



# AQA GCSE GEOGRAPHY REVISION GUIDE

**For the grade 9-1 GCSE examinations**

*Provided by The  
Coleshill School*



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## Paper 1 Section A NATURAL HAZARDS

### What is a natural hazards?

- 1) An event becomes a hazard when it affects people
- 2) A natural hazard is a natural process which could death, injury or disruption to humans, or destroy property and possessions.
- 3) A natural disaster is an event that has actually happened.

### What are the main types of hazard?

#### Geological Hazards

Geological Hazards are caused by land and tectonic processes. Examples include volcanoes, earthquakes and landslides

#### Meteorological Hazards

Meteorological Hazards are caused by weather and climate. Examples are tropical storms and flooding caused by extreme weather.

### What affects a countries ability to cope?

#### Vulnerability

- 1) The more people that are in areas exposed to natural hazards, the greater the probability they will be affected by a natural hazard. So hazard risk is higher
- 2) EG: People living at the base of a volcano in Naples, Italy are vulnerable to eruptions

#### Capacity to Cope

- 1) Natural Hazards have to affect human activities to count as a hazard. The better a population can cope with an extreme event, to lower the threat
- 2) EG: HICs are better able to cope with earthquakes as they can build earthquake proof buildings and repair the damage afterwards.

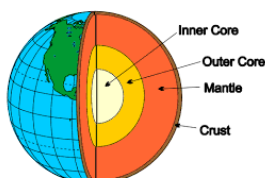
Hazard Risk is the probability that a natural hazard occurs. There are 3 main factors affecting risk:

#### Nature of Natural Hazards

- 1) Type - the hazard risk from some hazards is greater than others (eg tropical storms can be predicted but earthquakes can't).
- 2) Frequency - Some natural disasters occur more often than others (eg flooding)
- 3) Magnitude - More severe natural hazards cause greater effects than less severe events. Eg a magnitude 5 earthquake compared to a magnitude 8

## Tectonic Plates

The Earth's surface is separated into Tectonic Plates

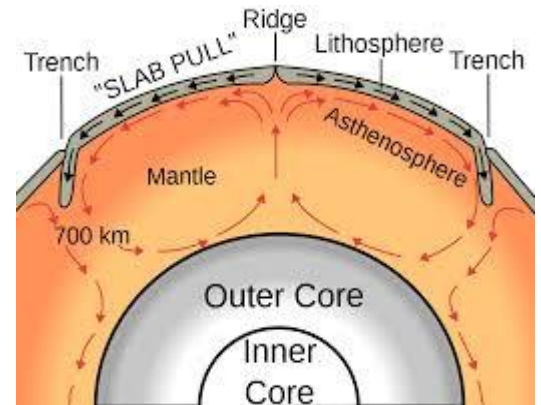


- 1) The inner core is solid and outer liquid
- 2) Around the core is the mantle - semi molten rock moving slowly
- 3) The outer layer is the crust and the crust is divided into slabs called tectonic plates. These plates can either be continental or oceanic plates. Where they meet is called a plate boundary/margin.
- 4) The plates move due to convection currents in the mantle.

# How do the plates move?

## What are convection currents?

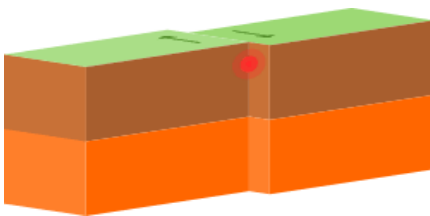
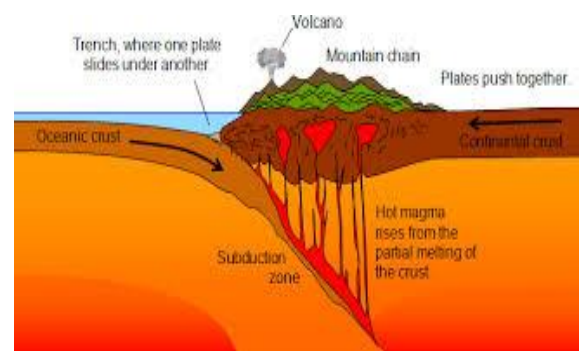
- 1) Heat rising and falling inside the mantle creates convection currents generated by radioactive decay in the core.
- 2) The convection currents move the plates.
- 3) Where convection currents diverge near the Earth's crust, plates move apart. Where convection currents converge, plates move towards each other.



## The 4 main Plate Boundaries

### Destructive Plate Boundary

- 1) Destructive Plate margins are where two plates are moving toward each other
- 2) When a heavier oceanic plate meets a continental plate it is forced down (subducted) into the mantle and melted (DESTROYED). This rising heat from the melting plate causes volcanoes. The 'scraping' of the plate as it is subducted is what causes earthquakes

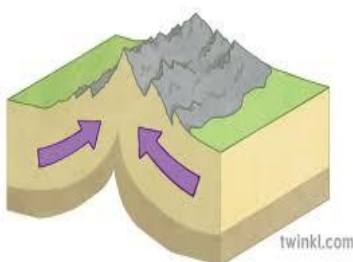
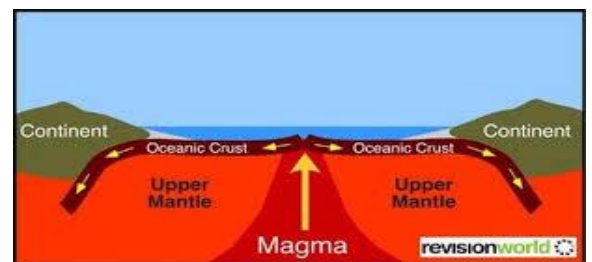


### Conservative Plate Boundary

- 1) Conservative Plate margins are where two plates are sideways past each other
- 2) As the plates move past each other they can cause friction, and as this friction builds and released, earthquakes occur

### Constructive Plate Boundary

- 1) Constructive Plate margins are where two plates move away from each other
- 2) Magma rises from the mantle to fill the gap and cools, **CONSTRUCTING** new crust.



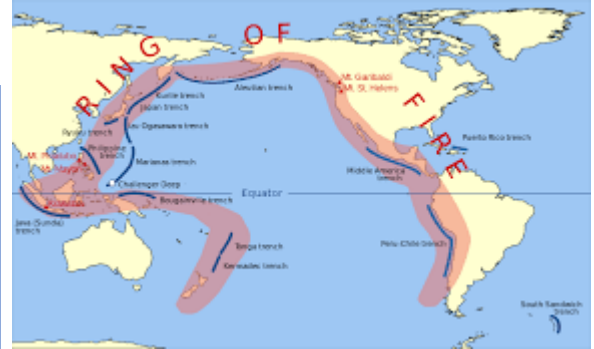
### Collision Plate Boundary

- 1) Collision Plate margins are where two plates move toward each other.
- 2) As both are continental crusts, one cannot be forced down, so both are pushed upwards forming 'fold' mountains
- 3) An example is the Himalayas and earthquakes happen here. (eg our Nepal case study)

# Volcanoes and Earthquakes

## Where do **volcanoes** occur?

- Sixty percent of all active volcanoes occur at the boundaries between tectonic plates.
- Most volcanoes are found along a belt, called the "Ring of Fire" that encircles the Pacific Ocean.
- Some volcanoes, like those that form the Hawaiian Islands, occur in the interior of plates at areas called "hot spots."

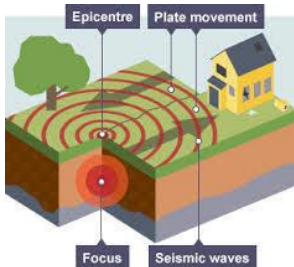
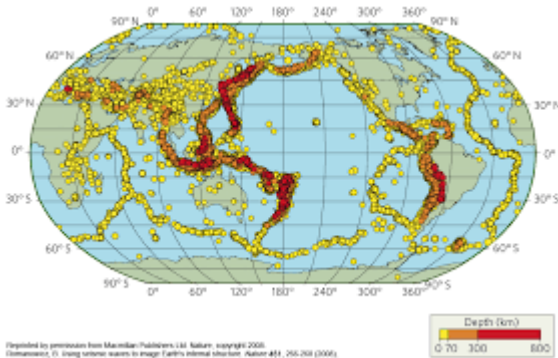


Volcanoes occur at Destructive and Constructive Plate Margins

Earthquakes occur at all 4 plate margins

## Where do **earthquakes** occur?

- Earthquakes are caused by the **tension** that builds up at all 3 plate margins
- **Destructive Plate Margin**: Earthquakes occur when the subducted oceanic plate scrapes against the continental as it slides underneath
- **Constructive Plate Margins** - tension builds along cracks within the plates
- **Conservative** - Tension builds when plates sliding past each other get stuck



- The **Moment Magnitude Scale** measures the amount of energy released by an earthquake (called magnitude) [we used to call this the Richter Scale]
- The Moment Magnitude Scale is **logarithmic** - so a magnitude 7 earthquake (like Nepal) is **10 times** more powerful than a 6 (like New Zealand)

- The plates eventually jerk past each other causing **shockwaves**.
- The shockwaves spread out from the focus (the point in the earth where the earthquake starts)
- If the **focus is shallow** then the waves are **stronger** and cause more damage
- The **epicentre** is the point on the earth's surface **directly above** the focus

## Earthquakes and Volcanoes have many serious effects:

**Primary Effects:** Immediate effects of a disaster (ie impacts of the ground shaking in an earthquake) **Secondary Effects:** Happen later on, often as a result of the primary effect.

Primary & Secondary Effects



# Tectonic Hazards- LIC & HIC Contrasting Examples

## 1) Earthquake in Nepal, a lower income country:

Place: Gorkha, Nepal

Date: April 2015

Size: 7.8 on the moment magnitude scale



- 8841 died, mostly from collapsed buildings
- 16 800 injured
- 1 million made homeless
- 7000 schools, 26 hospitals and Dharahara Tower (UNESCO site) destroyed

- Triggered an avalanche on Mount Everest which swept through the base camp
- Loss of income from a reduction in tourist numbers due to damage to historical buildings, hotels and transport.
- Rice seed stores wiped out, 2/3 of population depend on this

- International help requested in the form of rescue teams
- Temporary shelters set up and food, water and medical supplies were distributed to worst affected areas
- Facebook launched a safety feature so people could indicate that they were safe in difficult to reach terrain.
- Several companies didn't charge for phone calls

- 23 areas identified for rebuilding in post disaster assessment
- Mount Everest reopened to tourists in August after some trails were rerouted, climbing permits were also extended until 2017
- UN trained farmers to expand crop production and maintain and repair irrigation channels that were damaged by landslides

## 2) Earthquake in New Zealand, a HIC country:

Place: Christchurch, New Zealand

Date: February 2011

Size: 6.3 on the moment magnitude



- 181 died, mostly from 1 collapsed TV building
- 2,000 injured
- 80% of the city without power
- 50% of all buildings severely damaged

- Loss of income from a reduction in tourist numbers as Christchurch could no longer host rugby world cup matches
- Schools were closed for 2 weeks
- 1/3 of residents faced financial difficulties for up to 3 months after the event.

- The Australian Government donated NZ\$6.7 million to the Red Cross appeal
- 27000 chemical toilets were flown into the area as sanitation and sewerage works were damaged
- 7 million in international aid was provided
- The New Zealand Defence Force provided equipment, transport, evacuation, food and water aid to 1000 homeless people as a result of the earthquake

- Insurance companies paid \$898 million in claims.
- Water & Sewage was restored by August
- 80% of roads were repaired within 6 months)
- Long Term Temporary Accommodation was provided by the New Zealand Government to the 10,000 made homeless

Primary

Secondary

Immediate Responses

Long Term Responses

**GCSE Practice Question: Assess the extent to which primary effects are more significant than secondary effects.' (9)**

# Living with Tectonic Hazards

## Why do people live in areas at risk from natural disasters?

- They've always lived there - moving away would mean leaving friends and family
- They're employed in the area - moving away would mean having to find new jobs
- They're confident in the support they would receive from their government after a disaster
- Some people won't think that severe earthquakes or volcanoes won't happen in their lifetime
- The soil around volcanoes is fertile because it's full of minerals from volcanic ash and lava. This makes it good for farming
- Volcanoes are tourist attractions bringing visitors so jobs are provided in the tourist sector.
- Volcanoes can provide free energy through geothermal sources.

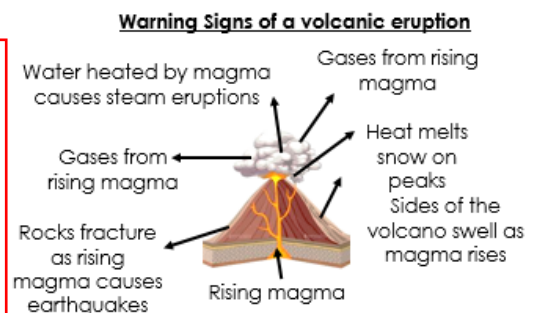
## How can we manage tectonic hazards?

### Monitoring

- 1) Networks of seismometers and lasers monitor earth's movements and can be used in early warning systems to give a small but vital warning before an eruption.
- 2) Remote Sensing - Satellites detect heat and changes to the volcanoes shape
- 3) Scientists can monitor the tell-tale signs that come before an eruption. Such as tiny earthquakes, escaping gas and changes to the shape of the volcano. (eg bulge in the side of the crater where magma is building up).

### Prediction

- 1) Earthquakes are difficult to predict, as they often occur without warning. However the general location of likely quakes is known, as they occur along plate margins.
- 2) Sensitive seismometers are used to measure the minor tremors and foreshocks that sometimes occur before quakes.
- 3) Volcanic eruptions can be predicted if the volcano is well monitored. Predicting when a volcano is going to erupt gives people time to evacuate

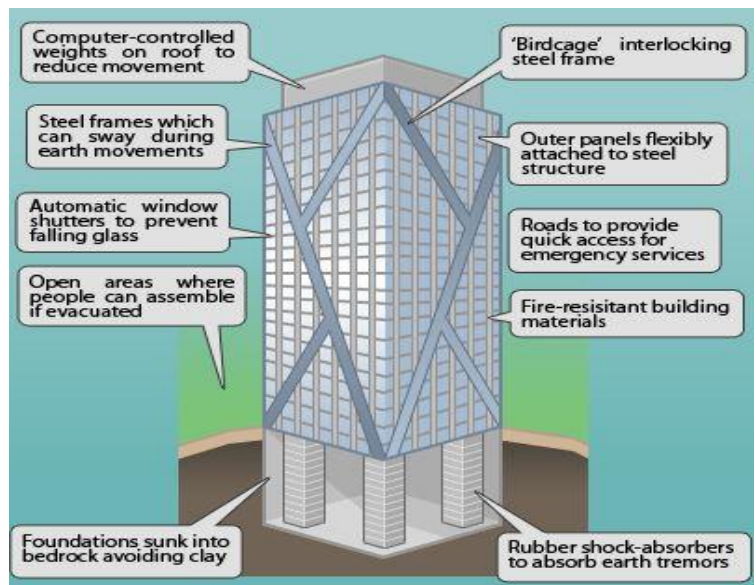


### Planning

- 4) Future developments can be planned to avoid the most at risk areas (called Land Zoning).
- 5) Emergency Services can train and prepare for disasters
- 6) People can be educated so that they know what to do if a disaster happens
- 7) Governments can plan safe evacuation routes to get people out quickly
- 8) Emergency supplies like blankets and 'meals ready to eat' [MRE] can be stockpiled.

## Protection

- 9) Buildings can be designed to withstand earthquakes, eg by using materials like reinforced concrete or building special shock absorbing foundations that absorb the earthquakes energy
- 10) Existing buildings and bridges can be strengthened (eg by wrapping pillars in steel frames) so they're less likely to collapse
- 11) Automatic shut off switches can be fitted that turn off gas and electricity supplies to prevent fires.



**GCSE Practice Question:** Explain how volcanoes can be monitored and eruptions predicted. [6].

**GCSE Practice Question:** Explain, using examples, why people might choose to live in areas at risk from tectonic hazards. [6].

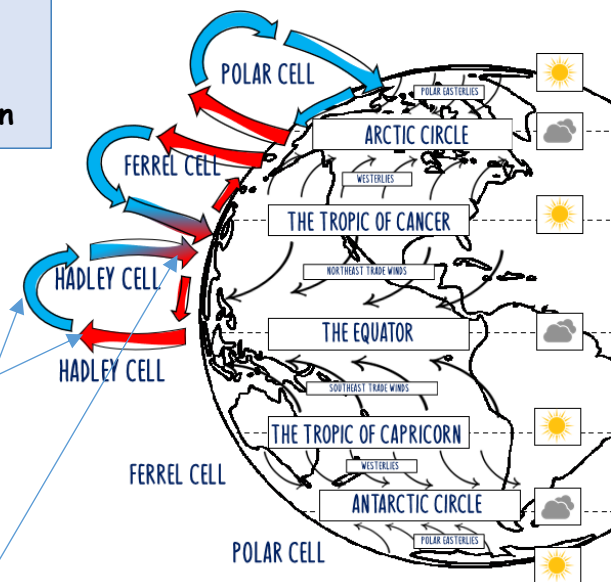
## Global Atmospheric Circulation

There's an overall movement of air between the equator and poles that affects the Earth's climate, this movement is called **Global Atmospheric Circulation**

The main cell to know is the Hadley Cell

Here's how it works:

- At the equator the ground is intensely heated by the sun
- This causes air to rise creating low pressure, air separates and moves towards the poles.
- When it reaches 30° north & south of the equator air cools and sinks, causing a high pressure zone.
- As air sinks it becomes warmer and drier with low rainfall. This is where deserts are found, on the Tropic of Cancer
- When air is sinking, this is HIGH Pressure
- When air is rising, this is LOW Pressure



Global Atmospheric Circulation causes areas so have some types of weather more than others. For example, the UK has a lot of low pressure systems from the Atlantic that bring wet and windy weather



# Tropical Storms

Tropical Storms are intense low pressure weather systems with heavy rain and strong winds that spiral around the centre. They can be called Hurricanes, Typhoons or Cyclones depending on where they occur.

## How do tropical storms form?

### Sequence

Air is heated above warm tropical oceans.

Air rises under low pressure conditions.

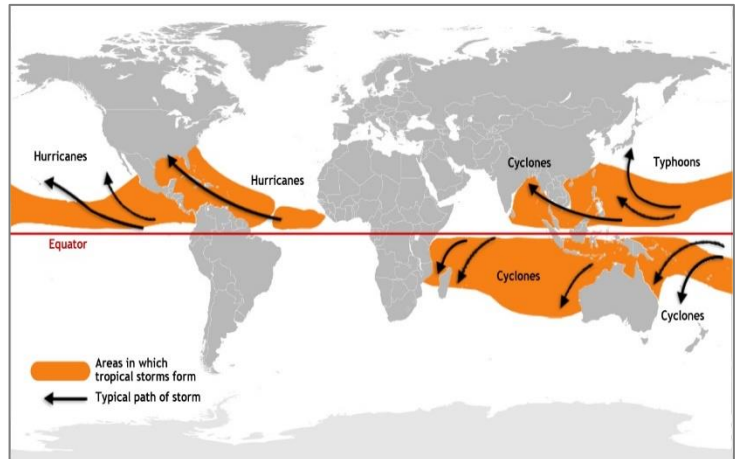
Strong winds form as rising air draws in more air and moisture causing torrential rain.

Air spins due to the Coriolis effect (spin of the earth) around a calm eye of the storm.

Cold air sinks in the eye so it is clear and dry.

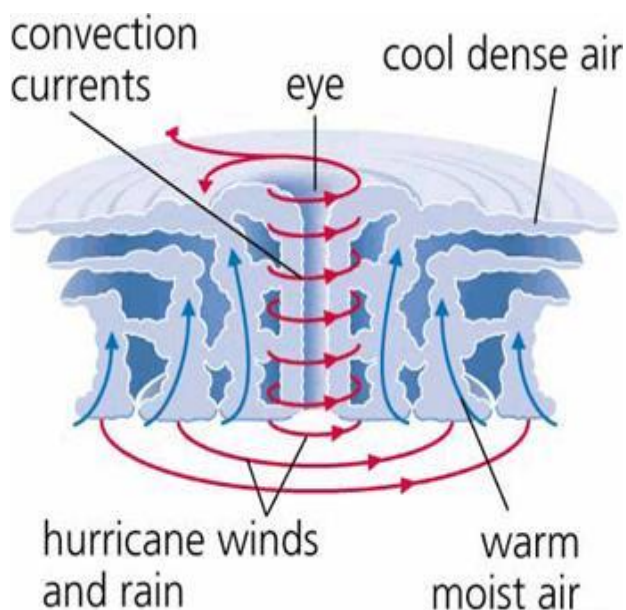
Heat is given off as it cools powering the storm.

On meeting land, it loses source of heat and moisture so loses power.



### Key Information

- They only form in ocean temperatures over 27 °C,
- A storm becomes a tropical storm once winds hit 74mph
- Storms are recorded on the Saphir Simpson scale, 1-5.
- They are only found in latitudes of 5-20 degrees north and south of the equator.
- The strongest part of the storm is the eye wall, where winds are fastest
- The centre of the storm is called the eye and is calm.



