can be high

How integrated approaches might reduce flood risk

This involves looking at all aspects of the river – at both physical and human geography. This ensures that the response will be more sustainable and provide solutions that do not damage the environment. They mostly focus on soft engineering which is more environmentally friendly.

	Advantages	Disadvantages
Washlands – areas on a flood plain that are allowed to flood	Gives a safe place for the floodwater to go. Inexpensive and natural	Flood plain cannot be used for other things
Afforestation – trees are planted in the drainage basin	Trees intercept the water and thus reduce the amount entering the river. Attractive	Land cannot be used for activities such as farming
Land use zoning – governments allocate areas to different uses according to their flood risk	Major building projects are placed in areas of low risk.	They may not be the best place for different activities in terms of public accessibility
Flood warning systems – rivers are carefully watched and places are warned downstream	People living in towns have the chance to evacuate	Sometimes it is not possible to give a warning due to flash floods, very expensive outcomes.

How to evaluate different types of flood management schemes

	Hard engineering in York	Soft engineering in Skerne
Cost	Expensive	Cheap response
Environmental impact	Raised embankments create visual pollution and upsets the natural flow of the river	River restored to natural meandering state – wetlands created and over 20,000 trees planted.
Degree of success at stopping floods	Despite the banks around the River Ings being raised and sluice controls put in place, in 2000 the river burst causing £1.3m in damage	Return to natural state of the river allows it to flood naturally and thus reduce impact on towns in the area
Impact on wildlife	No benefit	Wildlife in the area has increased e.g. dragonfly
Other factors	Have moved towards 'Aquabarriers' which allow water to drain away out the holes and are much cheaper	Environmentally friendly

OPTIONAL UNIT 7: OCEANS ON THE EDGE

What do I need to know?

☐ What different types of marine ecosystems are there and where are they located?

☐ The distribution of marine ecosystems globally

☐ How humans use mangrove swamps for resources

☐ Which human activities, like overfishing, are degrading marine ecosystems

☐ What nutrient cycles and food webs are

☐ How humans can damage marine food webs and nutrient cycles

☐ How climate change might damage marine ecosystems

☐ That marine resources are under increasing pressure and how this pressure affects ecosystems locally, such as the Firth of Clyde

☐ Why, locally, people's views on their ecosystems can lead to conflict

☐ What sustainable management means

☐ How sustainable management can protect ecosystems like the Firth of Clyde and Coral Triangle

☐ How global actions such as CITIES and the IWC can help improve global sustainability

Key terms:

Aquaculture	Commercial fish farming
Biodiversity	The number and variety of living species found in a specific area
Bleaching	Degradation of coral reefs under conditions of increased acidity in sea water
Climate Change	Long-term changes in temperature and precipitation
Continental Shelf	The submerged edge of a continental land mass
Coral Reef	A hard stony ridge, just above or below the surface of the sea. Formed by the external skeletons of millions of tiny creatures called polyps
El Nino	Usually occurs in the Pacific Ocean every 3 to 7 years. Unusually warm ocean conditions off the western coasts of Peru cause climatic disturbances
Estuaries	A river mouth that is wide and experiences tidal conditions
Eutrophication	The loss of oxygen in water after too much nutrient enrichment has taken place
Extinction	The permanent loss of something, generally used with reference to species of plants or animals
Food web	An illustration of the grouping of animals and plants found in an ecosystem, showing the sources of food for each organisms
Habitat	An animal or plant's natural home
Mangrove Swamp	A tidal swamp dominated by mangrove trees and shrubs that can survive in the salty and muddy conditions found along tropical coastlines
Marine ecosystems	A web of organisms that live in the ocean or a part of an ocean
Nutrient cycling	A set of processes whereby organisms extract minerals necessary for growth from soil or water, before passing them on through the food chain and ultimately back to the soil and water
Overfishing	Taking too many fish from the water before they have had chance to reproduce and replenish the stocks for the next generation
Pollution	The presence of harmful substances which can have poisonous effects on the environment
Run-off	Water that flows directly over the land towards rivers or the sea after heavy rainfall

What different types of marine ecosystems are there and where are they located ?

Ecosystem

- An ecosystem describes a group of plants and animals that are linked with its local physical environment

Marine ecosystem

- The web of organisms that live in the ocean or part of an ocean

Biodiversity

- The number and variety of living species found in a specific area

There are 2 main types of marine ecosystems:

1) Coral Reefs
2) Mangroves

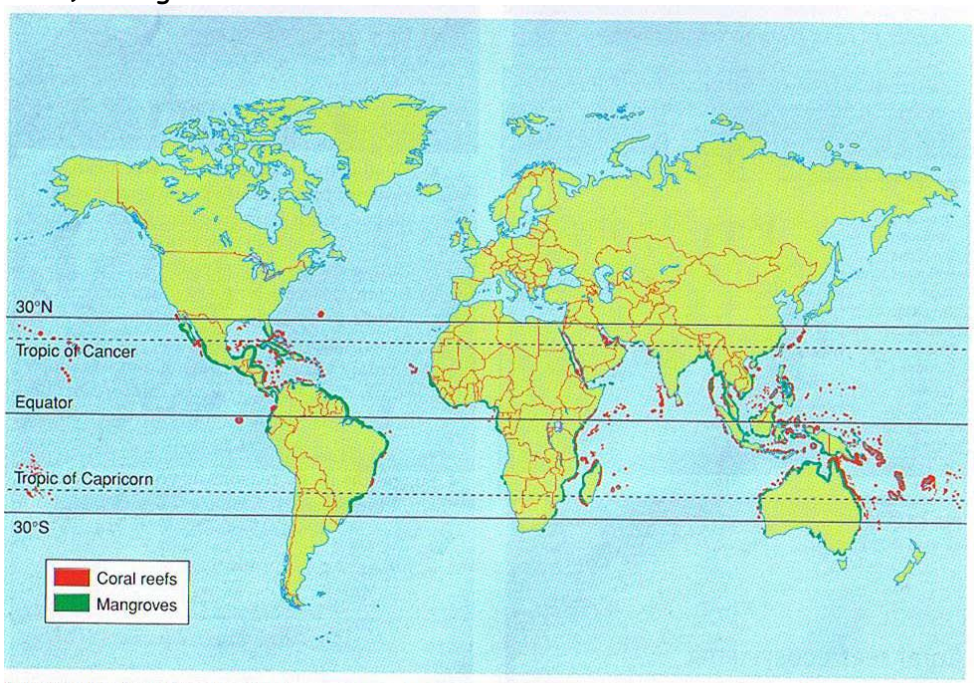
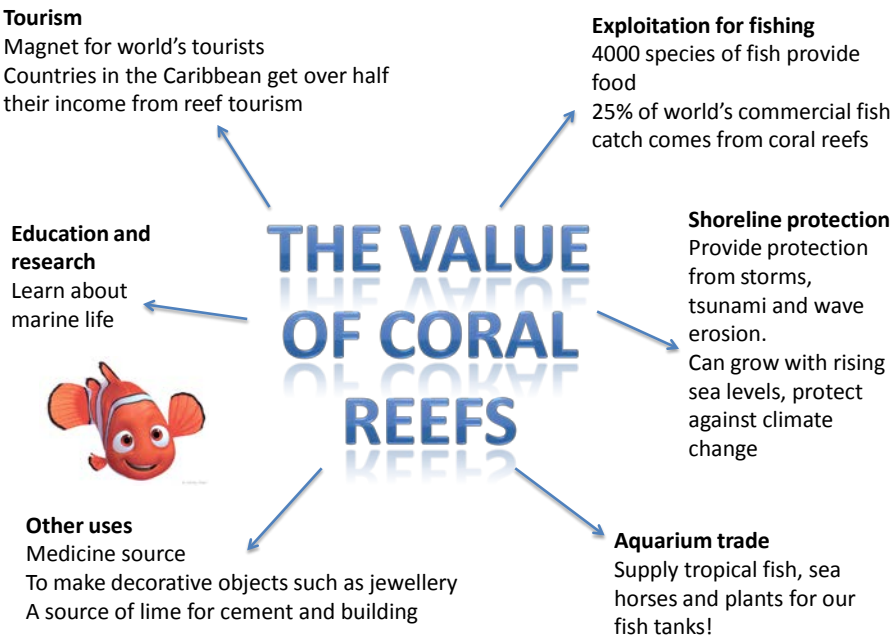


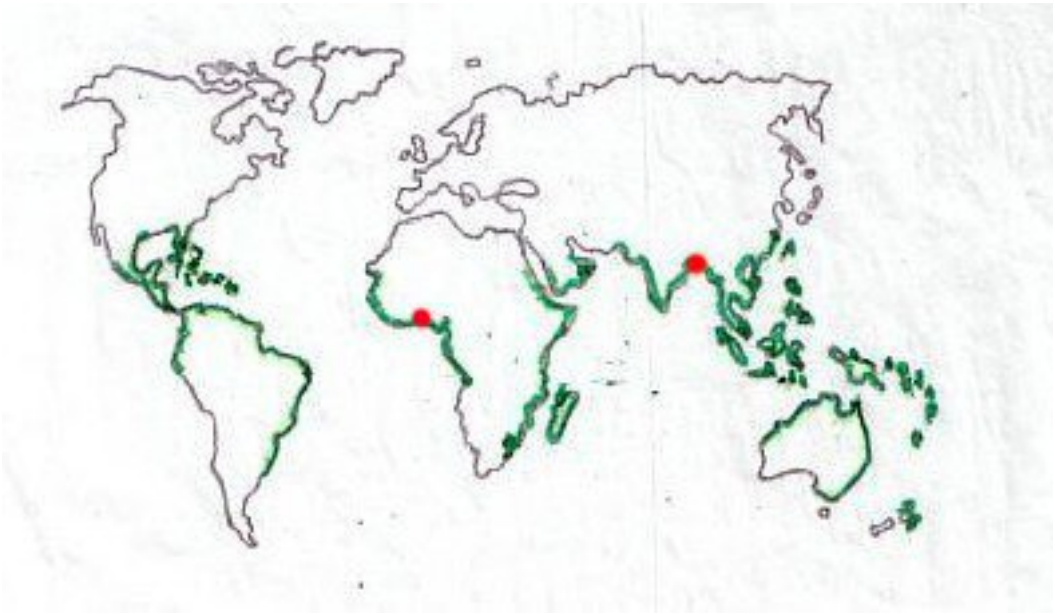
Figure 8.3 The distribution of coral reef ecosystems and mangroves.

Coral reefs cover less than 1% of the earth's surface and are located in areas with:

- Shallow water of 25m or less to ensure lots of light
- Tropical water temperature of 24-26°c
- Areas of saline water



Mangroves



Mangroves are swampy areas found in estuaries and long marine shorelines
- tolerate daily tidal flooding and high salinity (salt)

How humans use mangrove swamps for resources

Habitats
Mangroves are home to many animals who use them as a nursery for their young e.g. crocodiles, snakes, tigers, dolphins and birds

Exploitation for fishing
Prawns found here are in huge global demand (worth £30 billion per year)
Mangroves often removed and replaced with prawn aquaculture to increase yield

THE VALUE OF MANGROVES

Carbon store
Carbon dioxide is stored over the centuries in the rich mud beneath the swap – this is released once they are removed

Shoreline protection
Provides protection against tsunamis – the 2004 Asian tsunami showed that where mangroves still existed they protected people and property

Which human activities, like overfishing, are degrading marine ecosystems?