### Climate Change & Tropical Storms

- Global Temperatures are expected to rise as a result of climate change, so more of the world's oceans will be above 27. This means more places will experience tropical storms
- Oceans will stay above 27 for longer so tropical storm seasons will last longer
- Higher sea temperatures also mean storms will be stronger

# Tropical Storms- Effects and Responses

## Case Study - Hurricane Katrina

The effects of Hurricane Katrina were severe, particularly in the New Orleans where wind speeds reached 150mp/h making it a Category 5 and caused flood defences to fail.

**Hurricane Katrina struck the New Orleans, USA on 28<sup>th</sup> August 2005**

### Primary Impacts

- 1800 died
- 300,000 houses were destroyed leaving 1 million homeless
- Large areas were flooded, including 80% of New Orleans.
- 3 million people were left without electricity.
- 15 metre storm surge caused flooding and overtopping of the levees
- Bridges on the major US 90 highway were destroyed making access into the city difficult
- 1.3 million acres of forest land were destroyed costing about \$5 billion

### Secondary Impacts

- 1) Total cost of the damage was an estimated \$150 billion.
- 2) 230 000 jobs were lost from damaged businesses
- 3) Looting was rife, due to lack of food and supplies
- 4) The storm caused oil spills which resulted in over 26 million litres of oil being leaked
- 5) Water supplies were contaminated by sewage and chemicals
- 6) Airport was badly damaged and roads were blocked by flood waters which made rescue efforts and deliveries of supplies difficult
- 7) Katrina destroyed 30 oil platforms which cost the country billions

There were immediate and long term responses to these effects

### Immediate Responses

- 1) 70-80% of New Orleans residents were evacuated before the hurricane reached land.
- 2) Mississippi and Louisiana declared states of emergency they set up control centres and emergency shelters assisted with search and rescue and aid delivery
- 3) 10,000 army troops were stationed in the area to assist with relief
- 4) International aid was sent, this included food, water and medical supplies. The Red Cross has provided 902 shelters for 100,000 people
- 5) 20 000 people were evacuated, many to the Superdome, an indoor stadium
- 6) The Federal Government and FEMA delivered 17 million MRE's (Meals Ready to Eat)

### Long Term Responses

- 1) The Senate passed a bill deliver £5 billion funds to repair storm-damaged sewage treatment and drinking water plants within 2 years.
- 2) Rebuilding of flood defences costing \$14.5 million.
- 3) FEMA provided housing assistance (rental assistance) to more than 700,000 applicants
- 4) Congress provided \$17 billion to re build homes and infrastructure
- 5) Thousands of homes rebuilt away from areas at risk from coastal flooding by storm surges

**GCSE Practice Question: Assess the extent to which tropical storms have effects on people and the environment using an example you have studied (9 marks)**

## Tropical Storms- Reducing their effects

### Monitor

- Using technology to identify the formation of tropical storms and track their paths and strengths
- Satellites monitor the cloud pattern and can detect as the winds become more organised, into a spiral pattern and the eye develops.

### Prediction

- Scientists use computer models that use data from satellites to calculate a path for the storm
- Scientists use radar and aircraft to help monitor and predict the path of storms. Predicting the path gives people time to evacuate and board up homes.

### Planning

- Future developments, eg new houses, can be planned to avoid the areas at most risk.
- Emergency services can train and prepare for disasters. Eg practising how to rescue people from flooded areas with helicopters
- Governments can plan evacuation routes to get people away from storms quickly. Actions taken before a hazard strikes to reduce its impact, such as educating people in evacuation plans can reduce deaths.
- Families are encouraged to plan what they need to do and have in the event of a tropical storm: Disaster supply bag, fuel in vehicles, know where evacuation shelters are, storing loose objects.

### Protection

- Build hurricane proof homes and installing storm shutters on houses, e.g. in Florida,
- Sea walls can be built to protect key infrastructure from storm surges and storm drains can be designed to take away heavy rainfall
- Tropical cyclone shelters in Bangladesh have helped reduce the death toll from 500 000 deaths in 1970 to 4234 in 2007.
- Houses built on stilts to allow storm surge to pass underneath
- Salt marsh, wetlands and mangroves replanted provide natural protection from storm surges. (These ecosystems are often destroyed to make way for agriculture and building development).






**GCSE Practice Question: Explain why planning and being prepared is the best option for reducing the effects of tropical storms (4 marks)**

## Extreme Weather in the UK

**Extreme weather** is when weather is **significantly different** from the usual weather pattern. So a heatwave in the UK will look very different to a heatwave in Australia for example!

Weather hazards are quite common in the UK - and it's not just rain...

The UK experiences lots of **extreme weather** hazards

1. 	2. 	3. 	4. 	5. 
What examples of extreme weather do we get in the UK?				
DROUGHT- CAUSED BY LACK OF RAIN	HEATWAVE	STORMS WIND LIGHTENING	COLD SPELLS SNOW STORMS	FLOODING - CAUSED BY TOO MUCH RAIN

Weather in the UK is becoming more extreme

Extreme Weather

- 1) Temperatures have become more extreme in recent years. December 2010 was the coldest for over 100 years, with snow and ice causing several death and school and road closures. Just 4 months later April 2011 was the warmest ever!!!
- 2) It is raining more - more rainfall records have been broken since 2010 than in any other previous decade on record. 2013 was the wettest year, with December 2015 the wettest month ever!
- 3) Major flooding occurs often. In 2014 there was a major flood caused by storms and high rainfall in Somerset. This winter 2014 storm meant the UK experienced its wettest winter since records began in 1760. 2014 also saw the UK experience its stormiest weather for 20 years with over 20 major storms occurring. The year was also the warmest on record (until 2015)

**Climate change** can increase the frequency and intensity of extreme weather events. Flooding, for example is becoming more frequent in the UK as a warmer atmosphere can hold more moisture.

# Extreme Weather in the UK

## Case Study - 2003 UK Heatwave

### Causes

Low Rainfall - Rainfall over much of the UK was below what is normally expected during the months of June, July and August. High Pressure - The long-lasting high pressure system tended to reduce the amount of rain that fell. High pressure areas usually bring little cloud and warm conditions in summer

The heatwave affected all of the UK. The record temperature, of over 38.1C (100.6F), was recorded in Gravesend, Kent, SE England

### Social Impacts

- 1) +2,000 deaths were attributed to the heat
- 2) +20 people injured by lightning strikes brought by thunderstorms.
- 3) Increase in people experiencing breathing difficulties, poor air is suspected to account for 1/3 of deaths
- 4) Elderly suffering from heat exhaustion.

**GCSE Practice Question:** Using an example of a recent extreme weather event in the UK, assess whether the socio-economic effects were more severe than the environmental effects.

### Economic Impacts

- 1) +Transport - some railway tracks buckled in the heat meaning a 30mph speed restriction was imposed affecting commuters.
- 2) The London Underground became unbearable meaning people unable to travel to work.
- 3) Road surfaces melted effecting deliveries.
- 4) Low river levels prevented some boats from sailing affecting tourism income.
- 5) Major increase in UK tourism - an extra 1000 people packed onto Brighton beach for example
- 6) Farming Industry lost £13 billion due to crop failure

### Environmental Impacts

- 1) Air pollution - it is thought that one third of the deaths caused by the heatwave in the UK were caused by poor air quality.
- 2) Forest Fires destroyed ecosystems and habitats
- 3) Severe impacts on crop yields; wheat fell 12% in 2003 in the UK
- 4) Many natural animals to die affecting ecosystems, fish stocks were lowered in rivers. Over 1000 farm animals, mainly cows and pigs, were also lost

## Management Strategies can Reduce the Risk from Weather Hazards

The 2003 Heatwave could have been much worse if there weren't strategies to reduce the risk:

PREDICTION- warning systems, such as weather reports and heat warnings issued by the Met Office and Environment Agency (including 40 severe flood warnings) gave people time to prepare

PROTECTION- individuals and local authorities prepared for extreme weather before it happened. Workers altered their working hours. Some refuse collectors started earlier to pick up rapidly decomposing rubbish

PLANNING- emergency services and local councils planned how to deal with extreme weather events in advance. Department of Health launched a project called the Heat-Health Watch which now gives advanced warning of UK hot weather. Public water supply shortages occurred, which led to a temporary ban on using hose pipes.



# Climate Change - The Evidence

There's information stored in thick ice sheets, tree rings and pollen that scientists can use to find out what the earth's climate was like 1000s of years ago

## Ice Cores

- 1) Ice sheets are made up of layers of ice - one layer is formed each year
- 2) Scientists drill into ice sheets to get long cores of ice
- 3) By analysing all the gases trapped in the layers of ice, they can tell what the temperature was each year.
- 4) One Ice core from Antarctica showed us how the temperature has changed over the last 400,000 years.

## Temperature Records

- 1) Since the 1850s global temperatures have been measured accurately using thermometers. This gives a reliable but short term record of temperature.



## Pollen Analysis

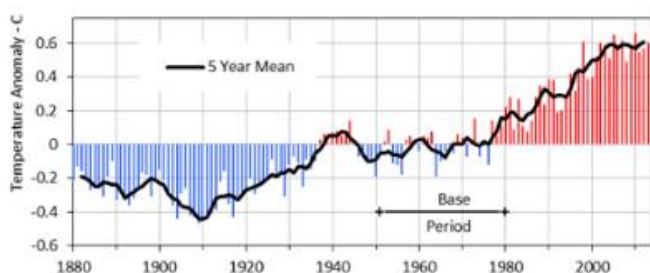
- 1) Pollen from plants gets preserved in sediment, eg at the bottom of lakes.
- 2) Scientists can identify and date the preserved pollen to show which species were living at that time.
- 3) Scientists know the conditions that plants live in now, so preserved pollen from similar plants shows that climate conditions were similar.

## Tree Rings

- 1) As a tree grows it forms a new ring each year - the tree rings are thicker in warm, wet conditions.
- 2) Scientists take cores and count the rings to find the age of a tree. The thickness of each ring shows what the climate was like.
- 3) Tree rings are a reliable source of evidence of climate change for the past 10,000 years.

## Global Temperature, 1880 - 2014

Land - Ocean Index: 1951-1980 Base



Source: Goddard Institute for Space Studies (GISS) and Climate Research Unit (CRU), prepared by ProcessTrends.com, updated by globalissues.org

## The Earth is getting warmer

Climate change is any significant change in the Earth's climate over a long period. The climate is constantly changing, and always has.

However, recently, the earth is seeing a rapid increase in global temperatures. This is called global warming. This sharp rise in global temperatures over the last century is a human induced climate change.

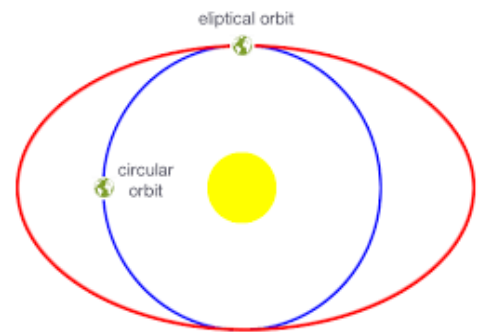
# Climate Change - The Causes

Climate change goes back long before humans roamed the earth. Some natural factors cause climate change, but in the last 150 years or so, human activities have begun to change the climate too.

## What are the Natural Causes of Climate Change?

### Orbital Changes

- The way the earth moves around the sun changes.
- Those changes affect the amount of solar radiation (sun energy) the earth receives. If the earth orbits closer to the sun, like the red orbit on this diagram, the climate will be warmer
- Orbital changes affect the glacial periods of ice ages



### Volcanic Activity

- Major volcanic eruptions eject large quantities of ash into the atmosphere.
- Some of these ash particles reflect and block the sun's rays, cooling the earth surface.

### Solar Output

- The Sun's output of energy always changes (every 11 years)
- When the sun has more energy (which can be witnessed through sun spots [darker areas on the sun]) the climate is warmer

## What are the Human Causes of Climate Change?

### Burning Fossil Fuels

- CO2 is released into the atmosphere when fossil fuels like coal, oil and gas are burnt. (eg from power stations)

### The Greenhouse Effect

- 1) The rate of recent rise in global temperatures is alarming
- 2) There is scientific agreement that human activities are causing global warming through the greenhouse effect.
- 3) The greenhouse effect is when greenhouse gases, such as CO2 absorb outgoing heat so less heat is lost and some is reflected back to earth.
- 4) Too much greenhouse gas in the atmosphere means too much sun energy is trapped and the planet warms up.

### Farming

- Farming of livestock produces a lot of methane
- Rice paddies contribute to global warming because flooded fields emit methane

### Deforestation

- Plants remove CO2 from the atmosphere and convert it into organic matter.
- When trees or plants are chopped down, they stop taking in CO2
- CO2 is also released when trees are burnt as fuel or when removed using 'slash and burn'

# Climate Change - The Effects

## Climate Change effects the environment....

### Environmental Effects

- Warmer temperatures are causing [glaciers to shrink](#) and ice sheets like Greenland to melt. This melted water goes into the sea, causing sea levels to rise
- [Sea ice is also shrinking](#), leading to the loss of polar habitats.
- [Rising sea levels](#) means low-lying and coastal area, like Bangladesh, will be flooded more often.
- [Coral reefs are dying](#) as sea temperatures rise (called Coral Bleaching)
- Precipitation (rain) patterns are changing. More warmth = more hot air rising = more rain
- Some [habitats are being destroyed](#) and this is effecting biodiversity and causing extinctions.

## And it affects humans too ...

### Effects on humans

- [Increased disease](#) eg. skin cancer and heat stroke.
- Winter deaths decrease with milder winters.
- [Crop yields affected](#) by up to 12% in South America but will increase in Northern Europe but will need more irrigation.
- [-Less ice](#) in Arctic Ocean increases shipping and extraction of oil and gas reserves.
- [-Droughts](#) reduce food and water supply in sub-Saharan Africa. Water scarcity in South and South East UK.
- [-Increased flood risk](#). 70% of Asia is at risk of increased flooding



**GCSE Practice Question: Give two pieces of evidence, other than the change in global temperature, that show climate change has taken**

**GCSE Practice Question: 'Humans are to blame for climate change.' To what extent do you think this statement is true?**

# Climate Change - Management

## Mitigation Strategies

### Carbon Capture

- Carbon Capture (CCS) is a new technology that involves capturing CO<sub>2</sub> and storing it deep underground.

Various strategies aim to **reduce the causes of climate change**, by reducing the concentration of greenhouse gases in the atmosphere.

### Alternate Energy

- Replacing fossil fuels with nuclear power and renewable energy will reduce greenhouse gasses
- In the UK, more offshore windfarms are being built, and tidal power projects are planned.

### International Agreements

- In 2015 most countries in the world agreed to monitor and cut greenhouses gases by signing the Paris Agreement
- Each country was set a target to cut emissions. The EU agreed to cut emissions by 20% by 2020.

### Planting Trees

- Planting trees increases the amount of CO<sub>2</sub> that is absorbed as trees act as a carbon sink

Adaption means responding to changes caused by climate change.

## Adaption Strategies

### Changing Agriculture Systems

Changing rainfall patterns and higher temperatures will affect the productivity of existing farming practises.

- 1) It may be necessary to plant a new type of crops that are more hardy and suitable for harsh conditions.
- 2) In some regions, biotechnology is being used to create new crop varieties which are more resistant to extreme weather.

### Managing Water Supply

Dry areas are predicted to get drier, leading to water shortages,

- 1) Water meters can be installed in people's homes to discourage use.
- 2) Rainwater can be collected and waste water can be recycled to make more water available

### Coping with Sea Level Rise

Dry areas are predicted to get drier, leading to water shortages,

- 1) Physical defences such as flood barriers are being built (Thames Barrier -London)
- 2) In LIC countries, with less money, houses are being built on stilts and flood shelters are being built.

**GCSE Practice Question:** 'To what extent is mitigation better than adaptation in tackling climate change? 9 marks

# Paper 1 Section B LIVING WORLD

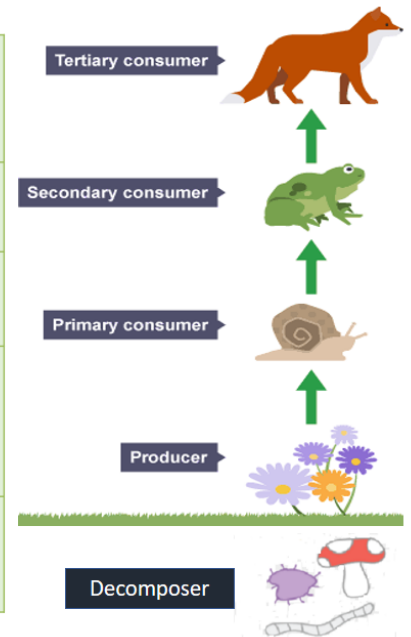
## What is an Ecosystem?

An ecosystem includes all the living and non-living parts in an area

A **food chain** shows what eats what. A **food web** shows lots of food chains and how they overlap.

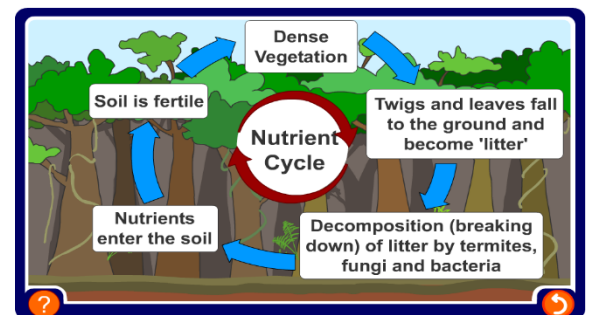
When **dead material is decomposed**, nutrients are released into the soil. The nutrients are then taken up from the soil by plants. The plants may be eaten by consumers. When the plants or consumers die, the **nutrients are returned to the soil**. This transfer of nutrients is called the **nutrient cycle**

<b>Tertiary consumers</b>	These top (apex) predators feed on the animals below them in the food web and have no predators of their own.
<b>Secondary consumers</b>	These are small carnivores that prey on the primary consumers.
<b>Primary consumers</b>	These are herbivores that eat producers.
<b>Producers</b>	These are the plants in an ecosystem. They form the foundation of food webs. Without producers, the ecosystem can not support any other fauna.
<b>Decomposers</b>	These organisms break down dead organic matter, which helps to return nutrients to the soil



A change to one part of an ecosystem has an impact on other parts

Some parts of the ecosystem depend on the others, eg **consumers depend on producers** for a source of food and some depend on them for a habitat. So, if one part changes it affects all the other parts that depend on it. Here is an example....



How are components linked?

If the number of common oak trees were reduced

then the

population of beetles and moth caterpillars would also decrease

because

their food (the common oak) would be scarce

this means that

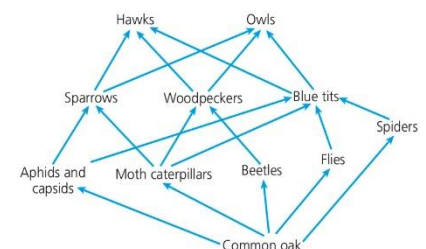
the number of woodpeckers would also decline

because

their food (beetles and moth caterpillars) would be harder to find

furthermore

the number of owls could decrease



**GCSE Practice Question:** 'Describe a food chain for a chosen small-scale ecosystem in the UK. (4 marks)



# Sutton Park: A Local Ecosystem Case Study

## Location

Sutton Park is a 2,400 acre National Nature Reserve located 6 miles north of the city centre of B'ham. It's is a National Nature Reserve

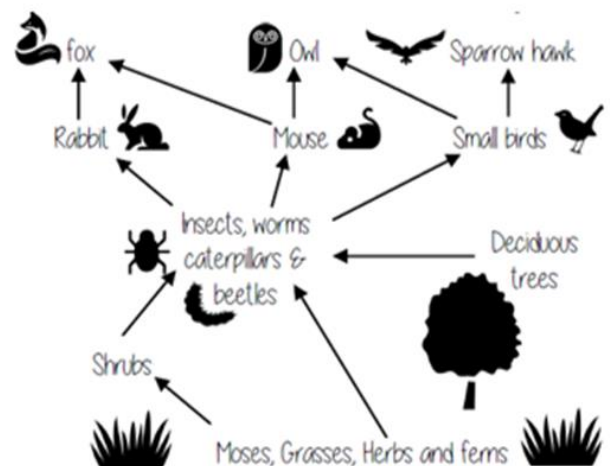
## Human uses for woodland

- For recreation - for example for walks
- For conservation to protect ecosystems
- As a resource - wood is used for fuel (firewood) or as timber for buildings,

Sutton Park has a complex food web composed of thousands of species, as the result of its careful management

- A wide variety of native tree species that include oak and ash.
- A shrub layer consisting of hazel and holly, along with grasses, brambles, fern and bracken
- Many primary consumers including insects, small mammals, grazing cows and 38 species of bird.
- Secondary consumers such as owls, adders and foxes
- Over 10 lakes and ponds providing important habitats for numerous species of fauna (animals) and flora (plants)

## Sutton Park's Food Web



## Sustainable Management

In 1989, work began to restore the heathlands. Large areas of birch trees and gorse were cleared from areas that should be open heathland. This work continues today. Low level intensity grazing will help to preserve the health of the heathland into the future.

### Tourist Management Strategies:

- Providing car parks, toilets, park rangers and maintaining footpaths to manage recreation.
- Providing three easy-access car parks for people with disabilities.**
- Preserving ancient earthworks and buildings.

### Other Sustainable Management Strategies

- Allowing old trees to die and collapse naturally (unless they're dangerous)
- Encouraging grazing (there's a herd of 50 cows) to maintain the grassland**
- Maintaining ponds & lakes to prevent them silting up.
- Preserving the herd of fallow deer.**
- Dead wood is generally left when it falls in the forest, as it provides a valuable habitat
- Some grassy areas are left uncut to encourage wildlife like butterflies.**

Human activity can have many impacts on ecosystems. Once one component has been changed it can have a serious knock on effect on the ecosystem.

## Threats to the Ecosystem

- Due to human management and tourism, lots of the natural woodland & heathland was destroyed for park land**
- Changes to grazing in Sutton Park have contributed to invasion by birch, gorse and bracken. Most of the areas covered in birch trees were open heathland up until 1976.
- Lack of grazing led to birch seedlings becoming established and coverage of large areas of heathland with woodland.

# Global Ecosystems

- 1) The climate in an area determines what type of ecosystem forms. So different parts of the world have different ecosystems because they have different climates.
- 2) The map below shows the global distribution of 6 global ecosystems

## Tundra

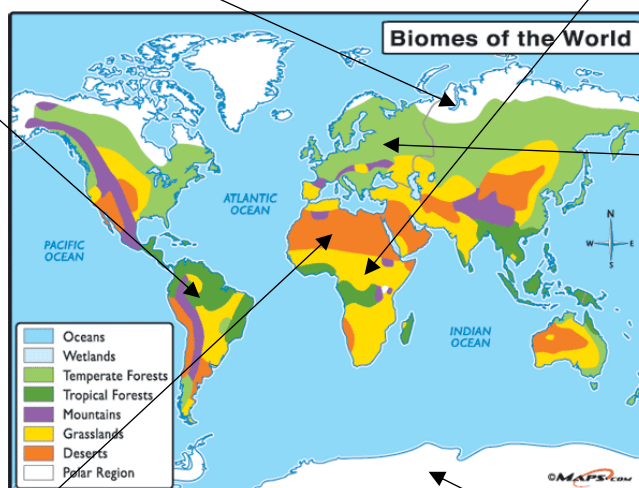
Found at high latitudes. Winters are very cold, summers are brief and little rainfall. There are few trees, and vegetation is mainly moss and grass. There is a layer of permanent frozen ground called permafrost

## Grassland

There are 2 types of grassland. Savannah grasslands are found between the tropics. These are dry with wet seasons with trees and grass. Temperate grasslands are found at higher latitudes when there is more variation in temperature and less rainfall. There are no trees here, just grass.

## Tropical Rainforest

Found around the equator, between the tropics, where it is hot and wet all year round. Convectional rainfall and sun make it ideal for vegetation growth



## Temperate Deciduous Forest

Found mainly in the mid latitudes where there are 4 main seasons. Summers are warm, winters are mild and it rains all year. Deciduous trees lose their leaves in winter to cope with cold weather.

## Hot Deserts

Found between 15 and 35 degrees north and south of the equator where there is little rainfall. Formed due to Hadley cell (see page 6). It's very hot during the day and very cold at night, so is a place of extreme temperatures. Shrubs and cacti are sparsely distributed in the sandy soil

## Polar

Found around the north and south poles. They are very cold, icy and dry. Not much grows at all. They remain dark for several months each year so the growing season is very short - about 2 months.

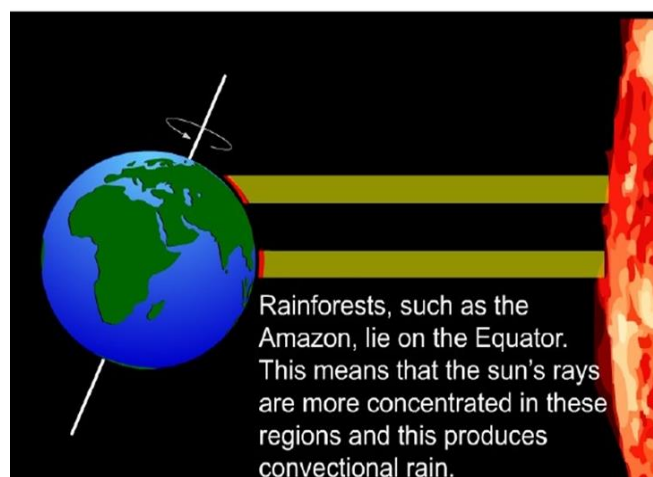
**GCSE Practice Question:** 'Describe the global distribution of the tropical rainforest ecosystem. (3 marks)

# Tropical Rainforests

The tropical rainforest is a hot, wet ecosystem found on and near the Earth's equator. Tropical rainforests contain far more species of plants and animals than any other biome. They cover approximately six per cent of the Earth's surface, and because they get 2,000 mm of rain per year and temperatures range from around 27 to 32°C, conditions are wet and hot all year round so it is a good environment for growth.

## Why is it **hot & wet** in a rainforest?

- The sun's rays shine directly on the land and sea at the equator, so it is the hottest part of the earth.
- The sun's heat warms the land, the air and the sea and causes water to evaporate into the air.
- The warm air can hold a lot of water.
- As the air rises it cools and the water turns back into rain, creating clouds.
- This means that there is lots of rain in the forests around the tropics.



- The emergent layer

The tallest layer - over 40 metres. Contains only a few tall trees which grow taller than the trees of the canopy. The plants are made for living in dry conditions because it's very sunny. They have small, waxy leaves to prevent them drying out.

- Canopy

The second highest layer - 30-45 metres. The canopy blocks out the sun from lower layers and intercepts (catches) rainfall. It contains the most plant species. This layer contains the most animal species.

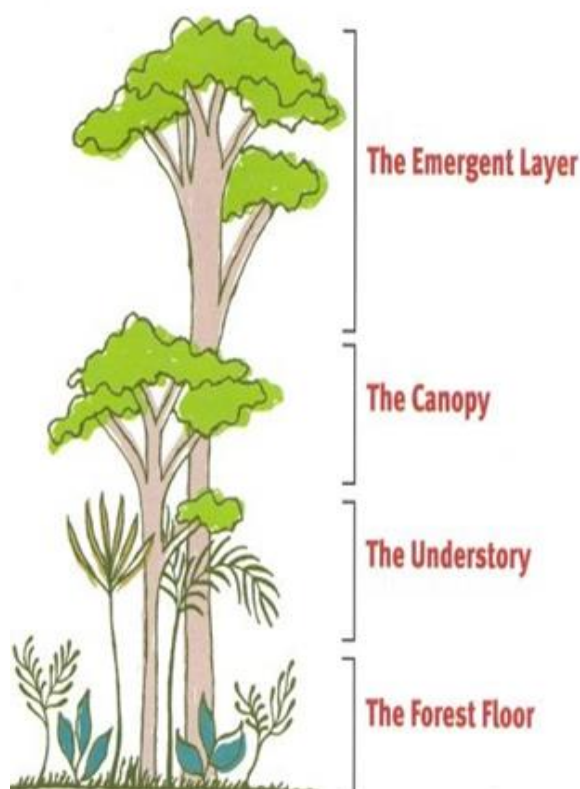
- Understory

Low light conditions (2-15%). Plants adapted to low light grow here. Birds, butterflies, frogs, snakes and lots of insects live here.

- Forest floor

Very little light reaches the forest floor (2%) - so plants grow slowly. The ground is covered in fallen leaves, rotting branches and twigs and a network of shallow roots. Lots of insects live here.

## What is the **structure** of the Rainforest?



# Tropical Rainforests - Adaptations

Rainforests have **extremely high biodiversity**. They contain around 50% of the world's plant and animal species.



## How have plants adapted?

1. Leaves	Thick, <b>waxy surface</b> of leaves protects against hot sun, heavy rain, and strong winds
2. Epiphytes	Epiphytes are plants <b>which live above</b> the ground growing on tree trunks and branches, Example orchids, ferns, mosses
3. Buttress roots	Wide roots stop these enormously tall trees from falling over. They also wind above the ground looking for food and nutrients rather than digging beneath the ground where nutrients are scarce.
4. Tree trunks	The trees <b>don't waste time growing</b> branches as they could use this energy to grow faster and reach the sunlight first!
5. Lianas	Lianas are <b>climbing woody vines</b> that drape rainforest trees. They have adapted to life in the rainforest by having their roots in the ground and climbing high into the tree canopy to reach available sunlight
6. Drip Tip leaves	These leaves allow <b>rain drops to run off</b> quickly. Plants need to shed water to avoid growth of fungus and bacteria in the warm, wet tropical rainforest

## How have animals adapted?

1. Sloths	The sloth uses <b>camouflage</b> and moves very slowly to make it difficult for predators to spot. They feed at night when it's cooler which helps them save energy.
2. Spider Monkey	The spider monkey has <b>long, strong limbs</b> to help it to climb through the rainforest trees.
3. Flying frog	The flying frog has fully <b>webbed hands and feet</b> , and a flap of loose skin that stretches between its limbs, which allows it to glide from plant to plant.
4. Toucan	The toucan has a long, <b>large bill</b> to allow it to reach and cut fruit from branches that are too weak to support its weight.



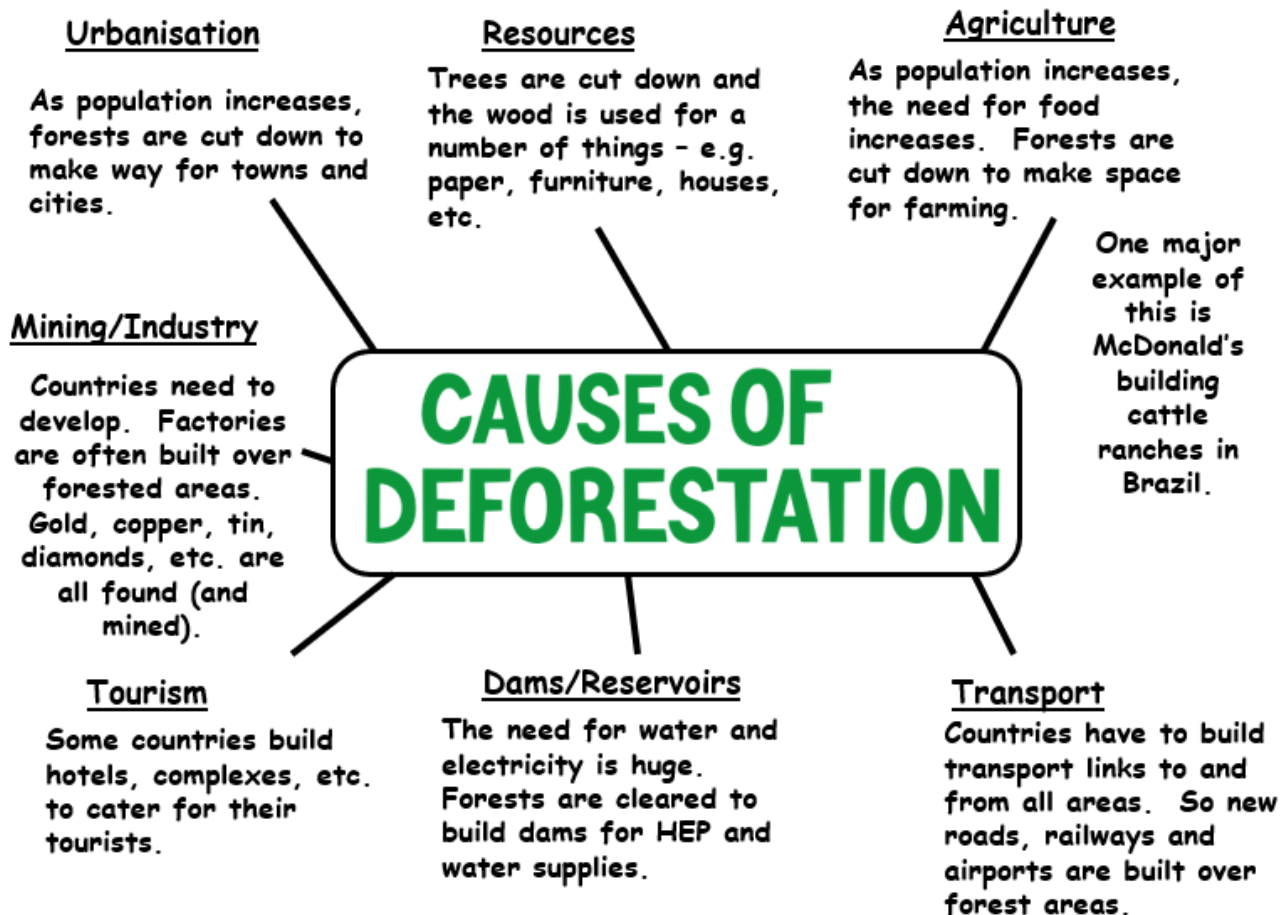
**GCSE Practice Question:** 'Explain how tropical rainforest vegetation adapts to the climate' (4marks)



# Tropical Rainforests – Deforestation

The removal of trees from forests is called deforestation. It's happening on a huge scale in many tropical rainforests. Deforestation has many impacts – some good and some bad!!

## What are the main **threats** to Tropical Rainforests?



## Why does Deforestation still occur in Brazil?

### What is deforestation worth to Brazil?

- 1) Brazil is the world's biggest beef producer, and it exported a record 1.64 million tonnes of the animal product last year. Total revenue for beef and leather came to about \$7.6 billion.
- 2) Soybeans are Brazil's biggest export – it exports \$25 billion of the commodity each year.
- 3) Mineral exports (including gold and iron) were worth \$36.6 billion to the Brazilian economy – 20% of all Brazil's exports.
- 4) Total export value of primary timber products in 2015 was about \$243.2 million.
- 5) Brazil intends to increase exports by about 20% in the next four years

## Environmental Impacts

### What are the environmental impacts?

- With no trees to hold the soil together, heavy rain washes away the soil (soil erosion).
- Without a tree canopy to intercept rainfall and tree roots to absorb it, more rain reaches the soil. This reduces soil fertility as nutrients are washed away.
- Trees are a carbon sink as they absorb CO<sub>2</sub>, and burning trees release CO<sub>2</sub>, so deforestation releases greenhouse gases into the atmosphere
- Deforestation is responsible for 15% of global CO<sub>2</sub> emissions.



# Tropical Rainforests – Amazon Case Study

The Amazon is the largest rainforest on earth, but it's shrinking due to deforestation.

## Why is Deforestation a problem in the Amazon?

- 1) The Amazon covers an area of around 8 million km<sup>2</sup> and is mainly found in Brazil (and Peru)
- 2) Since 1978, over 750,000 km<sup>2</sup> (3 times the size of the UK) has been destroyed.

There are lots of causes.....

- 70% of deforestation was caused by cattle ranching
- 25% was caused by agriculture and farming
- 3% was lost to logging
- 2% was lost to other activities such as mineral extraction (gold mining), road building and dam building



Population growth and migration to the area is also putting pressure on the Amazon rainforest, especially as the Brazilian Government offers land in the rainforest to poor people to reduce overcrowding in cities.

## What are the **impacts** of deforestation?

### Environmental Impacts

- 1) The Amazon stores around 100 billion tonnes of carbon. If there are fewer trees and plants, due to deforestation, then less carbon dioxide is removed from the atmosphere.

In this way deforestation contributes to global warming and therefore climate change.

- 2) Brazil is losing 55 million tons of topsoil every year because of soil erosion caused by farming
- 3) In the Amazon, 1 million species are threatened as human activity expands deeper into the rainforest.

From August 2018 to July 2019, the Amazon lost over 3,800 sq. miles of forest — an area equivalent to over 1.8 million football fields — which signified the highest rate of deforestation in the decade

### Economic Impacts

- 1) Countries that were very poor
- 2) Farming makes lots of money for Brazil. In 2008, Brazil made \$7 billion from trading cattle
- 3) As Brazil has expanding its agriculture into the Amazon, it is now the 5th biggest exporter of food in the world.
- 4) In the Amazon, 3,000 people are employed in the mining industry.
- 5) Logging accounts for 7% of Brazil's GDP (wealth). Brazil accounts for 3% of all forestry produce.
- 6) The money created from these enterprises allows a country to generate foreign income, which can then be used to pay off debts or be invested in further development projects

**GCSE Practice Question:** 'Explain how deforestation in tropical rainforests creates economic advantages but at a cost to the environment (6 marks)

# Tropical Rainforests – Sustainable Management

## Why is it important we manage the rainforests?

- TRF store  $\frac{1}{4}$  of the world's carbon
- TRF provide fruit, spices and rubber that are sold worldwide
- The TRF is used as a tourist site and generates jobs and income
- More than 20% of the world's oxygen supply is provided by the TRF
- TRF is rich in biodiversity with 6 million different species
- Around 25% of all medicines come from TRF plants
- TRF are home to 350 million people around the tropics. They are essential for shelter, health and food as well as being an intrinsic part of their cultures and traditions.
- $\frac{1}{4}$  of the world's fresh water is stored in the Amazon basin.
- TRF are part of a global irrigation system -that helps form clouds and distribute fresh water around the planet

## How can Tropical Rainforests be **managed** sustainably?

### Selective Logging

- Only some trees (eg just the older ones) are cut down
- Selective logging of mature trees ensures that the rainforest canopy is preserved. This method allows the forest to recover because the younger trees gain more space and sunlight to grow. Planned and controlled logging ensures that for every tree logged another is planted.

### Afforestation

- This is when new trees are planted to replace the ones that are cut down.
- This means there will be trees for people to use in the future
- It's important that the same types of tree are planted that were cut down, so the variety of trees is kept for future.
- In some countries, laws make logging companies replant when they clear an area

### Ecotourism

Ecotourism is environmentally friendly tourism where.....

- the people involved seek to protect the environment as much as possible
- there is education of the visitor
- some of the profits go back into conserving the rainforest environment
- the tourism is small scale with low visitor densities
- local people are employed and involved

### Debt Reduction

The rainforests are often found in poorer countries that want to exploit them. Debt reduction or conservation swaps offer an alternative to poorer countries to the reckless exploitation of their natural wealth.

These swaps basically see poorer countries have portions of their debts wiped out or paid for by richer nations or charities of richer nations in exchange for promising to protect or CONSERVE large parts of their forests

### International Agreements

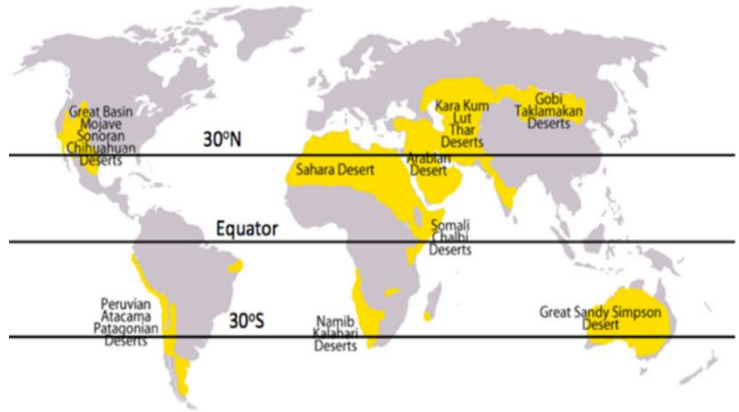
There are also international agreements on the uses of tropical hardwoods and logging. The International Tropical Timber Agreement was set up in 2006 to "promote the sustainable management of tropical timber producing forests".

# Hot Deserts

Deserts cover about one third of the Earth's land area. A desert is a very harsh environment with very little rain and extreme temperatures. An example of a desert is the Sahara, here the weather is very hot and dry, with less than 250mm of rain per year. There is not much life in the deserts as animals find it hard to survive.

## Where are deserts located?

The world's hot deserts are found in subtropical areas between 20 and 30 north and south of the Equator. The Tropic of Cancer or the Tropic of Capricorn passes through most of the world's hot desert regions. Deserts can be found in 5 of the world's 7 continents.

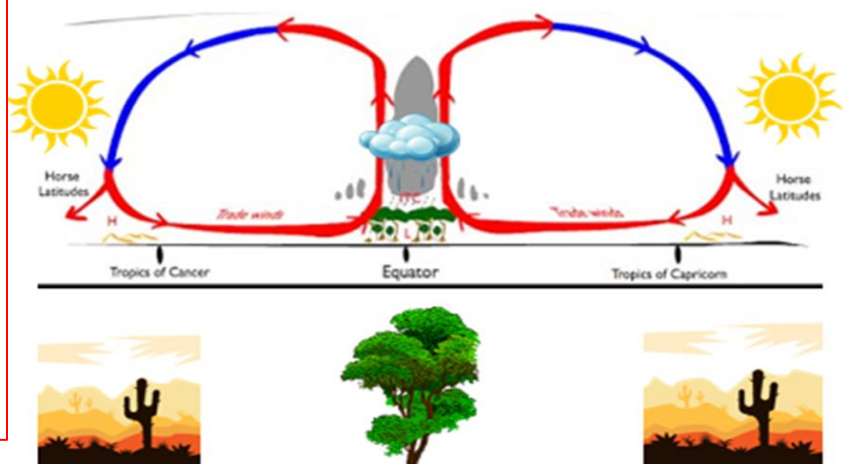


## Why are deserts NOT located at the equator?

- The sun's rays are more concentrated at the equator, so it is the hottest part of the earth.
- This intense heat warms the land, the air and the sea and causes water to evaporate into the air.
- This very warm, moist air then rises.
- **Once the warm air rises it cools and the water turns back into rain, creating clouds.**
- This means that although it is hot, there is lots of at the equator (hence rainforests are located here, NOT DESERTS!)