Named Example: Human impacts on coral reefs

There are a variety of ways in which human's impact upon coral reefs

1) Population growth – most coral reefs are located in developing countries with populations growing at 3% per year. People also migrate to these areas for jobs in tourism or fishing
2) Land development – building work disrupts the land and causes soil erosion → soil is washed into the sea with clouds the water → less sunlight able to reach the coral
3) Pollution from cars and industry e.g. oil
4) Coral mining for sand and lime for urban development as coral is often the only local building material
5) Blast fishing using dynamite or trawling reefs all cause damage
6) Overfishing of fish disrupts the food webs of the coral reefs
7) Tourism:
   - Demand for reef jewellery

- Damage from boat anchors
- Recreational fishing by tourists
- Trampling by snorkelers and divers breaks the coral
- Problems caused by feeding fish
- Extraction of fresh water for use at hotels
- Sewage and other pollutants come from hotels

8) Global warming will cause bleaching of the coral as rising temperatures causes coral stress and the algae that live in them are expelled

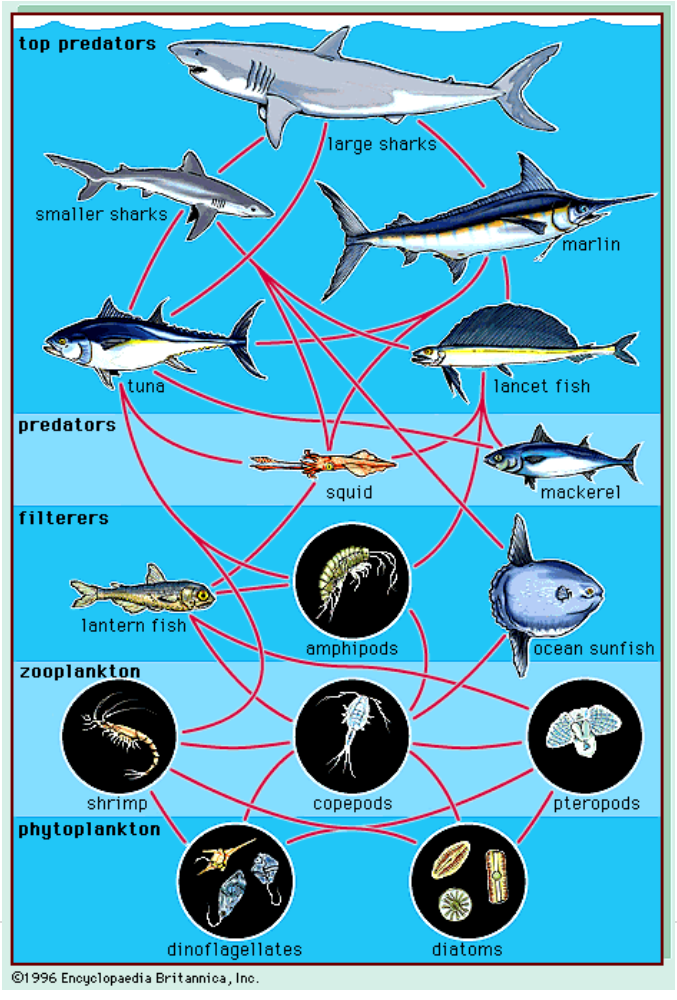
However it is important to note that natural factors are also causing the destruction of coral reefs:

1) Local warming of the oceans due to **El Nino** has the same effects as global warming
2) Hurricanes produce huge waves and heavy rainfall which increases siltation. Waves also cause damage to the actual reef

What nutrient cycles and food webs are?

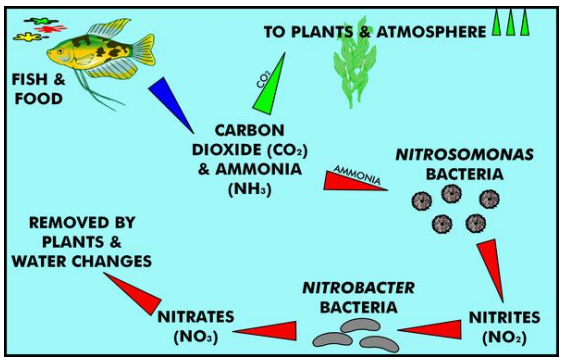
Ecosystems are made up of different animal and plant populations, all whom are dependent on one another in some way.

A food web is the relationships and natural balance between animals and plants within a particular ecosystem



This means that there are a relatively low number of top carnivores such as large sharks compared with the number of fish they feed on. This is because sharks use high levels of energy when chasing their prey so must eat large numbers of tuna for example to stay healthy

Nutrient cycles – describes the movement and re-use of important substances such as nitrogen within an ecosystem e.g. fish take in nitrates when they eat plants



How humans can damage marine food webs and nutrient cycles

Food web disruption:

- Overfishing interferes in the natural balance of ocean animal populations e.g. excessive hunting of a particular species e.g. tuna triggers a series of impacts:
- Humans directly reduce the number of tuna → impacts indirectly upon sharks as they cannot find enough tuna to feed on → decrease in the number of sharks → increase in organisms lower down in the food chain e.g. mackerel as tuna are no longer feeding on them