1. Equator is VERY hot
2. Warm air rises
3. By the time it reaches 30N or South the air has lost any moisture
4. It starts to cool down as it gets further away from the equator and the cool, dry air sinks back down.
5. As it gets closer to the EQUATOR again it heats back up and the process repeats

Why is there such little rain in the Desert?



## What is the soil like in a desert?

It is usually shallow with a coarse, gravelly texture. There's hardly any leaf fall so the soil isn't very fertile. Lack of rainfall and plant material mean the soil is often dry

# Hot Deserts - Plant and Animal Adaptations

Hot deserts have distinct characteristics that allow certain species to thrive in such an extreme environment. Plants and animals have developed adaptations which allow them to survive in hot

## Plant Adaptations

- **Small leaves** - these ensure that less water is lost from the plant by transpiration because the leaf has a smaller surface area.
- **Tap roots** - these are long roots (7-10 metres long) that reach deep under the ground to access water supplies. The tap roots are much longer and bigger than the plant which is visible at the surface.
- **Spines** - some plants have spines instead of leaves, eg **cactuses**. Spines lose less water than leaves so are very efficient in a hot climate. Spines also prevent animals from eating the plant.
- **Waxy skin** - some leaves have a thick, waxy skin on their surface. This reduces water loss by transpiration.
- **Water storage** - some plants, known as **succulents**, store water in their stems, leaves, roots or even fruits. Plants which store water in their leaves and stems also have a **thick waxy skin** so that they lose less water by transpiration.

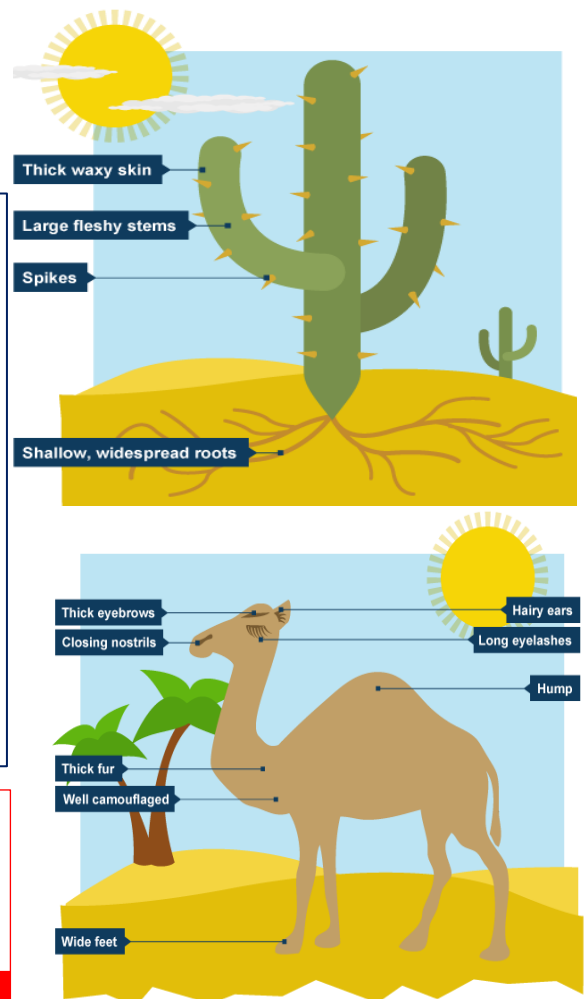
## How have animals adapted?

### How have camels adapted?

- long eye lashes, hairy ears and closing nostrils help to keep out sand
- thick eyebrows which stand out and shade eyes from the sun
- wide feet so they don't sink in the sand
- they can go without water for over a week because they can drink gallons in one go
- they can go months without food - they store fat in their humps
- body temperature can change to avoid losing water through sweating
- they are well camouflaged
- thick fur helps to keep them warm at night

Some animals are nocturnal so they can stay cool at night, such as **fennec foxes**. These foxes also have large ears to which provide a large surface area to lose heat as well as to hear prey. Their feet are also covered in fur to insulate.

Fennec Fox





# Hot Deserts - Thar Desert Case Study

The Thar is the most densely populated deserts in the world- it stretches across northwest India and into Pakistan. It covers around 200 000km<sup>2</sup>. Opportunities for economic development in the Thar Desert:

**There are lots of development opportunities in the Thar**

- 1) Mineral extraction- phosphorus for fertilisers, gypsum for cement and plaster and kaolin used in making paper. Provides jobs for local people.
- 2) Energy- large oil field near Barmer, huge solar power potential due to long hours of sunshine, India's third largest wind farm at Jaisalmer
- 3) Farming- Mostly subsistence farming involving grazing animals and growing crops, the Indira Gandhi Canal enables commercial farming to thrive as it provides irrigation
- 4) Tourism- several companies offer desert safaris and visits to Jaisalmer, ecotourism is popular with small groups taking camel treks into the wilderness areas and oasis.

**...but there are also challenges to development**

- 1) Most people live in small fertile areas, where water from a spring or well is used to irrigate the ground so that crops, e.g. maize can be grown. Others are nomadic, constantly searching for fresh grazing for their herds of goats, sheep and camels.
- 2) Development in the Thar Deserts is challenging- trying to locate and exploit resources in the hot, dry, remote desert:

## Extreme Temperatures

- 1) Due to the lack of cloud cover, daily temperatures can range from over 40°C during the day to below freezing at night. Exposure to high temperatures can cause illness or death, and healthcare may be a long distance away.
- 2) The hot season is often too hot for tourists so employment in the tourism industry can be seasonal.
- 3) Work outside is very hard, especially for farmers who have to work during the day
- 4) High temperatures lead to high rates of evaporation and water shortages

## Inaccessibility

- 1) The Thar Desert is huge- people and materials have to travel long distances- often by air, which is expensive.
- 2) Limited road network due to vast distances and high maintenance costs.
- 3) Sand can blow onto roads and tarmac can melt in the extreme heat. Many resort to traditional camels.
- 4) It's difficult to provide services, e.g. medical care, to remote regions making it hard for them to develop.

## Water Supply

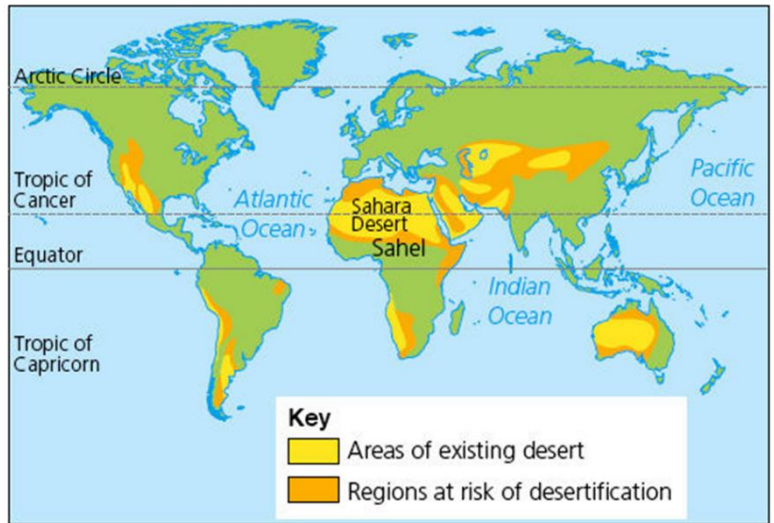
- 1) Thar Desert has very low annual rainfall with high rates of evaporation, a secure water supply is crucial for economic development.
- 2) Traditional water is stored in natural ponds called tobas, used by farmers in remote areas.
- 3) Most rivers are erratic but settlements tend to cluster along their edges. Climate change could make river flow less reliable.
- 4) Indira Gandhi Canal has transformed the desert, providing drinking water and irrigation.



# Hot Deserts - Desertification

**Desertification** is the segregation of land so that it becomes more desert like - it becomes drier and less productive.

A third of the world's land surface is at risk of desertification, particularly at the margins of current deserts. The most famous area at risk from desertification is the Sahel in Africa, just below the Sahara Desert.



## Causes of desertification

### Climate Change

- 5) **Rainfall** - climate change is expected to reduce rainfall in areas that are already dry. Less rain = less water for plant growth. If the plants die, the soil is easily eroded.
- 6) **Temperatures** - Global temperatures are expected to increase. Higher temperatures mean that more water evaporates from the land and from plants. This makes soils drier and means that plants die (so their roots no longer bind the soil together)

### Human Activities

- 1) **Removal of fuel wood** - many people in arid (dry) areas rely on wood for fuel or cooking. Removal leaves the soil exposed = erosion
- 2) **Overgrazing** - too many cattle eat the plants faster than they can re-grow. This leads to soil erosion as no plants left to bind the soil.
- 3) **Over-cultivation** - if crops are planted in the same area continually, all the nutrients in the soil get used up. This means that plants can no longer grow in this areas.
- 4) **Population Growth** - This puts pressure on the land, leading to more deforestation, more over-grazing and more over-cultivation.

- Increased risk of flooding
- Crop Failure
- Famine
- Increased Soil Erosion
- Lack of Vegetation for grazing
- Loss of nutrients in the soil
- Population decline as people move away
- Reduced biodiversity
- Salinization caused by over-irrigation.

### Effects

## Effects of desertification

Salinization occurs when the water in soils evaporates in high temperatures, drawing salts from the soil to the surface. These salts are toxic to many plants and make the land unusable. This has consequences such as low yields, poor profits and even starvation.

### Salinization

## Solutions to desertification

### Afforestation

- Planting more trees - the roots of trees hold the soil together and help to reduce soil erosion from wind and rain. Growing trees in amongst crops (agroforestry) helps protect the soil, as well as providing shade for the crops

### Water Management

- Water management - water can be stored in earth dams in the wet season and used to irrigate crops during the dry season. This is an example of using appropriate technology to manage water supplies in the desert environment. You can also grow crops that don't need much water (olives) which can reduce water use.

### Soil Management

- Improving the quality of the soil - this can be managed by encouraging people to reduce the number of grazing animals they have and grow crops instead. The animal manure can be used to fertilise the crops grown. Growing crops in this way can improve the quality of the soil as it is held together by the roots of plants and protected from erosion. This type of farming is more sustainable.
- Rotating crops that use different nutrients from the soil means the same nutrients don't keep getting used

### Appropriate technology e.g. Stone Lines (Bunds)

- Local farmers are encouraged to use the bunds to prevent soil erosion.
- Magic stones (or bunds) are circles or walls of stones placed on the ground to hold water on the soil rather than letting it run quickly over the surface. The picture to the right shows a Bund Wall.
- Solar cookers can also be used, these use the sun's energy to cook food rather than fuel wood and are cheap and easy to use.



**GCSE Practice Question: 'Assess the importance of management strategies used to reduce the risk of environmental damage caused by desertification.' (9 Marks)**

**GCSE Practice Question: 'Using a case study, to what extent have opportunities for economic activity been developed in your chosen environment?' (9 marks)**

**GCSE Practice Question: 'To what extent is the Thar Desert at risk from human activity? (9 marks)**

## Paper 1 Section Ca COASTS – Why do our coastlines change?

**Coastal erosion** is of great concern to many people as it can cause disruption to everyday life and services. Many people have consequently lost their homes and businesses to coastal erosion. But erosion is also responsible for some of the most spectacular **coastal features** too.

### How do our coastlines **erode** material?

#### Hydraulic Action

- This is the **power** of the waves as they smash onto the cliff. The trapped air is **forced** into cracks and holes in the rocks. Eventually forcing the rock to break apart.

#### Abrasion

- Fragments of rock, pebbles and sand are picked up by the waves and **hurled** at the base of the cliffs. They act like sandpaper, eroding the base of the cliff.

#### Attrition

- This is when rock fragments that are moving about underneath the water **rub against** one another knocking fragments off. This process happens continually and eventually wears the rocks down.

#### Solution

- Rocks can also be eroded through **chemical** action. This is when sea water **dissolves** certain types of rocks. In the UK, chalk and limestone cliffs are prone to this type of erosion.

### How do our coastlines **transport** material?

Material that's been eroded is moved around the coast and deposited by waves

#### Suspension

Particles carried (**suspended**) within the water.

#### Solution

This is rock being transported as **dissolved** chemicals, often from chalk and limestone cliffs.

#### Traction

This is when large pebbles are **rolled** along the seabed by the currents.

#### Saltation

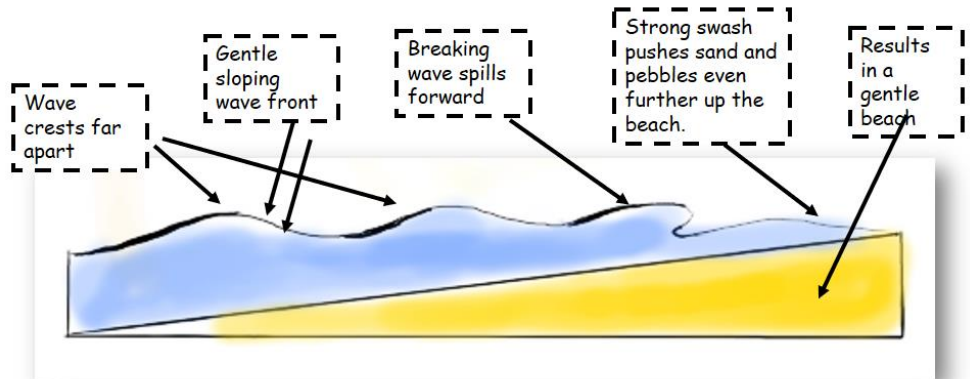
Turbulence and currents lift up pebbles which then **bounce** along the sea bed.

# COASTS - Why are waves important?

- Wind blowing over the ocean creates friction with the water surface causing ripples to form.
- The longer the waves travel for, the larger and more organised they become. The distance travelled is called the fetch!
- The stretch of the coastline that faces the waves is known as the aspect.

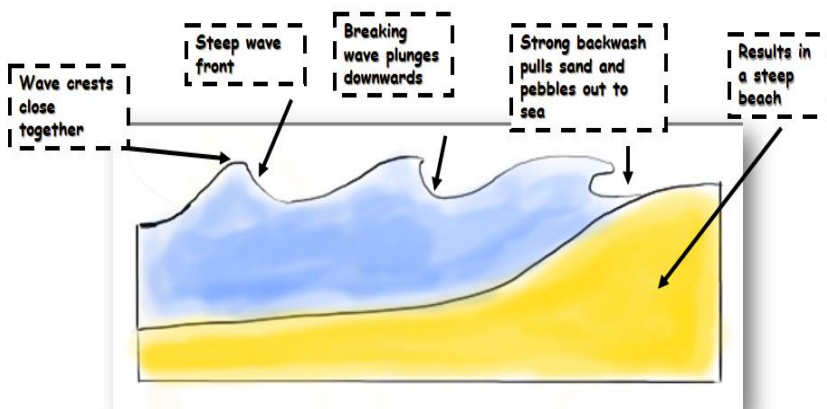
## Constructive Waves

These are low waves the surge up the beach and spill with a powerful swash. They carry large amounts of sand and pebbles, and construct the beach. They have travelled a very long way (Large fetch).



## Destructive Waves

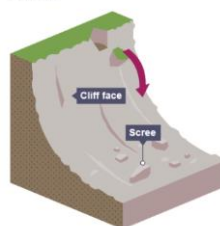
These are formed by local storms close to the coastline. They take beach material away, therefore they can erode the beach. They are steep, plunging waves, close together and have a stronger backwash than swash. This is why they are effective at removing sand and pebbles from the beach.



## Mass movement

- 1) Mass movement is the shifting of rocks and loose material down a slope (cliff). It happens when the force of gravity acting on a slope is greater than the force supporting it.
- 2) Mass movements cause coasts to rapidly retreat
- 3) They're more likely to happen when the material is full of water - it acts as a lubricant, and makes the material heavier
- 4) You need to know about 3 types

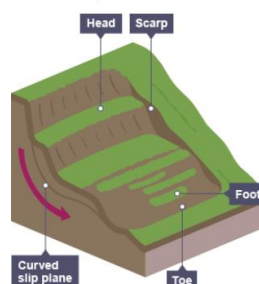
Rockfall



## Rockfalls

Bits of rock fall off the cliff face, usually due to freeze-thaw weathering.

Rotational slip

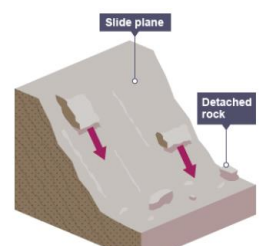


## Slumps

Saturated soil slumps down a curved surface...

## Landslides

Large blocks of rock slide downhill.

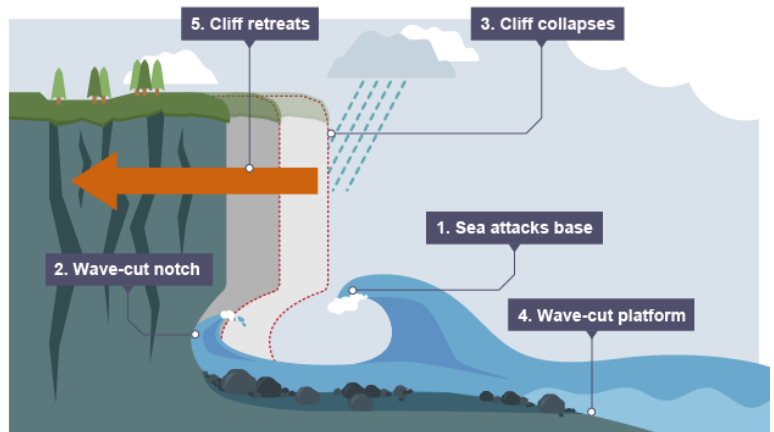




# COASTS - Landforms caused by erosion

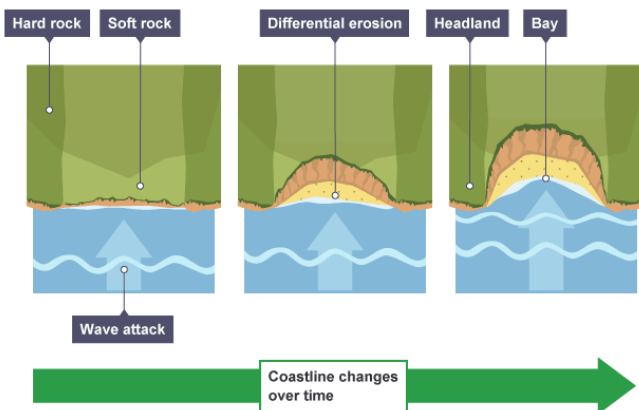
## Wave Cut Platform

- The waves cause the most erosion at the foot of a cliff
- This forms a wave-cut notch, which is enlarged as erosion continues
- The rock above the notch becomes unstable and eventually collapses
- The collapsed material is washed away and a new wave-cut notch starts to form
- Repeated collapsing results in the cliff retreating
- A wave-cut platform is the platform that's left behind as the cliff retreats



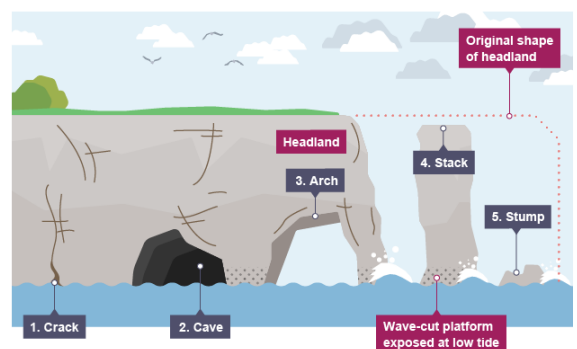
## Headlands & Bays

- Bands of soft rock such as clay and sand are weaker therefore they can be eroded quickly.
- This process forms bays.
- A bay is an inlet of the sea where the land curves inwards, usually with a beach.
- Hard rock such as chalk is more resistant to the processes of erosion.
- When the softer rock is eroded inwards, the hard rock sticks out into the sea, forming a headland.
- Headlands and Bays form where there are alternating bands of resistant and less resistant rock along a coastline.



## Caves, Arches & Stacks

- Cracks are widened in the headland through the erosional processes of hydraulic action and abrasion.
- As the waves continue to grind away at the crack, it begins to open up to form a cave.
- The cave becomes larger and eventually breaks through the headland to form an arch.
- The base of the arch continually becomes wider through further erosion, until its roof becomes too heavy and collapses into the sea. This leaves a stack (an isolated column of rock).
- The stack is undercut at the base until it collapses to form a stump.



Caves, arches, stacks and stumps are erosional features that are commonly found on a headland.

**GCSE Practice Question: 'Explain the formation of a wave-cut platform'. [4 marks]**

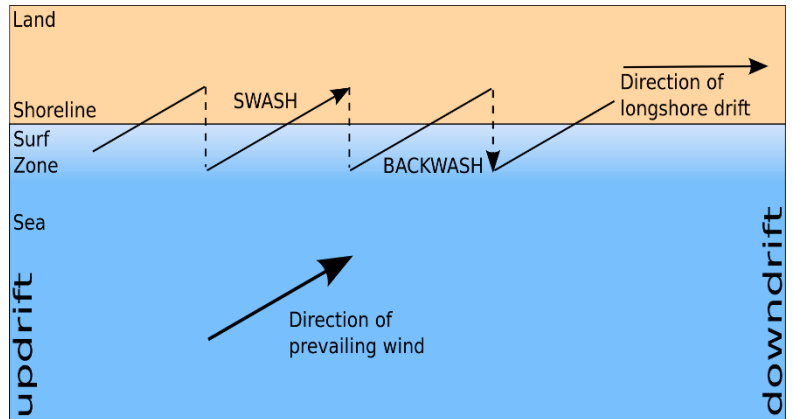


# COASTS - Landforms caused by Transportation & Deposition

## Longshore Drift

Material is transported along a coast by a process called Longshore Drift:

- 1) Waves follow the direction of the prevailing wind
- 2) They usually hit the coast at an oblique angle (any angle that isn't a right angle)
- 3) The swash carries material up the beach, in the same direction as the waves
- 4) The backwash carries material down the beach at right angles, back toward the sea.
- 5) Over time, material zig-zags along the coast.



## Deposition

Deposition is when material being carried by the water is dropped on the coast. It occurs when the water doesn't have enough energy to carry the sediment. Coasts are built up when the amount of deposition is greater than erosion.

## Spits, bars & Tombolos

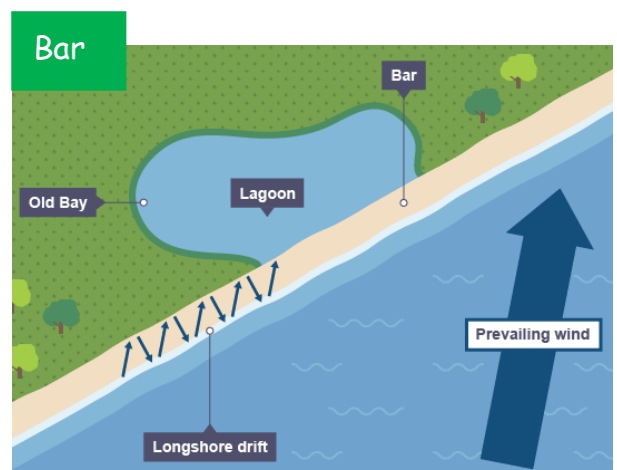
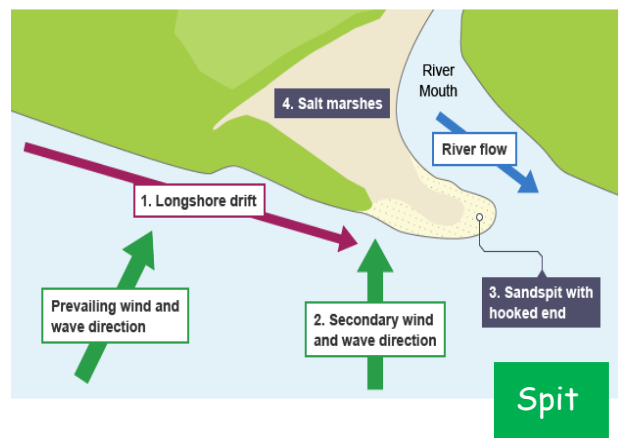
A spit is an extended stretch of sand or shingle jutting out into the sea from the land. Spits occur when there is a change in the shape of the landscape or there is a river mouth.

**This is how spits are formed:**

- Sediment is carried by longshore drift.
- When there is a change in the shape of the coastline, deposition occurs. A long thin ridge of material is deposited. This is the spit.
- A hooked end can form if there is a change in wind direction.
- Waves cannot get past a spit, therefore the water behind a spit is very sheltered. Silts are deposited here to form salt marshes or mudflats.

**Bar:** A bar is formed as above, with the difference being the spit joins across two headlands

**Tombolo:** When the spit forms an island



## Beaches

- Beaches are made up from eroded material that has been transported from elsewhere and then deposited by the sea. For this to occur, waves must have limited energy, so beaches often form in sheltered areas like bays.
- Constructive waves build up beaches as they have a strong swash and a weak backwash.
- Sandy beaches are usually found in bays where the water is shallow and the waves have less energy.
- Pebble beaches often form where cliffs are being eroded, and where there are higher energy waves.

## Sand Dunes

- Sand dunes are formed when sand deposited by longshore drift is moved up the beach by the wind.
- Obstacles cause the wind speed to decrease so sand is deposited. This sand is colonised by plants and grasses. The vegetation stabilises the sand and encourages more sand to accumulate there, forming small dunes called embryo dunes
- Over time, the oldest dunes migrate inland as newer embryo dunes are formed. These mature dunes can grow up to 10m tall.

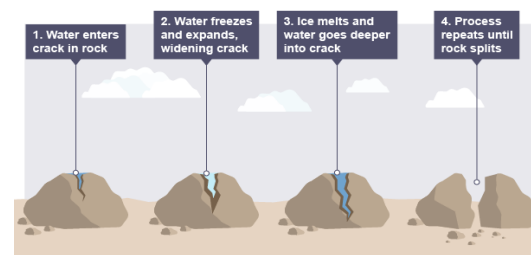
**GCSE Practice Question:** 'Explain how the processes of deposition lead to the formation of distinctive landforms. [6 marks]

# COASTS - Weathering

## Freeze-Thaw Weathering

Freeze-thaw weathering occurs when rocks are porous (contain holes) or permeable (allow water to pass through).

- Water enters cracks in the rock.
- When temperatures drop, the water freezes and expands causing the crack to widen.
- The ice melts and water makes its way deeper into the cracks.
- The process repeats itself until the rock splits entirely.



## Biological Weathering

Plants and animals can also have an effect on rocks. Roots burrow down, weakening the structure of the rock until it breaks away.

- Plant roots can get into small cracks in the rock.
- As the roots grow, the cracks become larger.
- This causes small pieces of rock to break away.

## Chemical Weathering

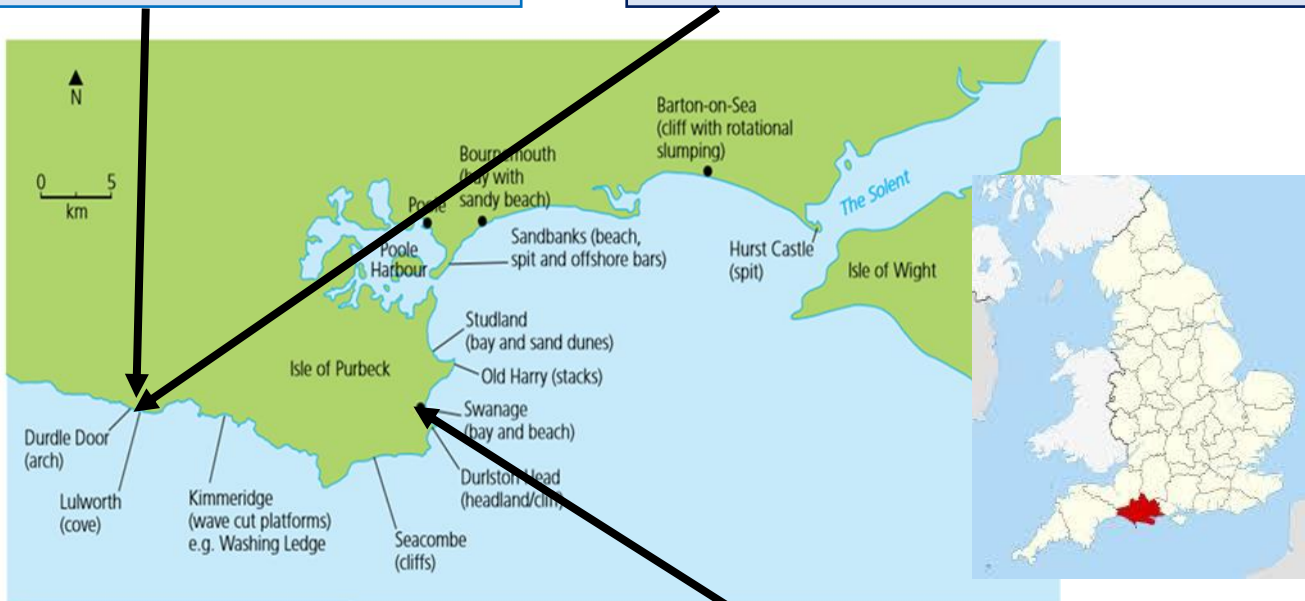
Rainwater and seawater can be a weak acid. If a coastline is made up of rocks such as limestone or chalk, over time they can become dissolved by the acid in the water.

## COASTS - UK Coast Example - The Dorset Coast

The Dorset Coast is made from bands of **hard rock** (limestone and chalk) and **soft rock** (clay). The rocks have been eroded at different rates giving headland and bays and lots of other coastal features.

**Durdle Door** is a great example of an **arch**. Erosion by the waves opened up a crack in the **limestone headland**, which became a cave and then developed into an **arch**.

**Lulworth Cove** is a small **bay** formed after a gap was eroded through a band of **limestone**. Behind the limestone is a band of **clay**, which has been eroded away to form the bay.



**Chesil Beach** is a **tombolo** (a type of spit) formed by **longshore drift**. It joins the Isle of Portland to the mainland. Behind Chesil Beach is a shallow lagoon called the Fleet Lagoon.

**Swanage Bay** is two bays with beaches called Swanage Bay and **Studland Bay**. They're areas of softer rock. In between them is called a **headland** called The Foreland which is made of harder rock (Chalk). The end of the headland has been eroded to become a stack called **Old Harry** and a stump called Old Harry's wife.



Lulworth Cove



Chesil Beach



Old Harry

**GCSE Practice Question:** Explain the formation of a spit. (4 marks)

# COASTS – Coastal Management Strategies

## Hard Engineering

Hard engineering management involves using artificial structures, whereas soft engineering management is a more sustainable and natural approach to manage coastal erosion.

## Soft Engineering

Soft engineering does not involve building artificial structures, but takes a more sustainable and natural approach to managing the coast.

Defence	What is it	Benefits	Costs
<b>SEA WALL</b>	A wall is made out of hard material like concrete that reflects wave energy back to sea	It prevents erosion of the coast. It also acts as a barrier to prevent flooding	It creates a strong backwash, which erodes under the wall. Sea walls are expensive and ugly
<b>GABIONS</b>	A wall of wire cages filled with rocks usually built at the foot of cliffs	The gabions absorb wave energy and reduce erosion. They're cheap & easy	They're ugly and the wire cages erode over time
<b>ROCK ARMOUR</b>	Boulders that are piled up along the coast.	The boulders absorb wave energy and reduce erosion and flooding. It is cheap	Boulders can be moved around and they are hard to get into place as are lacks and heavy
<b>GROYNES</b>	Wooden fences that are built at right angles to the coast. They trap material transported by longshore drift.	They create wider beaches which slow waves. This gives greater protection from flooding & erosion.	They starve beaches of sediment further down the coastline. These then have less protection against erosion.
<b>BEACH REPLENISHMENT</b>	Sand and shingle added to the beach.	It creates wider beaches which slow the waves and protects against flooding and erosion	It is very expensive and needs to be constantly repeated
<b>SAND DUNE REGENERATION</b>	Creating or restoring sand dunes.	Sand dunes provide a barrier between the land and the sea. Wave energy is absorbed which prevents flooding. It is cheap.	The protection is limited to a small area. It is very expensive.

## Managed Retreat

- 1) Managed Retreat involves removing coastal defences and allowing the sea bed to flood behind.
- 2) Over time the land will become marshland, which then protects the land further behind from flooding and erosion
- 3) It is cheap and easy and doesn't need maintaining. The marshland also creates new habitats.
- 4) It can cause conflict to those who lose land to the retreat, often farmers.



# COASTS - Coastal Management Case Study: LYME REGIS

## Location

Small coastland town in SW England. In the heart of a heritage coastline called the Jurassic Coast.

## Issues in Lyme Regis

- The town is built on unstable cliffs. The town is built on a layer of strong limestone which is very solid. On top of that layer there are slippery muds, clays and sands which slide over the limestone layer to form the landslides.
- The sea erodes the cliffs at the bottom of the landslide, causing it to become unstable and slip even further.
- Houses, buildings and roads become damaged as the land slips towards the sea.

## Why does Lyme Regis need protecting?

- The local economy depends on tourism as its main source of income
- 37,500 people are employed in the tourist sector in the town
- The area generates £800 million per year from tourism
- The town hosts many festivals, including an annual fossil festival.

## GCSE Practice Question:

'Coastal management schemes are effective in protecting the coastline from physical processes.' Do you agree? Use an example in your response (9)

## Management of the Coastline

The Lyme Regis Environmental Improvement Scheme was set up in the early 1990s to provide long-term coastal protection and reduce the threat of landslips

### Phase 1:

- New sea wall and promenade constructed to the east of the River Lim. In the winter of 2003 a £1.4 million emergency project was completed to stabilise the cliffs 1000 steel pins were used to hold rocks together.

### Phase 2:

- Creation of a wide sandy beach (nourishment) to absorb wave energy and increase use of the shore: the beach was nourished with 75,000 tonnes of shingle dredged from the Channel

### Phase 3:

- Initial plan to prevent landslips and coastal erosion to the west of the Cobb were shelved. It was decided to leave this stretch of the coast alone as the costs outweighed the benefits.

### Phase 4:

- The final phase focused on the coast east of the town. It cost £20 million and involved constructing a new 390m sea wall in front of the existing wall.

## Advantages

- The new beaches have increased visitor numbers and sea front businesses are thriving
- The new defences have stood up to recent stormy winters
- The harbour is now better protected, benefiting boat owners and fishermen.
- Residents can now get house insurance

## Disadvantages

- The scheme was very expensive, over £30 million
- The beach needs to be replenished every 3 years.
- The sea wall will need replacing in 30 years
- Locals complained about construction noise
- Sea defences may speed up erosion further down the coastline



## Long Profile

- The path of a river as it flows downhill is called its course
- Rivers have an upper course, a middle course and a lower course
- Rivers form channels and valleys as they flow downhill
- They erode the landscape, transport material and then deposit material
- The shape of the river changes along the river depending on whether erosion or deposition is taking place
- A rivers long profile of a river shows how the gradient (steepness) changes over time,

### Upper Course

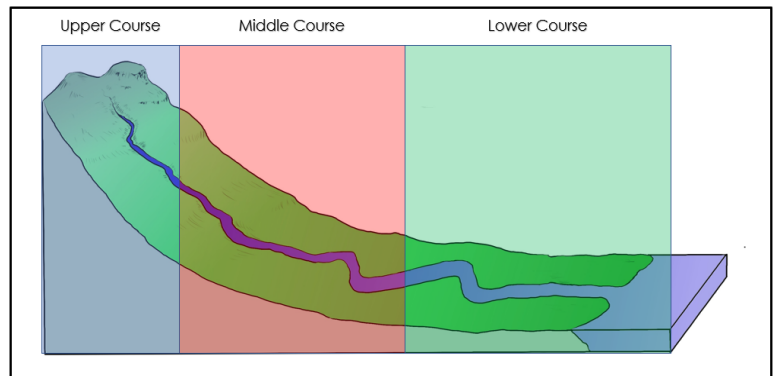
- Steep
- V-Shaped valley with steep sides,
- narrow and shallow

### Middle Course

- Gently sloping
- Sloping Valley sides,
- Wider and deeper channel

### Lower Course

- Steep
- V-Shaped valley with steep sides,
- narrow and shallow

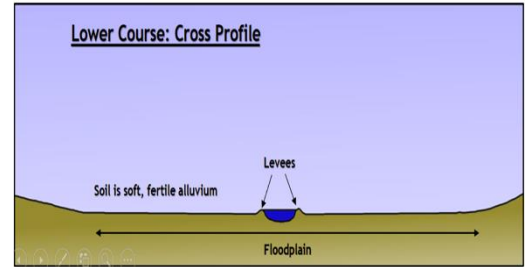
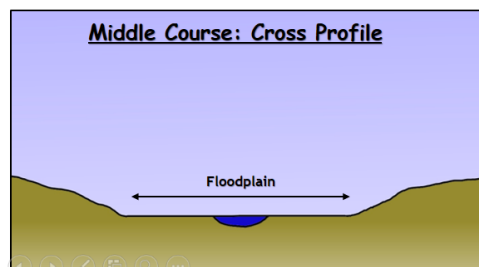
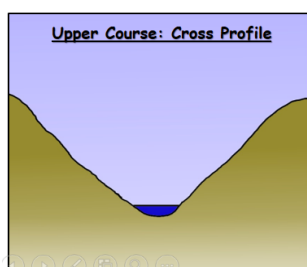


### GCSE Practice Questions:

- 1) Explain why the upper course of a river valley has a different cross profile from the lower course (4)
- 2) Describe how the shape of a river valley changes downstream (4)

## Cross Profile

A **river's cross profile** is an imaginary slice across a river channel and its valley at a particular point and **will change downstream**. It generally becomes flatter and wider as the river is eroding more laterally the further down you go.



Erosion can be both vertical or lateral - both types happen at the same time, but one is usually dominant over the other at different points along the river.

### Lateral Erosion

This **widens** the river valley (and channel) during the formation of meanders. It's dominant in the **middle and lower** courses

### Vertical Erosion

This **deepens** the river valley (and channel) making it V-Shaped. It's dominant in the **upper course**. High turbulence causes rough, angular particles to be scraped along the bed causing downwards (vertical) erosion

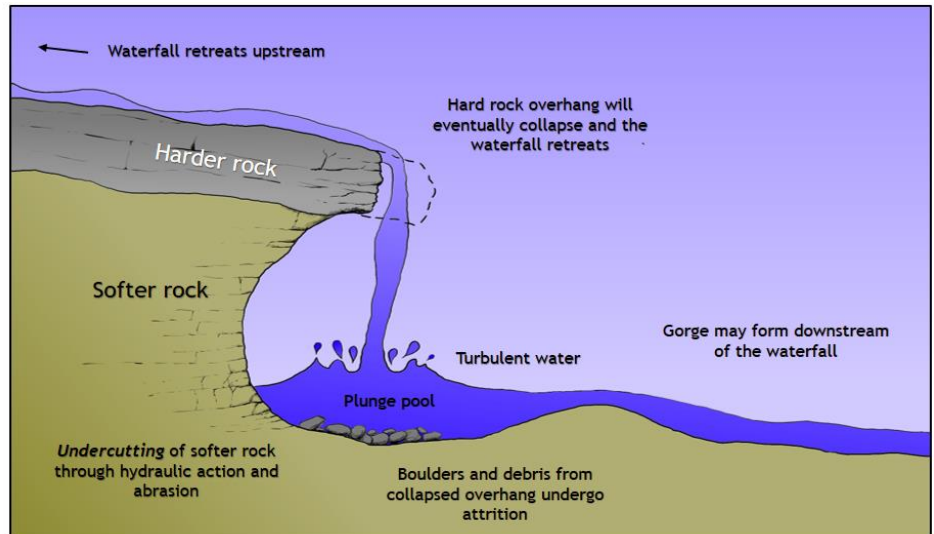
# RIVERS – Erosional Landforms

There are 4 processes of erosion, hydraulic action, attrition, abrasion and solution (pg 29) that change the landscape and create distinctive landforms....

## Waterfalls

- Waterfalls form where a river flows over an area of hard rock followed by an area of softer rock

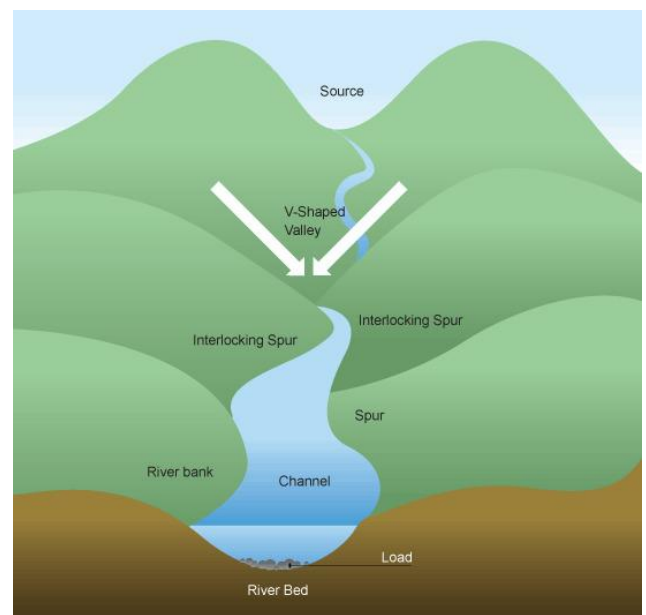
- The softer rock is eroded by hydraulic action & abrasion more than the harder rock, creating a step in the



- As water goes over the step it erodes more and more of the softer rock
- A steep drop is eventually created, which is called a waterfall
- The hard rock is eventually undercut by erosion. It becomes unsupported and collapses
- The collapsed rocks are swirled around at the foot of the waterfall where they erode the softer rock by abrasion. This creates a deep plunge pool
- Over time, more undercutting causes more collapses. The waterfall will retreat (move back) leaving behind a steep-sided gorge.