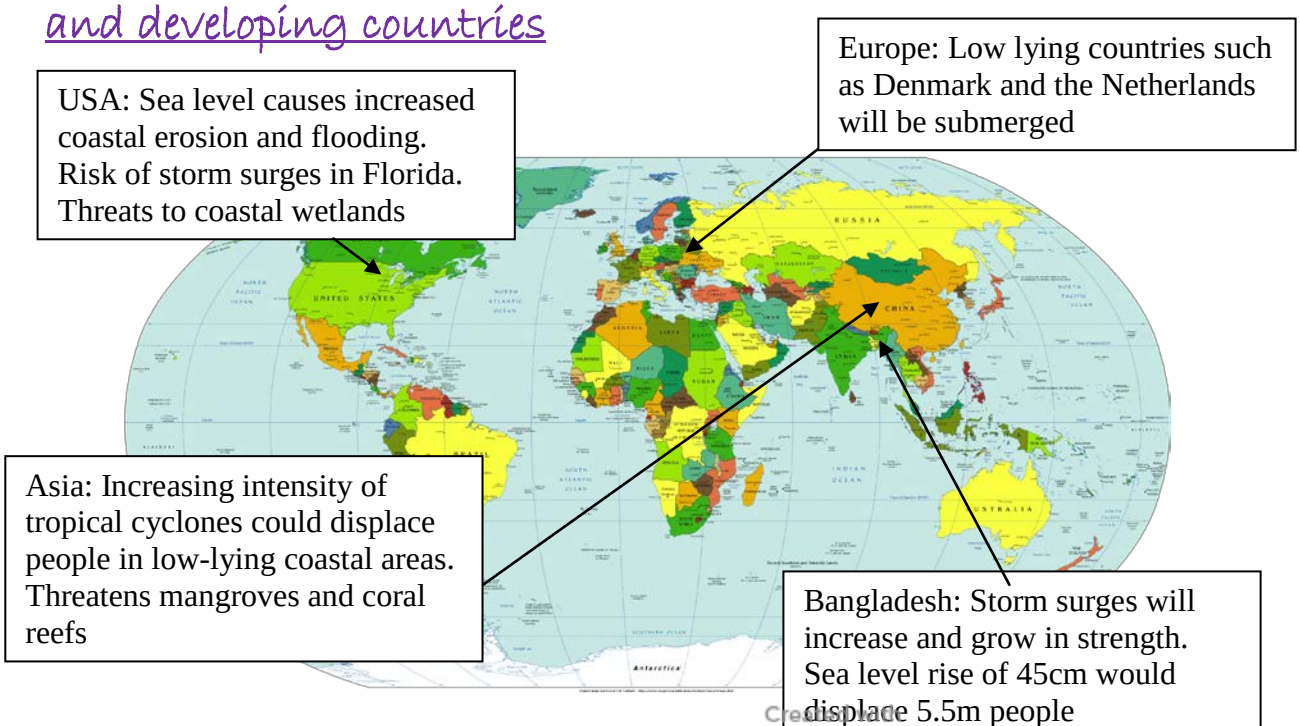
Nutrient cycle disruption:

- Excessive amounts of nutrients are added to a body of water e.g. fertilisers get carried by rain run-off from farmland into rivers (Eutrophication) → the nutrient rich waters cause an explosion of marine life known as algal bloom → the presence of so much algae uses up most of the water's oxygen → fish suffocate in the water

How climate change might damage marine ecosystems

Direct impacts	Indirect Impacts
• Increases in temperature → coral ecosystems become vulnerable to bleaching • Extreme weather events such as storms and flooding → damage ocean ecosystems by increasing pollution and siltation • Increases in temperatures → glaciers melt → increase in freshwater into the oceans → sea becomes less salty and less dense → impact on the sea currents which distribute heat • Higher sea levels → mangrove swamps/ salt marshes could be submerged • Coral reef islands such as Maldives would be completely submerged • Low-lying countries such an Netherlands would disappear • Increasing sea levels → higher rates of coastal erosion	• Warmer water temperatures cause oceans to expand → combined with melting glaciers → sea level rise of between 20cm and 1 metre

Named Examples: Impact of climate change on developed and developing countries



Marine resources are under increasing pressure and how this pressure affects ecosystems locally

*****Named Case Study: Firth of Clyde******

Location: 60km stretch of sea water along Scotland's West Coast

Threats facing the ecosystem:

1) Fishing
   - Important source of local income due to the Gulf Stream have made commercial fish sizes very high
   - Overfishing of species like cod have caused the numbers to crash
2) Tourism
   - Falling incomes from fishing and farming have led to local businesses to try and make more of tourism and leisure along the coastline
   - Now the 2nd largest yachting centre which disturb wildlife
3) Sewage disposal
   - In the past on-land sewage treatments were limited so waste from toilets flowed straight into the sea. Now less of a problem
4) Military Testing
   - Perfect testing ground for the Royal Navy's nuclear submarines. A serious accident would have terrible effects on the ecosystem

Why, locally, people's views on their ecosystems can lead to conflict

- Many outsiders have moved to places bordering the sea to enjoy the views and these people want to see the water treated well and would like it free from exploitation.
- However, local fishermen rely on the Firth of Clyde for their livelihood and see laws like the no-fish zone in Lamlash Bay
- IMPORTANT: the COAST aims provide conflict in themselves!
- Government aims such as 31% electricity from renewable sources by 2011 means off-shore wind resources can be exploited but could interfere with navigation for ships and ruin the look of the local landscapes

Management:

- Local divers formed a group called COAST (Community of Arran Seabed Trust) which campaigned for a no-take zone to be established in Lamlash Bay. It aimed to:
  - improve the marine environment and reverse fish decline
  - Sustain the livelihoods of people dependent on tourism, as well as fishing
  - Increase the popularity of the area as a tourist and diving destination
- 2008 the Scottish Government made part of Lamlash Bay a no-take zone, the rest of the bay is a management area where scallops can be fished but only in less destructive ways
- Will soon be designated a Coastal and Marine Park (CMP) to ensure that coastal and marine-based activities are managed in a sustainable way to bring long term economic benefits to people, whilst protecting the environment
- Scottish Marine Bill – new set of laws to help manage future conflicts in Scottish waters

What sustainable management means

Sustainable Management is a balancing act between ecosystem conservation and helping local people to make a living without overharvesting resources

This involves:

- ✓ Using fishing equipment which doesn't harm habitats such as coral reefs
- ✓ Using marine resources at a rate that won't destroy them for future generations
- ✓ Allowing poor people to use resources of subsistence activities
- ✓ Local people to be involved to decide how fishing and other uses should be managed

How sustainable management can protect ecosystems

Named Case Study: Local scale: Shetland Islands Aquaculture

Reasons for problems:

1) Increased longlining – ships can now lay 150km length of baited hooks on the seabed
2) Sonar – now used to detect shoals of fish that might otherwise have been missed
3) Factory ships – now have freezers allowing them to stay out at sea for longer

Solution: Aquaculture

Intensively farmed salmon and cod are now raised in closed enclosure along the northern European coastlines. Shetland Aquaculture – an association established in 1984 provides alternative to traditional unsustainable fishing methods.

- 1200 residents of the Shetland Islands now work in the aquaculture sector
- Production expanded from 50 tonnes in 1984 to more than 50,000 tonnes today
- Now introduced more varieties of fish e.g. trout, mussels
- Own hatchery and supplies both fish and eggs to help commercial firms to become established
- Around ½ of fish eaten in the UK is farmed in Shetland Islands
- Outbreaks of disease are common among caged fish in cramped conditions
- 100,000's of salmon escape from farms each year threatening wild populations

***Named Case Study: Regional scale: North Sea Fishing ***

The EU Common Fisheries Policy has tried to bring fish stocks back from dangerously low levels. Every year the EU reviews its fisheries policy and there are huge conflicts between fishermen who want a large quota and marine scientists who argue that no fishing reserves need to be created. These are very expensive and you have to compensate the fishermen, so you pay them not to fish!

Needs a whole ecosystem approach:

- Ensuring mesh of the nets allows young undersized fish to escape
- Limiting the hours and days fishing boats can operate
- Quota management – limit placed on the number of tonnes of fish from each species that can be caught
- Discard management – fewer unwanted fish are discarded
- Setting up marine reserves which protect all species
- Further research into how fishing affects the whole ecosystem

How global actions can help improve global sustainability

****Named Case Study: Global Solution – CITES ****

The Convention of International Trade in Endangered Species of Wild Fauna and Flora gives global protection to all of the great whales as many species of whales were hunted almost to extinction during the 205th century. CITES also helped protect other species such as sturgeon fish whose eggs were used to make caviar.

Problems:

- ☒ Japan has a long history of defying international whaling laws and continues to kill them
- ☒ Norway objected to plans for the South Pacific to be made into a whale sanctuary

****Named Case Study: Global Solution – Law of the Sea ****

Was developed to prevent certain nations from taking an unfair share of the ocean's wealth. Treaty was established in 1994 and 40% of the ocean was placed under the law of adjacent coastal states. It also addresses issues so as:

- ✓ Fisheries
- ✓ Navigation
- ✓ Continental shelves
- ✓ The deep sea
- ✓ Scientific research
- ✓ Pollution of the marine environment

OPTIONAL UNIT 8: EXTREME CLIMATES

What do I need to know?

- ☐ What is meant by an extreme climate
- ☐ Facts and figures for your chosen climate
- ☐ Where your extreme climate can be found
- ☐ How plants and animals have adapted to live there
- ☐ How people adapt and cope with life in an extreme climate
- ☐ The value and uniqueness of the people who live there
- ☐ How climate change could alter your extreme climate zone
- ☐ How your climate zone could be affected by other threats
- ☐ How local people are adapting to the threats they face
- ☐ How global actions might protect extreme environments

Key terms:

Adaptation	Changes that take place to react to a situation or condition
Carrying Capacity	The maximum number of people that can be supported by the resource and technology of a given area
Cultural dilution	Where a particular culture is changed and weakened, usually be exposure to other competing cultures
Desertification	
Exploitation	Making full use of something (often implying that the use is unfair and has negative impact)
Extreme Climate	A climate that is unusually challenging, usually in terms of its temperature conditions or type and extent of precipitation
Fauna	Animals
Flora	Plants
Glacial region	An area that is covered in ice
Hot arid regions	Parts of the world that have a high temperature and very low precipitation
Intermediate technology	A technology that local people are able to use relatively easily and without much cost
Land degradation	The declining quality and quantity of land, generally because of human action
Latitude	The position of a place north or south of the equator
Nomadic pastoralism	A type of farming where farmers have no permanent land and migrate with their cattle etc. from one place to another
Permafrost	Permanently frozen ground, found in polar regions
Polar Region	Relating to the north or south pole
Pollution	The presence of chemicals, noise, dirt or other substances that have harmful or poisonous effects on the environment
Solifluction	The movement downhill of soggy soil when the ground layer beneath is frozen
Temperate Climate	A climate that is not extreme
Tundra	The flat, treeless artic regions of Europe, Asia and north America, where the ground is permanently frozen

What is meant by an extreme climate

There are areas where it is extremely cold (polar) or extremely hot and dry (hot arid). Places with extreme climates climate the ability for flora and fauna to survive and therefore they have a low carrying capacity.

Facts and figures for your chosen climate: Deserts

These are areas that receive less than 250mm of rainfall each year. Arid regions are known as deserts and include Sahara, Australian and Kalahari deserts.