## Interlocking Spurs

- In the upper course of a river most of the erosion is vertical. This creates steep valley sides.
- The rivers aren't powerful enough to erode them laterally (sideways) - they have to wind around the high hillsides that stick out into their paths
- The hillsides that interlock with each other (like a zip) as the river winds around them are called interlocking spurs

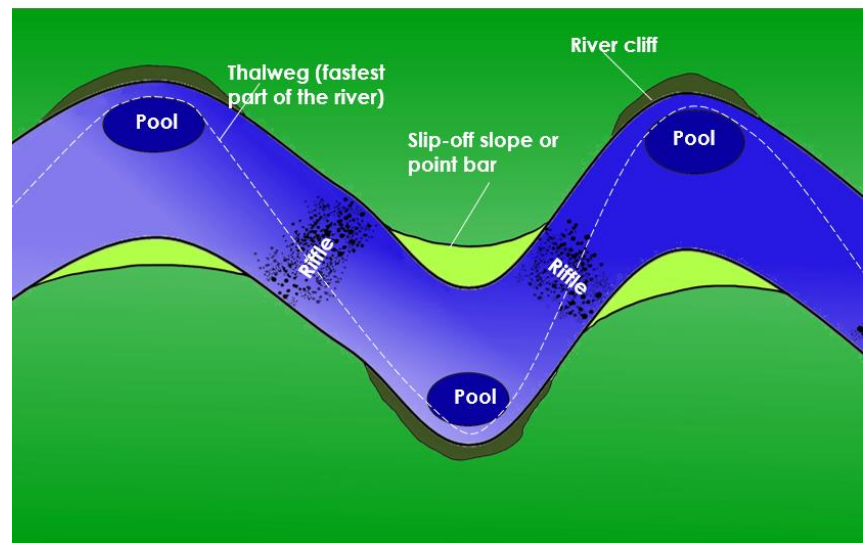
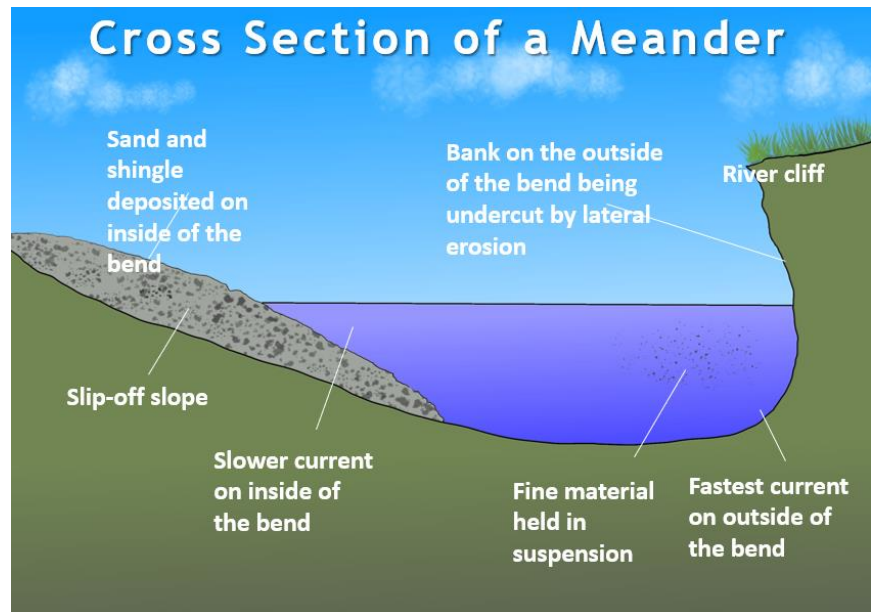


# RIVERS – Meanders

When a river is eroding and depositing material, meanders and oxbow lakes can form.

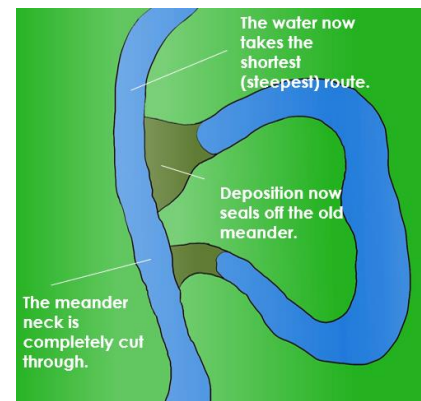
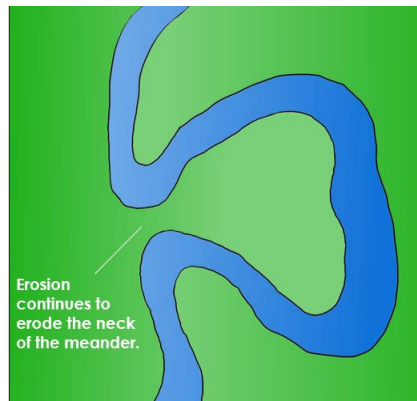
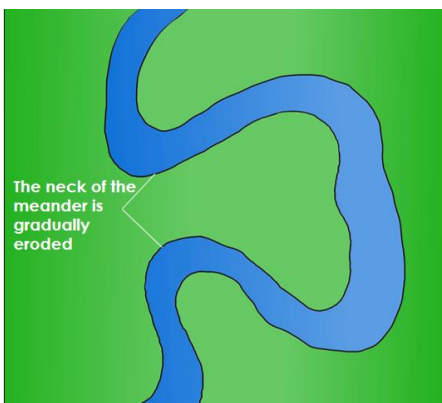
Rivers develop large bends called meanders in their middle and lower courses.

- The current is **faster** on the **outside** of the bend because the river channel is deeper (less friction to slow it down)
- So **more erosion** takes place on the **outside** of the bend, forming river cliffs
- The current is **slower** on the **inside** of the bend because the river channel is shallower (there's more friction to slow it down)
- So eroded material is **deposited** on the **inside** of the bend, forming slip-off slopes
- The fastest flow of a river through a meander is called a **thalweg**



Meanders get larger over time -they eventually turn into an oxbow lake

## Ox bow Lakes



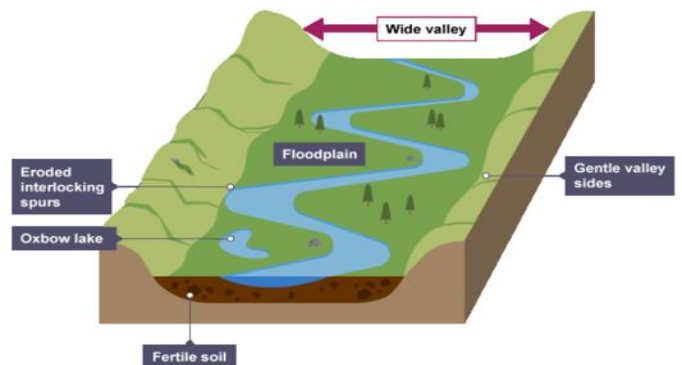
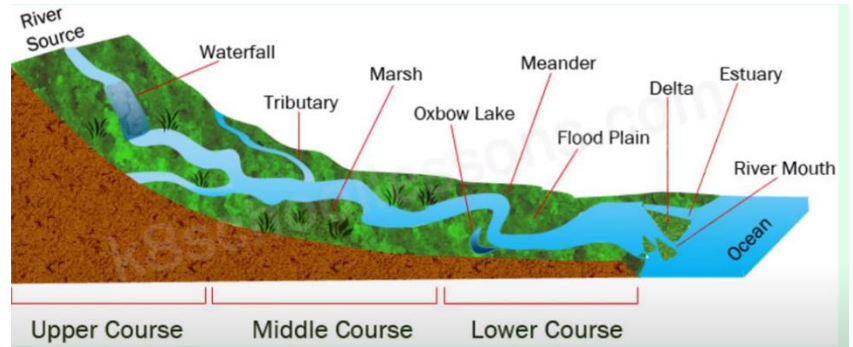
# RIVERS - Depositional Landforms

## Floodplains

A floodplain is an area of land which is covered in water when a river bursts its banks. Floodplains form due to both erosion and deposition. Erosion removes any interlocking spurs, creating a wide, flat area on either side of the river.

During a flood, material being carried by the river is deposited (as the river loses its speed and energy to transport material). Over time, the height of the floodplain increases as material is deposited on either side of the river.

Floodplains are often agricultural land, as the area is very fertile because it's made up of alluvium (deposited silt from a river flood).



## Estuary

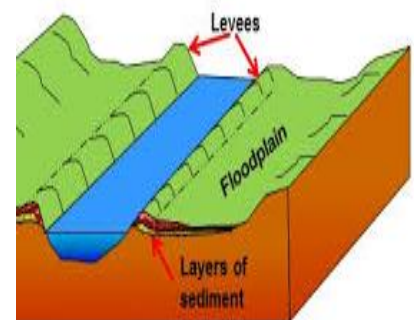
- An estuary is where the river meets the sea.
- The river here is tidal and when the sea retreats the volume of the water in the estuary is less reduced.
- When there is less water, the river deposits silt to form mudflats which are an important habitat for wildlife.
- The land of an estuary is not very fertile so it is not good for agriculture, however it does create good habitats for wildlife.

## Delta

- Deltas are found at the mouth of large rivers - for example, the Mississippi. A delta is formed when the river deposits its material faster than the sea can remove it.
- As the river approaches the sea it loses energy and deposits material. The sediment may be sorted as the heaviest material is deposited first.
- Over time, more and more sediment is added.
- If the tides are strong enough the sediment will be washed away. If not, it will build up a land mass (delta) at the mouth of the river.

## Levees

- Levees are natural embankments along the edges of a river
- During a flood, eroded material is deposited over the whole flood plain.
- The heaviest material is deposited closest to the river channel, because it gets dropped first when the river slows down
- Overtime, the deposited material builds up, creating levees along the edges of the channel.





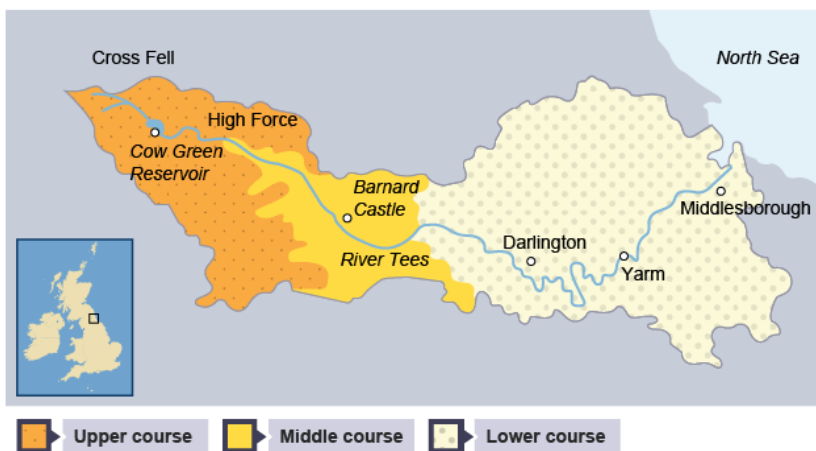
# RIVERS - UK River Case Study - The River Tees

## Location

The River Tees is located in **NE England**. Its source is high in the Pennine Hills. From here it flows 128km to its mouth in the North Sea near Middlesbrough

## Upper Course

- The **upper course** has hard **impermeable rocks**. Here, vertical erosion has formed a V-shaped valley.
- High Force, the UK's largest **waterfall** at 21 metres high is located in the upper course. An area of hard rock, called Whin Sill (or Whinstone), is located above a layer of soft rocks (sandstone and shale) and together they create this impressive **waterfall**.



## Middle Course

- As the River Tees starts to erode sideways (lateral erosion), it forms **meanders**.
- These can be identified in the **middle course** near Barnard Castle.

## Lower Course

- Near Yarm, the **meanders** in the lower course are much larger, and **oxbow lakes** have formed. In this area there are also levees which have formed when the river has flooded.
- The River Tees has a very large **estuary with mudflats** and sandbanks which supports wildlife in the area. Sites such as Seal Sands are protected areas.

## Human Uses

- **Farming** - Sheep farming in the upper course
- **Tourism** - The Pennine Way walk and the High Force Waterfall
- **Transport & Settlement** - The River Tees has been important for transport for centuries. Towns such as Yarm owe their existence to trading stops on the river.

## GCSE Practice Questions:

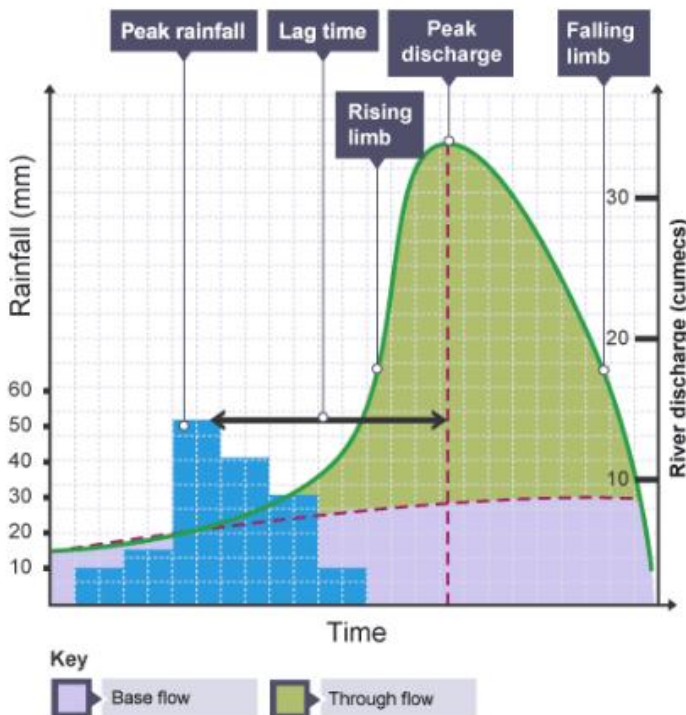
- 1) 'Explain how an ox-bow lake could form on the river' (4)
- 2) 'Explain how waterfalls are created by physical processes' (4)
- 3) 'Explain the formation of a floodplain' (4)
- 4) Using a named example, which river features are found in the middle and lower course (6)



# RIVERS - Hydrographs & Flooding

## Hydrographs

- **River discharge** is just the volume of water that flows in a river per second. It's measured in cubic metres per second. **Hydrographs** show how the discharge at a certain point in a river changes **over time** in relation to rainfall.



- **Peak discharge** - maximum amount of water held in the channel.
- **Peak rainfall** - maximum amount of rainfall (millimetres).
- **Lag time** - the time taken between peak rainfall and peak discharge.
- **Rising limb** - shows the increase in discharge on a hydrograph.
- **Falling limb** - shows the return of discharge to normal/base flow on a hydrograph.
- **Base flow** - the normal discharge of the river.

### Factors influencing lag time include:

- Size of drainage basin
- Vegetation
- Valley side steepness
- Soil type

- **The lag time** can be short or long depending on different factors. For example, if there is **no vegetation** in an area, the **water runs off into the river quicker**, therefore it would have a short lag time.
- Alternatively, if there is **plenty of vegetation** in the area, the **lag time would be longer** as the plants would intercept the rainfall. A short lag time means water is reaching the river quickly, so there is a greater chance of a flood.

### Human & Physical Factors that affect flood risk

**Rainfall:** After a long period of rain, the soil becomes saturated. Any further rain can't infiltrate, which increases runoff into rivers. This increases discharge, so flooding is more likely.

**Rock Type:** Clay soils and some rocks are impermeable and don't allow water through and run off is increased.

**Relief:** If a river has steep sides, water will reach the river much quicker, increasing discharge and making flooding more likely.

**Trees:** Trees intercept and rainwater, and also take up water from the ground. Cutting down trees therefore by deforestation increased the risk of floods.

**Land Use:** Buildings are often made from impermeable materials like concrete, as well as being surrounded by roads. Impermeable surfaces increase runoff and drains quickly take water to rivers.

# RIVERS – Hard & Soft Engineering

The UK can receive heavy amounts of rainfall and this has caused many floods to different areas. Whilst we obviously cannot stop the rain, many strategies have been implemented to try and prevent floods from occurring or limiting the impacts of them. **The 2 main types of preventing flooding are called Hard and Soft Engineering strategies.**

**Hard Engineering** involves using man-made structures to prevent or control natural processes from taking place. This form of flood management is usually very expensive.

**Soft Engineering** does not involve building artificial structures, but takes a more sustainable and natural approach to managing the potential for river flooding.

Method	What is it	Advantages	Disadvantages
<b>Dams and reservoirs</b>	The dam traps water, which builds up behind it, forming a reservoir. Water can be released in a controlled way.	<ul style="list-style-type: none"> <li>Can be used to produce electricity by passing the water through a turbine within the dam.</li> <li>Reservoirs can attract tourists.</li> </ul>	<ul style="list-style-type: none"> <li>Very expensive.</li> <li>Dams trap sediment which means the reservoir can hold less water.</li> <li>Habitats are flooded often leading to rotting vegetation. This releases methane which is a greenhouse gas.</li> <li>Settlements are lost leading to the displacement of people.</li> </ul>
<b>River straightening and dredging</b>	Straightening the river speeds up the water so high volumes of water can pass through an area quickly. Dredging makes the river deeper so it can hold more water.	<ul style="list-style-type: none"> <li>More water can be held in the channel.</li> <li>It can be used to reduce flood risk in built-up areas.</li> </ul>	<ul style="list-style-type: none"> <li>Dredging needs to be done frequently.</li> <li>Speeding up the river increases flood risk downstream.</li> </ul>
<b>Embankments</b>	Raising the banks of a river means that it can hold more water.	<ul style="list-style-type: none"> <li>Cheap with a one-off cost</li> <li>Allows for flood water to be contained within the river.</li> </ul>	<ul style="list-style-type: none"> <li>Looks unnatural.</li> <li>Water speeds up and can increase flood risk downstream.</li> </ul>
<b>Flood relief channels</b>	The floodwater flows into the relief channel and is taken either to an area where it can be absorbed, or re-enters the river further down its course.	<ul style="list-style-type: none"> <li>Removes excess water from the river channel to reduce flooding.</li> </ul>	<ul style="list-style-type: none"> <li>Expensive to build.</li> <li>If water levels continue to rise, the relief channel may also flood.</li> </ul>
<b>Floodplain zoning</b>	Allowing only certain land uses on the floodplain reduces the risk of flooding to houses and important buildings.	<ul style="list-style-type: none"> <li>More expensive buildings and land uses are further away from the river, so have a reduced flood risk.</li> <li>Less damage is caused, leading to fewer insurance claims.</li> </ul>	<ul style="list-style-type: none"> <li>Not always possible to change existing land uses.</li> <li>Planners have to decide what type of flood to plan for.</li> </ul>
<b>Flood Warnings</b>	The Environment Agency warns people in advance	<ul style="list-style-type: none"> <li>Warnings give people time to evacuate</li> </ul>	<ul style="list-style-type: none"> <li>Warnings don't stop a flood from happening.</li> </ul>

# RIVERS - Flooding Case Study - Somerset 2014

## Location

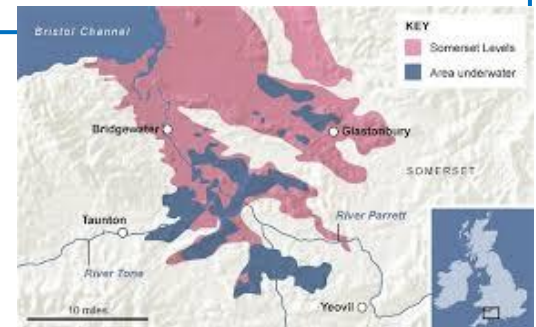
Somerset is located in SW England. In January 2014 Somerset experienced floods greater than any other in living memory. Estimates suggest that 10% of the area was underwater

## Causes of the flood

- A quick succession of prolonged Atlantic storms, with persistent rainfall and gale-force winds were the major cause of flooding, it was the wettest January since records began as 350mm of rain fell (100mm above average).
- The storms hit during high tides causing a storm surge which made coastal flooding worse
- Rivers hadn't been dredged so their capacity to carry water was lower

## Social Impacts

- 600 houses were flooded and 16 farms were evacuated
- Villages were cut-off and residents needed to be evacuated
- Power supplies were cut and phone lines damaged



## Economic Impacts

- Somerset Council estimated the cost of the flooding to be £10 million
- 14,000 Ha of agricultural land was lost
- 1000 livestock were killed
- Fuel used to power emergency pumps cost £200 000 per week
- The Somerset floods cost the tourism industry £200 million

## Environmental Impacts

- Flood waters were contaminated with sewage
- Stagnant water was toxic and had to be treated before being pumped back into rivers
- It took over two years to restore the soil before crops could be grown.

**GCSE Practice Questions:**  
'Use a case study to describe responses to river flooding. (6)

## Short Term Responses

- Sixty-five pumps were used to drain 65 million m<sup>3</sup> of floodwater.
- 40 Royal Marines issued sandbags and distributed food
- Rescue boats were used to help stranded people by the fire brigade who also visited hundreds of properties
- The Government pledged £15 million immediate aid to build temporary flood barriers
- The Environment Agency issued several flood warnings for the area.

## Long Term Response - New Flood Defences

- A new Flood Defence scheme was introduced as part of a 20-year plan for the Somerset Levels and will have a total cost of £100 million.
- The defences involved the construction of a tidal barrage and additional permanent pumping stations.
- 8km of the River Tone and Parrot were dredged increasing capacity
- Culverts (large drains) have been added to major roads and 4 roads have been raised.

## Paper 2 Section A URBAN ISSUES & CHALLENGES

### What is urbanisation?

- Urbanisation is the growth in the proportion of a country's population living in an urban area.
- Nearly 60% of the world's population now live in cities, that's 3.8 million people
- Urbanisation is happening fastest in LIC/NEE countries, Good transport, internet, communication networks mean people can live in rural areas perfectly well in HICs.
- Urban areas are growing rapidly. They can cause a range of opportunities and challenges.
- Urban planning is important to ensure that the opportunities are maximised and the challenges are minimised.

1) Rural to urban migration is the movement of people from the countryside to the city. The rate of rural-urban migration is affected by push (things that encourage people to leave) and pull (things that encourage people to move to an area) factors.

#### Push Factors

- Natural disasters
- War and Conflict
- Mechanisation (of agricultural equipment so less farming jobs)
- Drought/Desertification
- Lack of employment

#### Pull Factors

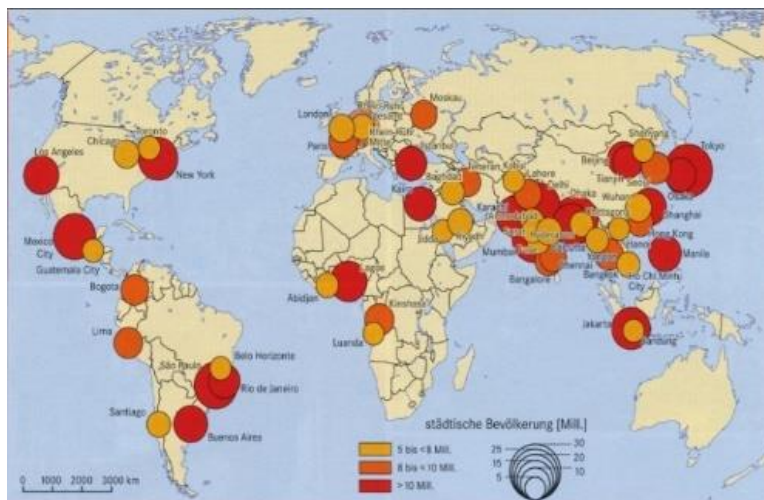
- More Jobs
- Better education & healthcare
- Increased quality of life.
- Following family members

2) **Urbanisation** is caused by natural increase. Natural increase is when the birth rate is higher than the death rate (more people being born than dying) so the population grows

3) It's normally the **young** who move to cities to find work.

4) **The young** then generally start families, which increased the population further. Also better healthcare means people in cities live longer

5) High rates of urbanisation are leading to the growth of mega cities. A megacity is a city with a population over 10 million. In total, in 2020, there are 35 megacities, with most located in Asia (red circles on the map below).



**GCSE Practice Questions:** 'Why do people who move to cities from rural areas often have to work in the informal sector?' (6marks).

**GCSE Practice Questions:** 'Why are urban populations in less developed countries growing rapidly?' (4marks).



# NEE Urban Case Study - Rio De Janeiro

## Location

- Rio is a coastal city situated in the South East region of Brazil within the continent of South America. It is the second most populated city in the country (6.5 million) after Sao Paulo.

## Why is Rio Important?

- Regional importance- Has the second largest GDP in Brazil.
- National importance- It is home to headquarters of many of Brazil's main companies, particularly banking; it is the wealthiest Brazilian city, adds 7% to Brazil's economy
- International Importance- Hosted the 2014 World Cup and 2016 Summer Olympics. Sugar Loaf Mountain is one of the Seven Wonders of the World and attracts tourists.

## Rio offers people better jobs and a better quality of life...

Rio has better access to services and resources than rural Brazil:

- 1) More healthcare centres and hospitals
- 2) More reliable wages than farming in rural Brazil
- 3) Good community spirit within slums, e.g. Rocinha
- 4) 12 million people have internet access in the city
- 5) Better Schools - 95% of children over 10 can read in Rio.
- 6) Culture - Rio is famous for its annual carnival, samba schools, and sporting events.

### Social Opportunities

Rural Brazil is very poor- most people come to Rio in search of better jobs

- 1) Rapid growth of the city means there are lots of construction jobs
- 2) Rio is a major trading port, with important oil refining and ship-building industries. The main exports from Rio are crude petroleum and semi-finished iron and steel products.
- 3) Sport - football is the national sport in Brazil, and major global sporting events take place here.
- 4) Tourism - provides 1000s of jobs. Rio is one of the most visited cities in the southern hemisphere. Major attractions include the Christ the Redeemer statue

### Economic Opportunities

## ...But rapid growth has led to loads of problems

- Over 25% of the population live in slums, E.g. Rocinha
- Slum housing- made from wood, metal and rubbish which are unstable and can collapse
- Communal toilets- in Dharavi there is 1 toilet per 500 people
- Only 30% of people have access to healthcare
- Poor sanitation- diseases spread quickly, e.g. typhoid, cholera
- High levels of crime, violence and drug abuse blight many of the favelas.

### Social Challenges

- Huge gap between rich and poor.
- Unemployment rates can be greater than 20% in the favelas.
- People who work in the informal sector do not pay taxes and therefore do not receive insurance or unemployment benefit.
- Around one-third of workers in Rio are in the informal sector

### Economic Challenges

- 3.1 million tons of waste is generated in Rio every year. Most is taken to landfill.
- As materials decompose in landfill sites they release gas which is harnessed to fuel vehicles and provide a source of energy for electricity.
- High water pollution- sewage and industrial waste is dumped into rivers
- High air pollution- overreliance on using fossil fuels to meet energy demands, increase emissions from vehicle use

### Environmental Challenges



# NEE Urban Case Study – Rio De Janeiro – SLUMS

## Squatter Settlements in Rio

- Rio's planners and city authorities have not been able to keep up with rapidly expanding population. The average population density in Rio is 6,000 people per km<sup>2</sup>. This puts pressure on the supply of housing, services and infrastructure.
- The majority of those who move to Rio from rural areas end up living in slums (called Favelas)

### Squatter Settlements in Rio

- A problem of rapid rural to urban migration is the development of squatter settlements. In Rio the squatter settlements are now home to over 1.5 million people. The most famous slum is Rocinha, which is built on the steep slopes surrounding the main Rio city. The squatter settlement is unplanned and has the following characteristics:
- overcrowded, noisy and smelly
- houses are made from cardboard, wood, corrugated iron, plastic sheeting and metal from oil drums
- lack of sanitation, clean drinking water and open sewers
- pollution and disease are common
- thousands of workshops and people employed in the informal job sector



Rio has a shortage of drinking water, despite being surrounded by water. The water surrounding the city is saltwater. Around 15% of Rio's population does not have a piped water supply, leaving it to obtain water from other sources, such as groundwater or storage cans. This can be contaminated, either by sewage. The only alternative is to buy water from a water vendor.

### Water Supply in Rio

The whole city suffers frequent blackouts due to a shortage of energy. The growing population and the amount of stolen electricity make the problem worse. To combat energy problems, Rio has installed 60km of new power lines, and has built a new hydro-electric complex which will increase Rio's supply by 30%. It took 6 years to build and cost US\$ 2 billion, but Rio lost a large proportion of its surrounding rainforest to accommodate the dam.

### Energy Supply in Rio

# NEE Urban Case Study – Rio De Janeiro

## The Favela-Bairro Project helps poor people in Rio's Favelas

Often the poorest people in urban areas are the worst affected by the problems of urban growth. Urban planning schemes can help reduce the impact of these problems and improve the quality of life for the quality of life for the urban poor. An example of an urban planning scheme is the Favela-Bairro Project in Rio:

- 1) Rio is in SE Brazil. It has some 600 squatter settlements called favelas. 1/5<sup>th</sup> of the city's population live in these favelas.
- 2) The Favela-Bairro Project ran from 1995-2008 and involved 250,000 people in 73 favelas. It led to many social, economic and environmental improvements:

### Social Improvements

- Day Care centres and after school schemes were started
- Adult education classes were started to improve the amount of adult literacy rate and improve job prospect.
- Health Centres were set up to help people affected by drug and alcohol addiction.
- Installation of a cable car that took people from the favelas to the city centre. It was free one way from the favela with the idea people could earn money for that day and pay for the return.

### Economic Improvements

- Residents can now apply to legally own their own homes.
- Training Hubs were started to improve adult skills to enable people to work in more higher skilled formal jobs.
- 100% mortgages were offered to help fund purchases of their homes.

### Environmental Improvements

- Wooden buildings are being replaced by brick to reduce fire risk
- Street widening and paving were completed, along with installing some sewage facilities into the favela.
- Rubbish Collected were implemented to reduce the amount of rubbish left in the streets.
- Self-help schemes have also been supported. Here, local residents are provided with building materials like concrete blocks and cement in order to replace home-made shelters with permanent dwellings. These are often three or four storeys high, and with water, electricity and sewage systems installed.

### Successes

- The quality of life, mobility and employment prospects of the slums' inhabitants have improved.
- The project has been recognised by the UN as a successful model and has been used in other Brazilian cities.

### Problems

- The budget of \$1 billion still isn't enough to cover every favela in Rio
- The newly build infrastructure and housing isn't been maintained properly as residents lack the skills and materials for repairs
- Rents rise where improvements have been made meaning some people can no longer afford to live there.

**GCSE Practice Questions:** 'Using an example from an LIC, explain how a rapidly growing urban population has led to social challenges. (6 marks)

**GCSE Practice Questions:** 'Explain how an urban planning scheme in an LIC or NEE has had a positive effect on people living in the area. (4 marks)

## Section 2A Urban Issues & Challenges: UK CITIES

Cities don't just spring up in any old place, most of them are where they are for a reason. London is the UK's largest city, with nearly 9 million people and almost 10% of the population. It is the national capital and has many industries (eg it is one of the global financial centres).

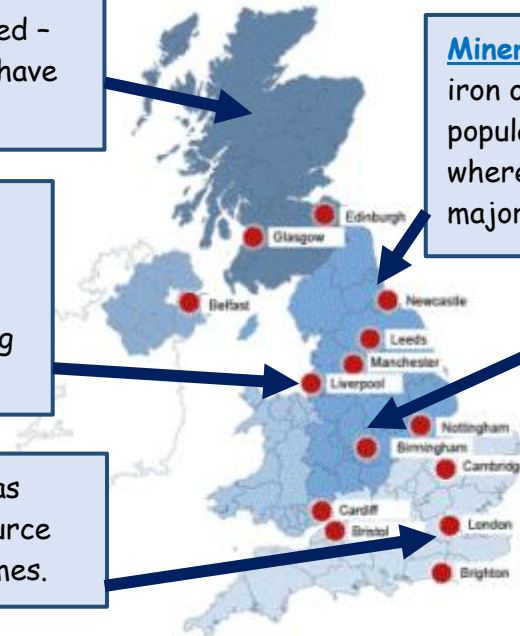
Upland Regions such as northern Scotland are sparsely populated - they are difficult to farm and have few natural resources

Coastal areas have attracted human settlement as they are very good places to locate harbours and ports for trading goods. Eg Liverpool

Rivers have attracted cities as they are useful as a water source and trading. Eg London / Thames.

Mineral Wealth (especially coal and iron ore) has often led to rapid population growth because this was where industries developed on major coalfields. Eg Newcastle

Lowland areas have attracted cities as they are easy to build on and have a milder climate. Eg Birmingham

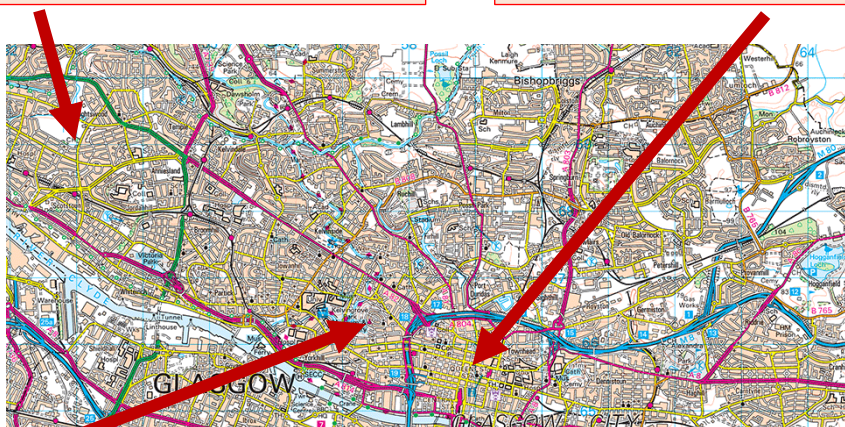


### Cities have different zones...

Most UK cities have distinct areas called zones. You might be asked to spot one on a map. There are 4 main zones....

The suburbs are found towards the edge of the city. They are mainly residential areas, often with semi-detached houses. Look out for lots of short, curved streets or cul-de-sacs on a map.

The Central Business District (CBD) is usually in the middle of a city. It has its main public buildings, train and bus stations, hotels, major shops, offices and restaurants. The CBD is often surrounded



The inner city area often has a mix of land uses - mainly residential (including old terraced housing). It has lots of short parallel roads which represent the terraced housing on the map.

The rural-urban fringe often has a mix of land uses - mainly residential (including old terraced housing). It has lots of short parallel roads which represent the terraced housing



## Section 2A Urban Issues & Challenges: BIRMINGHAM

- Birmingham is the UK's second largest city and the only city other than London to have a population over 1 million.
- Its metropolitan economy is the second largest in the United Kingdom with a GDP of \$121.1bn (2014), and its six universities make it the largest centre of higher education in the country outside London.
- Its central location made it an ideal for a city location.



### National Importance

### Why is Birmingham important?

- Birmingham is the greenest city in the UK, with over 8,000 acres of parks and open space
- It has more railways and more motorways connecting it to every part of the UK than any other city. New Street Station is the busiest station outside of London.
- It is the most culturally diverse city in the UK and around 300 languages are spoken

### International Importance

- Birmingham's historic Jewellery Quarter is now the largest jewellery making centre in Europe
- It is home to massive global brands such as Cadbury, HSBC and Jaguar Land Rover
- Birmingham International Airport had nearly 12.5 million customers in 2018, due to rise in 2022 due to the city hosting the Commonwealth Games

**GCSE Practice Questions:** 'Describe the national and international importance of a city in a HIC you have studied'. (4 marks)

### How has migration affected Birmingham...

Birmingham is one of the most culturally diverse cities in the UK. In 2015, the city had a population of 1.1 million drawn from 187 nations. This means that Birmingham has a variety of cultural/ ethnic groups within the community

#### National Migration to Birmingham

- Those moving to Birmingham from the UK are mainly 16-21 year olds. Remember, Birmingham has 4 major universities.

#### International Migration to Birmingham

- Migrants move to Birmingham usually in search of work and live in the inner city where housing is cheaper. This provides Birmingham with a young working population.

#### Advantages

- Younger working population
- Contributing to both the local and national economy (taxation, multiplier effect)
- Enriching the Birmingham's cultural life (restaurants, festivals, arts, music, shops)
- Migrants are entrepreneurs, setting up businesses which stimulate the local economy
- Improving the level of skills, where there are shortages

#### Disadvantages

- More demand on schools and services (healthcare, sanitation, utilities)
- Migrants usually live in the most deprived areas of the inner city and can lead to overcrowding
- Challenge of wider integration into the wider community (tendency of migrants to live among their own group and establish enclaves)
- The need to provide education for children do not speak English



## Birmingham's Opportunities and Challenges

- During the industrial revolution there was **growth of manufacturing** industries and rapid urbanisation.
- This was followed by **industrial decline** - many industries relocated overseas or to the rural-urban fringe
- Lots of people moved to the suburbs, and inner city areas and **CBD's declined**
- **Regeneration projects** have helped to make city centres more attractive again.
- These changes have created various opportunities and challenges.

### Urban change has bought opportunities to Birmingham...

Birmingham suffered greatly due to industrial decline. However, due to regeneration and focusing on a service based economy, Birmingham now has the **strongest economy** of any UK city outside London, with an economy worth **£28.1 billion in 2018**.

### Birmingham's opportunities?

#### SOCIAL OPPORTUNITIES

- 1) **Cultural mix**- **ethnic diversity** from **migrations** has bought a range of **foods, festivals** and **cultural experiences** to the city, which **attract lots of people**, e.g. **Christmas Market** which attracts **5.5 million visitors**.
- 2) **Employment**- the **tourism** and **service** sectors now offer **many jobs**, along with **new business** developments particularly in the **finance/insurance industry** with companies such as **HSBC** locating in the city.

#### ECONOMIC OPPORTUNITIES

- 3) **Recreation & entertainment**: **Bull Ring** constructed for **shopping, 2 football teams, NEC and NIA** that hold concerts and exhibitions, **£500 million** was invested in the new **Grand Central Station**.
- 4) **Infrastructure**- **£100 million** investment in **broadband** to become a **Super-Connected city**
- 5) The **BIG CITY PLAN** regeneration scheme is the largest in Europe.

#### ENVIRONMENTAL OPPORTUNITIES

- 6) **The Eastside City Park** is a new park developed to increase the amount of green space.
- 7) To reduce pollution, traffic has been managed by creating a **park and ride** scheme and a **congestion charge** in the city centre.
- 8) Canals have been cleaned up & more **cycle and pedestrian routes** are being created e.g. A38 'Street Corridor' cycle path
- 9) Renewable energy has increased and there has been a 30% reduction in energy use. There are also **400 electric** car charging points across the city.

**GCSE Practice Questions:** In a HIC city that you have studied, how is the city making use of the changes to promote economic growth? [6 marks]

**GCSE Practice Questions:** 'Explain how international migration has led to changes in the character of a named UK city' (4 marks)

# Birmingham's Opportunities and Challenges

...but also **Challenges**

## Birmingham's Challenges

### SOCIAL & ECONOMIC CHALLENGES

- 1) Industrial decline in the 20<sup>th</sup> Century left much of Birmingham's inner city very deprived, e.g. Ladywood is in the top 10% deprived area in the country.
- 2) Birmingham's unemployment rate in Birmingham is more than twice the national average predominantly caused by this decline in manufacturing jobs.
- 3) Urban growth in parts of the city has left to increased inequality- people in wealthier areas have better access to housing, education, employment and healthcare, e.g. Sutton Coldfield.
- 4) Students in Ladywood, an inner city suburb only half as likely to gain 5 GCSEs as those in the wealthy suburb of Sutton Coldfield.
- 5) Urban sprawl to the north east of the city has been caused by a high demand for housing from a growing population and led to an increase in house prices.

### ENVIRONMENTAL CHALLENGES

- 1) Growing population meant high rates of landfill and little recycling- 65% of Birmingham's waste still goes to landfill
- 2) Heavy vehicle use led to high volumes air pollution caused by emissions.
- 3) The growth of the city and movement of people to the suburbs means there is pressure to build on greenfield sites. This has destroyed natural habitats. Building on brownfield sites is better for the environment but lands needs clearing and decontaminating first which is expensive.
- 4) As people left inner city areas, buildings were left derelict becoming a target for graffiti and vandalism

These **challenges** have led to **urban regeneration**...

### Brindley Place Regeneration

Brindley Place was one of the largest regeneration projects in Birmingham, It is a large **mixed-use** canal side development built on an old **brownfield** site of disused factories.

#### Social:

- The development provided **143 houses** for city workers
- Operate a **same day doctor** scheme

#### Economic:

- The overall cost was **£350 million**.
- Attracted new business such as RBS HQ which created **10,000 new jobs** and 95% of those living in the redeveloped area have high level qualifications.

#### Environmental:

- They **recycle 100% of the waste**.
- They operate a car share scheme for workers.
- 16 people are employed to keep area clean.



#### GCSE Practice Questions:

'Using a HIC city that you have studied, suggest how regeneration of an area can improve the quality of life for the people living there. (6 marks)

## Birmingham's Opportunities and Challenges

### Urban sprawl puts pressure on the rural-urban fringe

Urban sprawl is the unplanned growth of urban areas into the surrounding countryside, it is a transition area where there's a mix of urban and rural land use.

- 1) Birmingham has sprawled outwards, especially to the North and South where Solihull & Sutton Coldfield has developed.
- 2) Commuter settlements- places in the rural-urban fringe where the majority of the population leaves town each day to travel to work elsewhere. This can cause challenges such as demand on housing leading to increased house prices and new development and businesses closing as many choose to do their shopping whilst in town. There is also the increase in air pollution from high vehicle use.
- 3) Out of town shopping developments, eg Merry Hill and The Fort, take advantage of cheaper land on the outskirts of the city. However, large areas of rural land are lost when they are built and they can lead to air and noise pollution and traffic congestion as people tend to travel to them via car.

### Urban growth in Birmingham puts pressure on waste

As the population and number of businesses in Birmingham increase, the amount of waste generated also increases. Waste disposal is an environmental challenge.

The United Kingdom produces in the region of 30 million tonnes of household rubbish each year. As recently as the 1990s, more than 80% of this waste used to go direct to landfill. The government has recognised that this must change as landfill sites become scarce and demand for recycling gathers pace.

Through various legislative initiatives, recycling is becoming an accepted way of dealing with some of our domestic waste and currently approximately 25% of domestic waste is recycled. 65% still goes to landfill sites for burial, with about 6% having energy or value recovered from it in some way.

Birmingham's waste strategy reflects the national policy of viewing waste as a resource rather than rubbish. In partnership with Birmingham City Council we are working towards achieving a 40% recycling rate by 2026.