- The biggest desert is the Sahara at 9 million km2.
- In the Australian outback the summertime temperatures +40 degrees
- After Antarctica, Australia is the world's driest continent

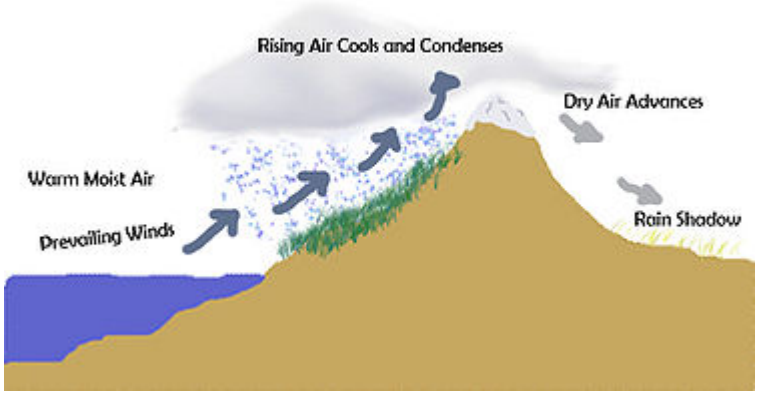
On the edges of deserts are semi-arid areas called drylands e.g. the Sahel.

Where your extreme climate can be found

Many hot deserts lie in the subtropical zones. The Sahara Desert is the World's largest desert and covers 3.5 million square miles (9 million square kilometers), making it larger than the whole Australian continent. Temperatures during the day can soar over 100° F (38° C), but drop below freezing at night. Another hot desert can be found in the Namib Desert in southern Africa.

NAMED EXAMPLE: Bourke, New south wales, Australia

Why is most of Australia desert?

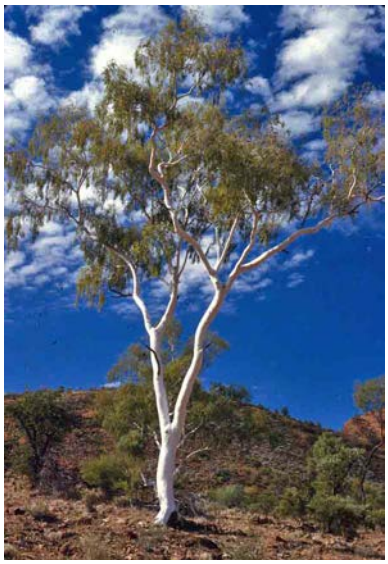


PACIFIC Great Dividing Range

- The mountains that border the coast = a rain shadow effect.
- The further west the winds blow the drier they become. Western Australia = the driest.

How plants and animals have adapted to live there

PLANTS…



SUCCULENCE → plants store water in fleshy leaves, stems and roots.

- Water is captured and stored
- They quickly absorb water through their long roots and store it for long periods.
- Waxy stems and leaves make them waterproof.
- Metabolism slows during times of drought. Growth stops.
- Spikes/toxic/camouflage → protect them against animals wanting to eat them.

DROUGHT TOLERANCE

- During drought they shed their leaves
- Become dormant (asleep)
- Deep roots to get to underground water

DROUGHT AVOIDANCE

- Most of these survive one season, rapid life cycle and die after seeding.
- Seeds last years and only germinate when soil moisture is high.

AMIMALS...

THE BILBY – small mammal with a pouch.

- Nocturnal → shelters from the heat to avoid dehydration
- Burrows for moister, cooler conditions
- Obtains enough moisture from food → bulbs, insects etc.

THE PERENTE – Lizard

- Digs burrows
- Hibernates May-Aug to avoid cold
- Low moisture needs

RED KANGAROO

- Hops (fast, energy efficient travel)
- Feeds at dawn and dusk – air is cooler
- Sleeps during the heat of the day
- Dew = water intake
- Rain triggers hormones so breeding only occurs during rains

How people adapt and cope with life in an extreme climate

- The problem is making a living. The soil is poor. There is little grazing. In the Outback the farms are therefore very large.
- Recent droughts = pressure on the landscape. The grass soon starts to die. With no roots to bind the soil together it erodes.
- Underground water stores are overused and the water tables are falling

Managing Water Supplies...

- Farmers have dams and reservoirs to store water for cattle and sheep to drink.
- Boreholes used to tap underground water (aquifers beneath the ground are rocks that store water).
- Most people don't farm, they work in the mines.
- They need a lot of energy to run air conditioning needed to make life more bearable.

NAMED EXAMPLE: PRAIRIE HOTEL, PARACHILNA

- 1 Metre below the ground – cooled by the surrounding rocks.
- Solar panels for electricity → lights and fans
- Kitchen and bathroom water is recycled and used to water the gardens

The value and uniqueness of the people who live there

THE ABORIGINES…

- Life expectancy of 52 instead of 78 for white Australians
- Worst drug and alcohol abuse
- Homelessness = a problem
- Traditional lifestyle disappearing

FOOD:

FRUIT = Bush tomatoes, desert limes, native peaches, bush bananas.
SEEDS: Wattle seeds, sandalwood nuts
GRUBS: witchetty grubs
MEAT: Wild animals e.g. crocodile, kangaroo

BELIEFS AND LIFESTYLE – The land is sacred and to be protected.

- Hunting and gathering
- Create conditions for grubs
- Dam rivers to catch fish
- Use fire to drive animals out so they can be hunted
- Craft based on hunting (boomerangs) or music (didgeridoos)
- Customs and stories never written down

THREATS TO ABORIGINAL CULTURE

- Ayers rock is a sacred site for the Aborigines. It is also the most visited spot in Australia.

NAMED EXAMPLE: Uluru

World Heritage Site

- Aboriginal paintings etc.
- The number of visitors increases rapidly. 60% are from overseas.

What problems do tourists bring?

- Aboriginal culture exploited for entertainment
- People come for the experience – climb the rock etc. rather than to learn about the Aborigines.
- Aborigines have no part in management of the tourist resort
- Tour guides ignore 'awkward' aboriginal history e.g. children taken forcibly from their parents until the '70s.

→ a new Aboriginal culture centre → educates people about aboriginal peoples
→ charges an admission fee which then goes to the community
→ creates jobs
→ tourists do not climb Ayers rock (as it is sacred)

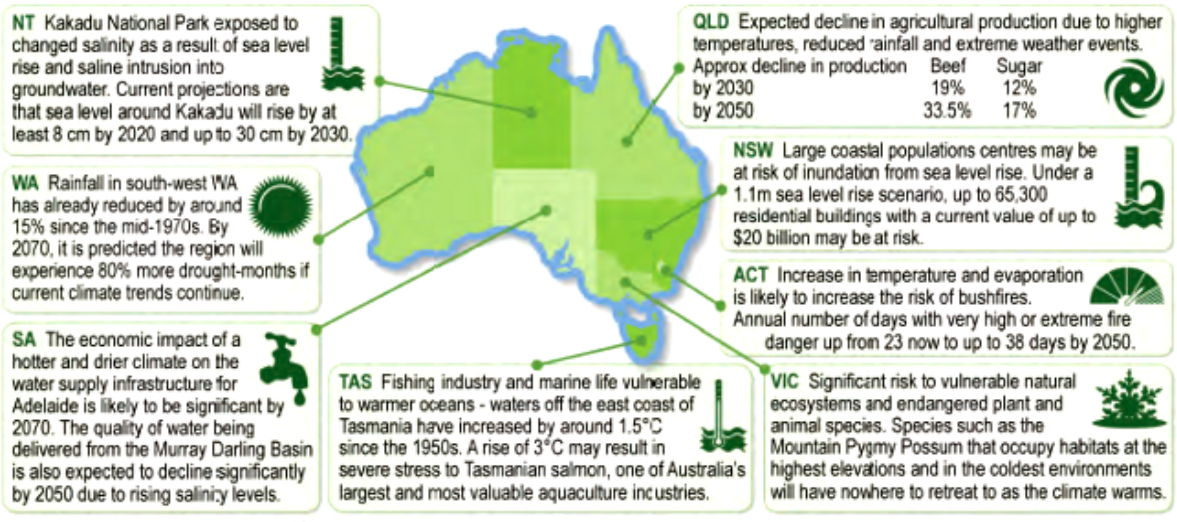
How climate change could alter your extreme climate zone

Global temperatures are rising. If outback temperatures rise it would make it very difficult to live in.

→ more frequent droughts
→ more evaporation
→ more bushfires

It is estimated that rainfall will fall in Southern Australia, especially the southwest. The southern desert boundary will move 100-200km.

Most of central Australia has less than 25 'rain days' a year.



http://www.cleanenergyfuture.gov.au

How your climate zone could be affected by other threats

The threat of El Nino (the reversal of normal air currents across Australia which brings drought to Australia every 5-7 years)

- Every 5-7 years instead of winds bringing rain from the Pacific, El Nino reverses everything. The winds blow W→E and by the time the winds reach the east = dry = drought. Most severe droughts are linked to El Nino.

The impacts of 2006/7 drought (short term):

- Severe water shortages Queensland
- More dust storms and bush fires for New South Wales
- Farmers New South Wales lose 80% income
- Melbourne and Sydney = water restrictions
- Crops failed in Western Australia

The impacts of climate change (long term):

- Farms abandoned and rural communities destroyed
- Landscape change – native plants e.g. eucalyptus die
- Rainfall decresed20-40% by 2070
- In 2002 drought reduces exports $1 billion (Australian dollars)
- 14% bird species and 25% mammals could be extinct by 2100.

How local people are adapting to the threats they face

NAMED EXAMPLE: the Sahel

- One of the poorest regions of the world
- 50 years of rapid population growth, deforestation, overgrazing and drought → barren land.
- Soil is poor and water scarce
- Trees usually protect the soil from wind. They are disappearing as they are cut for fuel wood.
- Grassland is under pressure – grazing too many cattle. Farmers have to grow food for more people so = +intensive → squeeze all they can out of the soil.
- Rainfall varies greatly year to year = major cause of poverty in the Sahel
- If the rains don't come, the grass dies and exposes the soil to be blown away by the wind.
- When the rains do come, heavy rain erodes and washes away the soil.

NAMED EXAMPLE: siguin vousse, Burkina faso, Africa, sahel

- Badly affected by drought
- Deforestation and over use of the land → unable to grow enough food to feed themselves. No trees to bind the soil together so when it rained the soil was washed away.

→ in 1979 Oxfam project → prevent further soil erosion, preserve as much rainfall as possible.

→ farmers encouraged to build diguettes – a line of stones across the land. Slows rainwater and lets it soak in. trap soil and decrease soil erosion.

- The diguettes were a success. Almost everyone in the village had improved crop yields.
- Families now feed themselves
- 1 bag of groundnuts has become 2 bags
- It's an example of intermediate technology – little know how needed. Materials found locally. Labour free. Cheap solution.

How global actions might protect extreme environments

How GLOBAL ACTION can protect Africa's dry lands from climate change

Africa is most vulnerable, even though only 4% CO2 is from there.

- Many parts are becoming drier. Africa depends on rain for farming.
- Food emergencies x3 in 20 years
- Climate change could decrease African crop yields by 10%
- In Africa 70% population are farmers
- Farming = 40% GDP

How should Africa deal with this?

- Global agreements to **mitigate** (decrease) climate change by decreasing emissions of CO2.
- Charities e.g. Oxfam help Africa to **adapt** to climate change.

Adapting to drought…
Charities and Non Governmental Organisations (NGO's) are working with communities in Africa.

NAMED EXAMPLE: Oxfam working in zambia- the evangelical fellowship of zambia (efz)

- To help people adapt to drought
- Trains them to use conservation farming → traps moisture, improves soil quality, minimises soil erosion and resists drought.
- Crop yields increase x10
- Multi-cropping → plant several species instead of just one. – only requires moderate but constant farm work. Suits HIV+ as otherwise too weak.

Conservation farming…

- Plough only where you plant instead of all of the land → less soil erosion and moisture only evaporates from the parts that have been dug.
- Spread the planting over a year instead of all at once.
- Several crops mixed together. All land used – none wasted between rows of crops. If one crop fails there are others so no one starves.
- Work spread over the year
- Prices remain stable

The Kyoto Summit

- In 1997 to cut greenhouse gases by 5.2% by 2012
- 141 countries signed up. 181 by 2008.

GROUP 1 = signed and meeting targets e.g. UK, France
GROUP 2 = siged but not meeting – Canada, Denmark
GROUP 3 = Signed but not set targets – China, India and other LEDC's. MEDC's produce most emissions and LEDC's ought to be given time to develop targets.
GROUP 4 = didn't sign e.g. USA (the world's biggest polluter) and Australia (later signed when they had a change of Prime Minister)

Practice Exam Questions

Topic 1: Restless Earth

1. Describe the main features of a composite volcano (2 marks)
2. Describe 2 ways in which buildings in developing countries can be made more resistant to earthquakes (2 marks)
3. Foundation: using examples, describe some of the hazards of living on a destructive plate margin (4 marks)
4. Higher: Using an example, outline the impact of a major earthquake on people and property in the developing world (4 marks)
5. Explain how tectonic plates move (4 marks)
6. Using example, explain how volcanic eruptions can be predicted (4 marks)
7. Explain why earthquakes happen on destructive plate margins. You may draw a diagram to help with your answer (4 marks)
8. Explain how preparation and mitigation could reduce tectonic hazards (4)
9. Explain why some areas are more vulnerable than others (4)
10. Explain the role magma plays in shaping shield volcanoes (2)

Topic 2: Climate Change

1. Explain one natural cause of climate change in the past (2 marks)
2. Describe how human activities produce 2 different types of named greenhouse gas (4 marks)
3. What is the enhanced greenhouse effect (3 marks)
4. Explain one possible good effect of global warming and one possible bad effect of global warming (4 marks)
5. Describe some of the evidence that tells us climate was different in the past (4 marks)
6. Using examples, describe how ecosystems were affected by climate change in the past (4 marks)
7. Using examples, describe how global warming in the UK could have both costs and benefits (5 marks)
8. Foundation: Describe 2 human activities which are increasing the amount of greenhouse gases in the atmosphere (4 marks)
9. Higher: Describe 2 challenges the UK might face in the future due to global warming (4 marks)
10. What is megafauna? (2)

Topic 3: Battle for the biosphere

1. Describe how local factors affect the growth of rainforest (4 marks)
2. The earth's biosphere provides vital goods and services for people. Indentify how the rainforest could be used to provide these (3 marks)
3. Describe the impacts that human activities are having on a named biosphere (4 marks)
4. Choose a local example of biosphere management. Explain the methods used to make it more sustainable (4 marks)
5. Foundation: Describe some of the goods and services the biosphere provides humans with (4 marks)
6. Higher: Describe 2 services the biosphere provides and explain why these are important (4 marks)
7. Explain how one biome is being threatened by human interference (4 marks)
8. Explain the value of one biome you have studied (4 marks)
9. Using examples, explain some ways of conserving threatened species (4 marks)

Topic 4: Water World

1. Describe how deforestation could affect water-cycle processes (4) Foundation
2. Explain how human activity could change the amount of infiltration (3) Higher
3. Name the two largest water stores on earth (2)
4. Explain why Australia's water is considered unreliable (4)
5. Describe two ways in which climate change could impact on water supplies (4)
6. Explain why the biosphere and lithosphere are important to the hydrological cycle (4)
7. Using a named example, describe how water schemes in LEDC's improve quality of life. (4)
8. Describe the causes of river pollution and explain how people dealt with it (5)
9. Explain why the biosphere and lithosphere are important in the hydrological cycle (4 marks)
10. Using examples explain why pollution threatens water quality (4 marks)
11. Using examples, show how different water uses can have unintended effects (4 marks)
12. Using examples show how big dams can bring either benefits or problems (4 marks)
13. Using examples, explain how water use could be made more sustainable (4 marks)

Optional Topic 5: Coastal change and conflict

1. Describe the advantages and disadvantages of different hard engineering methods used to protect coastlines (6) Foundation
2. Explain why some cliffs erode more rapidly than others (6) Higher
3. Describe and explain the process of Longshore Drift (6)
4. What is a concordant coastline? (2)
5. Describe how changing sea levels can impact coastlines (4)
6. Using named examples, explain the effects of erosion at the coast on people (6)
7. Using named examples, explain how coastal management choices can cause conflict at the coast (6)
8. Describe how strategic retreat would work as a coastal management strategy (4)
9. Using examples, explain how sea level rise could threaten people and their property (6 marks)

Optional Topic 7: Oceans on the Edge

1. Using examples, describe the threats facing marine ecosystems (6) Foundation
2. Using named examples, explain the short and long-term threats facing marine ecosystems (6) Higher
3. Describe the type of area a mangrove swamp might be found (2)
4. How can an undisturbed mangrove swamp support human activities? (2)
5. How could an increase in demand for one type of fish impact on the food chain? (6)
6. Explain how the change in ocean s=currents could impact marine ecosystems? (6)
7. Explain why the worlds oceans are under threat (4)
8. With reference to an example, explain the problems and successes of sustainable fishing (4)
9. Using examples, explain the impacts of climate on either developed or developing countries (6 marks)
10. Using an example, explain why marine environments are so difficult to protect (6 marks)