### How is Birmingham managing its waste problem?

- Household Waste recycling centres: These are collection points for recyclable waste to be taken. Birmingham has 5 and it currently recycles 52,000 tonnes of rubbish
- Energy Recovery: Birmingham operates a state-of-the-art Energy Recovery Facility which takes 350,000 tonnes of rubbish per year and turns it into electricity.
- Education: Birmingham waste management company (Veolia) work in partnership with local schools to provide education and facts about recycling and how to reduce your waste. Birmingham also runs a promotional campaign called 'reduce, reuse and recycle'
- Re-users Shops: The first re-user shop opening in 2016 and sells items no longer wanted by Birmingham citizens.

**GCSE Practice Questions:** 'Using a case study of a major city in the UK, assess the success of attempts to reduce the environmental effect of waste disposal. (6 marks)

# Birmingham's Traffic Management

Cities have so many people and so many cars that traffic congestion is a massive problem. Fortunately there are some solutions....

## Why is traffic a problem?

- **Environmental Problems** - lots of traffic increases [air pollution](#) and the release of [greenhouse gases](#) contributing to climate change.
- **Economic Problems** - congestion can make people [late for work](#) and delay deliveries by lorries, which causes companies to lose money
- **Social Problems** - congestion can lead to more air pollution which affects people with [breathing difficulties](#) such as

## How can HS2 reduce traffic?

- One strategy to improve Birmingham's growth is to make [large-scale transport improvements](#).
- **HS2** is a High Speed Rail link currently being built between London and Birmingham.
- Its overall objective is to [improve 'Connectivity'](#). HS2 aims to create better transport links between our cities and regions is bringing more investment to the Midlands and North, helping to level up the country - [reducing the 'North-South' divide](#).
- Birmingham stands to benefit from an additional [50,000 jobs](#), an average salary increase of £680 per year and an extra [£4 billion](#) in the economy.....
- However, not all are pleased to see the building begin!

### Advantages

- Rail travel in the past was a driving force of the UK's growing economy - HS2 has the ability to do the same thing in the 21st Century. It is estimated Birmingham will benefit by £4 billion
- HS2 will free up rail lines so freight can be transported easily as less trucks are needed on the roads
- HS2 will provide more train services. Current railways are struggling to cope with the amount of passenger numbers - 1.46 billion people per year travel on trains in the UK.

### Disadvantages

- HS2 is very expensive & will cost an estimated £32 billion
- Many homes and buildings will be demolished to make way for the HS2 and people have already been forced to leave homes despite the completion date being 2032
- Wildlife trusts are concerned that the proposed route will pose a threat to wildlife. They estimate more than 150 nature sites could be affected,
- House prices along the route have dropped with many buyers pulling out of deals as they do not want to live next to the railway

## How else can traffic be managed in UK cities?

- [Self-service bicycles](#) are available to hire for as little as 30 minutes a time in many UK Cities, including Birmingham and London. Cycle lanes can improve safety!
- Many cities have [park and ride](#) facilities on the outskirts of the city which allow people to drive to a car park and then get a train/bus into the city centre (Coleshill Parkway is an example in B'ham).
- [Metro Railways](#) have been built in many UK cities, including Birmingham. These can connect the city to the suburbs and reduce commuter traffic.
- [Electronic Payment Cards \(eg Oyster\)](#) allow people to automatically pay for journeys, making public transport quicker and easier to use



# Sustainable Urban Living – Freiburg, Germany

## Why do Urban Areas need to be more sustainable?

- Sustainable living means doing things in a way that lets the people living now have the things they need, but without reducing the ability of people in the future to meet their needs.
- Basically, it means behaving in a way that doesn't irreversibly damage the environment.
- Big cities use so many resources, they're unlikely to ever be truly sustainable, but they can do things to make themselves more sustainable.....

## What makes Freiburg sustainable?

- Involving local communities and providing a range of employment.
- Reducing the reliance on fossil fuels- and rethinking transport options
- Providing more green spaces
- Minimising the use of greenfield sites by using brownfield sites instead.
- Recycling water (including grey water) to conserve supplies
- Conserving cultural, historical and environmental sites and buildings
- There is a large cluster of solar manufacturers located in the city, which is known as 'solar valley'

## What has Freiburg, Germany done to become sustainable?

- More than 88% of packaging is recycled.
- Freiburg has reduced annual waste disposal from 140 000 to 50 000 tonnes in 12 years
- There are 350 community collection points for recycling.
- More than 10 000 people are employed in 1500 environmental businesses in the city.
- Local people can invest in renewable energy resources (solar, windmills and hydroelectric – there is also an energy conservation scheme at the local school)
- Increasing green spaces, 40% of the city is forested.
- Green roofs, that look attractive and are used to harvest rainwater
- Freiburg produces 10 million kilowatts of electricity per year from solar energy from 400 solar panels.
- 400km of cycle paths with 9,000 parking spaces for bikes, including 'bike and ride' facilities at railway and bus stations
- Restrictions on car parking spaces; in the city centre each space costs £20,000 per year!



Green roofs and solar panels in Freiburg.



Cycle Lane in Freiburg.

**GCSE Practice Questions:** 'Explain how urban living can be made more sustainable. (6 marks)

**GCSE Practice Questions:** 'Evaluate the effectiveness of an urban transport scheme(s) you have studied. (9 marks)

## Paper 2 Section B – The Changing Economic World

**Development is when a country is improving**

- Development is the progress in economic growth, use of technology and improving welfare that a country has made. When a country develops its quality of life improves.
- The level of development is different in countries, eg UK is more developed than Brazil. The difference in development between two countries is called the development gap.

**How can we measure development?**

**Development Indicators**

Indicators	Measures	Description
<u>Health</u>	Life expectancy	The average age a person is expected to live
	Death rate: deaths per 1,000 per year Birth rate: births per 1,000 per year	The number of deaths/births per 1000 people
	Infant mortality rate	The number of infants who die under the age of 5
	People per doctor	The percentage of people with access to a doctor
<u>Education</u>	Percentage in primary education	The number of children who have access to primary education.
	Literacy rate	The percentage of people who can read and write.
<u>Economic</u>	GNI (gross national income)	The total value of all goods and services produced by a country divide by population
	GDP (gross domestic product)	The total value of all goods and services produced by a country

- Individual indicators can be misleading if they are used on their own because as a country develops, some aspects develop before others. EG China, whose wealth indicators are high but social indicators are low
- Using more than one measure of development avoids these problems, which is why it is always best to use the Human Development Index

Indicator	Measure	Description
<b>Multiple</b>	Human Development Index	This is the number that's calculated using <u>life expectancy</u> , <u>literacy rate</u> and <u>GNI</u> . Every country has a HDI score of between 0 (least developed) and 1 (most developed).

# Development and the DTM

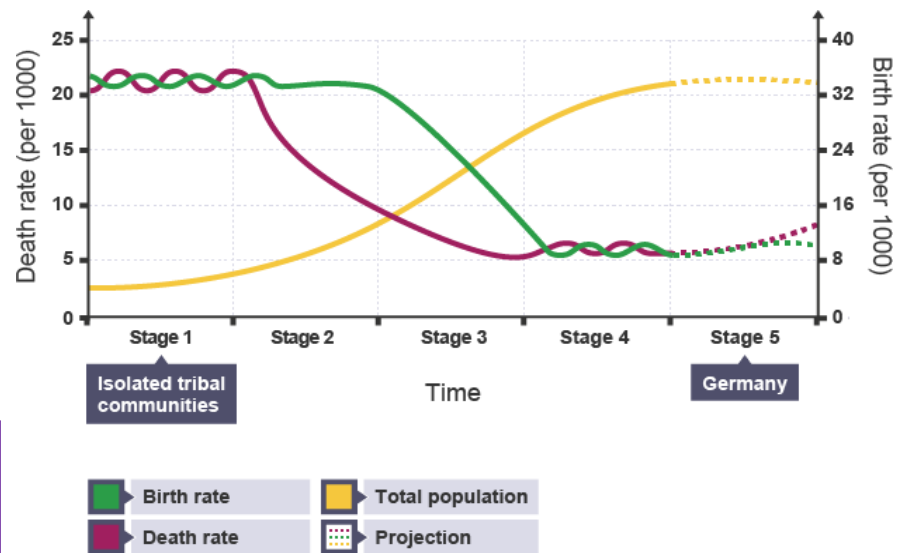
The level of development of a country shows how economically, socially, culturally or technologically advanced that country is. The way in which countries are classified is changing. The **Demographic Transition Model (DTM)** shows population changes over time. There are **five stages** in the DTM and these stages can be linked to levels of development.

- The DTM shows how **changing birth rates and death rates** affect population growth
- When the birth rate is higher than the death rate, more people are being born than dying, so the population grows - this is called **natural increase**
- Birth rates and death rates differ from country to country. This means that population growth is faster in some countries than others, especially LIC's
- Population growth also changes within a country over time as it develops.
- Changing birth and death rates are linked to a country's economic development
- So the **5 stages of the DTM** are linked to a country's level of development

## Stage 1: High fluctuating

**Birth rate** High  
**Death Rate** High  
**Population** Low and fluctuating

- Little health care, low life expectancy and no birth control.
- Population fluctuates due to disease, famine and war.



## Stage 2: Early expanding LIC

**Birth rate** High  
**Death Rate** Rapidly decreasing  
**Population** Rapidly increasing

- Improved standards of living, hygiene and access to health care reduce down the death rate.
- Life expectancy increases.
- The gap between birth rate and death rate leads to a high natural increase in total population.

## Stage 3: Late expanding NEE

**Birth rate** Rapidly decreasing  
**Death Rate** Slowly decreasing  
**Population** Slowly increasing

- The death rate continues to fall, albeit slowly.
- The birth rate falls quickly as birth control becomes available.
- It also becomes beneficial to have smaller families as children become more expensive (i.e. they go to school rather than working) - this also leads the birth rate to fall

## Stage 5: Population's decreasing HIC

**Birth rate** Slowly Decreasing  
**Death Rate** Slowly Increasing  
**Population** Slowly Falling

- Death rates increase as the proportion of older people goes up due to longer life expectancies wages are high).
- Birth rates fall as people choose careers over family, or as economic uncertainty puts people off having children.

## Stage 4: Fluctuating HIC

**Birth rate** Low  
**Death Rate** Low  
**Population** High

- Low birth and death rates will fluctuate with economic situation (i.e. people have more children when jobs are plentiful and wages are high).

# Causes of Uneven Development

You need to know the reasons why there are global inequalities - i.e. why so many countries differ in how developed they are

A country is likely to be less developed if it has.....

## Physical Factors affecting development?

Natural Resources	Natural Hazards
<ul style="list-style-type: none"> <li>Fuel sources such as oil.</li> <li>Minerals and metals for fuel.</li> <li>Availability for timber.</li> <li>Access to safe water.</li> </ul>	<ul style="list-style-type: none"> <li>Risk of tectonic hazards.</li> <li>Benefits from volcanic material and floodwater.</li> <li>Frequent hazards undermines redevelopment.</li> </ul>
Climate	Location/Terrain
<ul style="list-style-type: none"> <li>Reliability of rainfall to benefit farming.</li> <li>Extreme climates limit industry and affects health.</li> <li>Climate can attract tourists.</li> </ul>	<ul style="list-style-type: none"> <li>Landlocked countries may find trade difficulties.</li> <li>Mountainous terrain makes farming difficult.</li> <li>Scenery attracts tourists.</li> </ul>

## Human Factors affecting development?

Aid	Trade
<ul style="list-style-type: none"> <li>Aid can help some countries develop key projects for infrastructure faster.</li> <li>Aid can improve services such as schools, hospitals and roads.</li> <li>Too much reliance on aid might stop other trade links becoming established.</li> </ul>	<ul style="list-style-type: none"> <li>Countries that export more than they import have a trade surplus. This can improve the national economy.</li> <li>Having good trade relationships.</li> <li>Trading goods and services is more profitable than raw materials.</li> </ul>
Education	Health
<ul style="list-style-type: none"> <li>Education creates a skilled workforce meaning more goods and services are produced.</li> <li>Educated people earn more money, meaning they also pay more taxes. This money can help develop the country in the future.</li> </ul>	<ul style="list-style-type: none"> <li>Lack of clean water and poor healthcare means a large number of people suffer from diseases.</li> <li>People who are ill cannot work so there is little contribution to the economy.</li> <li>More money on healthcare means less spent on development.</li> </ul>
Politics	History
<ul style="list-style-type: none"> <li>Corruption in local and national governments.</li> <li>The stability of the government can affect the country's ability to trade.</li> <li>Ability of the country to invest into services and infrastructure.</li> <li>War, especially civil wars, can slow development as money is spent on arms and fighting instead of development.</li> </ul>	<ul style="list-style-type: none"> <li>Colonialism has helped Europe develop, but slowed down development in many other countries.</li> <li>Countries that were colonised (ruled by another country) are often at a lower level of economic development when they gain independence as a lot of the wealth has been stripped.</li> <li>Countries that went through industrialisation a while ago, have now develop further.</li> </ul>



# Consequences of Uneven Development

**Uneven development** leads to great differences in wealth & health and caused large amounts of immigration

<b>Wealth</b>	People in more developed countries have higher incomes than less developed countries. For example, GNI in the UK is 40 times higher than Chad in Africa.
<b>Health</b>	Better healthcare means that people in more developed countries live longer than those in less developed countries. Eg life expectancy in the UK is 81, but Chad in Africa is 51. Infant mortality is also much higher in LICs.
<b>Migration</b>	If nearby countries have higher levels of development or are secure, people will move to seek better opportunities and standard of living. Eg every year 130,000 Mexicans move to the USA to seek better jobs and education.

## How can we reduce the development gap?

Reducing the **development gap** is a massive task, but some strategies have proved successful.....

<u>Microfinance Loans</u>	<u>Foreign-direct investment</u>
<ul style="list-style-type: none"> <li>This involves people in LICs receiving <b>small loans</b> from traditional banks.</li> <li>Loans enable people to begin their own businesses</li> <li>It's not clear they can reduce poverty at a large scale.</li> </ul>	<ul style="list-style-type: none"> <li>This is when one country buys property or infrastructure in another country.</li> <li>Leads to better access to finance, technology &amp; expertise.</li> <li>Investment can come with <b>strings attached</b> that countries will need to comply with.</li> </ul>
<u>Aid</u>	<u>Debt Relief</u>
<ul style="list-style-type: none"> <li>This is given by one country to another as money or resources.</li> <li>Improve literacy rates, building dams, improving agriculture.</li> <li>Can be <b>wasted by corrupt governments</b> or they can become too reliant on aid.</li> <li><b>Long Term Aid</b> = Aid given that ensures long term change.</li> <li><b>Short Term Aid</b> = Aid given when there is an immediate need</li> </ul>	<ul style="list-style-type: none"> <li>This is when a country's <b>debt is cancelled</b> or interest rates are lowered.</li> <li>Means more money can be spent on development.</li> <li>Locals might not always get a say. Some aid can be tied under condition from donor country.</li> </ul>
<u>Fair trade</u>	<u>Technology</u>
<ul style="list-style-type: none"> <li>This is a movement where farmers get a fair price for the goods produced.</li> <li><b>Paid fairly</b> so they can develop schools &amp; health centres.</li> <li>Only a tiny proportion of the extra money reaches producers.</li> </ul>	<ul style="list-style-type: none"> <li>Intermediate technology includes tools, machines and <b>affordable equipment</b> that improve quality of life.</li> <li>Renewable energy is less expensive and polluting.</li> <li>Requires initial <b>investment</b> and skills in operating technology</li> </ul>

**GCSE Practice Questions:** 'Explain how short term aid can help reduce the impact of a natural disaster.' (4 marks)

## How can tourism reduce the development gap?

As you've already seen, tourism can be used to help poor countries develop. Here is an example of how **Jamaica** has turned itself into a popular tourist destination and how that has reduced the development gap.

### Where is Jamaica?

Jamaica is the **fourth-largest** island country in the Caribbean. It has a tropical climate with high temperatures throughout the year. Jamaica is famed for its beautiful, sandy beaches and rich cultural heritage. It has excellent communications and is a **popular destination** for cruise ships.



### Why does it need tourism?

Jamaica is one of the largest islands in the West Indies. Its population is 2.7 million, just over a third of the size of London.

Its economy is based upon a range of minerals (such as bauxite and oil), agricultural products (sugar and rum) and some manufacturing. It is classed as an 'upper middle income country' but has suffered from slow growth, debt and high unemployment over a long period.



### Advantages to Jamaica's tourism?

- In 2014 tourism contributed to 24% of Jamaica's GDP
- Income from tourism is US\$2 billion each year and taxes paid to the government further increase the economy
- Tourism is the main source of employment in Jamaica. Providing 200'000 jobs either directly or indirectly.
- A water treatment plant has been built in Logwood to reduce pollution from hotels
- Community and eco-tourism are expanding in more isolated regions, with people running small scale guesthouses or acting as guides
- There are now areas of high quality housing on the north coast where much of the tourist industry is located

### Disadvantages to Jamaica's tourism?

- Annually 1.1 million cruise passengers pass through tourism however they only spend roughly \$70 as everything they need is on board the ship so there is no multiplier effect
- Excessive waste and harmful emissions have increased as the number of tourists increased.
- Many tourists who visit the island stay in large international chain hotels. As a result much of the money is not spent/ directly impacting on local people
- Although development in infrastructure has happened, it has tended to focus only in popular tourist areas to the north of the island. There hasn't been much development in the rural parts so many areas remain isolated.

**GCSE Practice Questions:** 'Explain using an example you have studied how tourism has improved the quality of life and standard of living of the people and therefore closed the development gap. (6 marks)

# NEE CASE STUDY: Economic Development in BRAZIL

For our NEE case study we will be investigating Brazil. Brazil is a large country, who is growing rapidly but still has huge levels of poverty with a massive gap between rich and poor.

## What is the global importance of Brazil?

- In 2020 Brazil became the world's 5th largest economy
- Brazil is a major exported of food. It is the 5th largest exporter of food in the world
- Brazil accounts for more than 50% of South America's territory, population, resources and wealth
- Brazil has lived peacefully with its neighbours with no wars since 1860.
- Brazil is a member of the G20, a group of 20 of the most important nations who meet regularly to discuss world financial affairs.



Development in Brazil is happening in a unique political, social, cultural and environmental context and this has consequences for development

<u>Political Context</u>	<u>Social Context</u>
<ul style="list-style-type: none"> <li>• Brazil remained a Portuguese colony until 1822. It is the largest Portuguese speaking country in the world</li> <li>• Brazil has been very politically stable with its neighbours for centuries, with its last conflict occurring in 1860.</li> <li>• <u>Brazil is a member of BRIC</u> (Brazil, Russia, India, China). Economists believe these four nations will become dominant suppliers of manufactured goods, services, and raw material by 2050 due to low labour and production costs</li> </ul>	<ul style="list-style-type: none"> <li>• Brazil is one of the most <u>multicultural and ethnically diverse</u> nations, due to over a century of mass immigration from around the world</li> <li>• Brazil's people are football mad. The Brazilian football team has won the <u>World Cup</u> a record 5 times, and hosted the event in 2014 along with the <u>Olympics in 2016</u>.</li> <li>• In Brazil's largest cities, Rio and Sao Paulo, 1/5th of the population live in slums.</li> </ul>
<u>Economic Context</u>	<u>Environmental Context</u>
<ul style="list-style-type: none"> <li>• <b>Food</b> Products is a major commodity that Brazil export. It is the <u>5th largest exporter of food globally</u></li> <li>• In 2007, Brazil discovered significant amounts of <u>oil</u> off of the coast that will soon make it a leading distributor and <u>exporter of oil</u> worldwide.</li> <li>• Brazil has a huge disparity in wealth, with the <u>richest 10%</u> of Brazilians <u>earning 42.7%</u> of the nation's income, the poorest 34% earn less than 1.2%</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Deforestation</b> has meant that much of the natural vegetation in Brazil's Amazon has been replaced by agriculture. Since 2006 an area the <u>size of Greece has been lost</u></li> <li>• The Amazon Rainforest is the largest land <u>Carbon Sink</u> in the world.</li> </ul>

## NEE CASE STUDY: Economic Development in BRAZIL

The economy of Brazil is changing, and it has shifted from mainly PRIMARY based economy reliant on farming and extractive industries such as oil and gas, to one which is making more money or GDP from manufacturing or secondary industries and more services in the tertiary sector

- 1) Primary industry (e.g. agriculture) now employs 1% of the working population, this has dropped by 20% in the last 40 years
- 2) Secondary industry (e.g. manufacturing) has grown to employ 25% of the workforce. Secondary industries are stimulating economic development. They provide people with reliable jobs (compared to seasonal agricultural work), and selling manufactured goods overseas brings more income into Brazil. It makes up 1/3 of Brazil's GDP and growth is happening in the energy sector.
- 3) Tertiary (services) and quaternary (knowledge) industries have come a much larger part of the economy, employing 75% of the workforce. The economy is becoming more balanced. Tertiary jobs are growing particularly in the finance sectors.



## TNC CASE STUDY: BP in Brazil

A trans-national company is a company that is located in more than one country.

- 1) Many TNCs operate in Brazil, one major TNC we studied was BP- one of the world's biggest oil producers.
- 2) TNCs can help economic development by increasing the amount of manufacturing industry and they can bring great benefits to the countries they operate in, but they also have disadvantages.
- 3) BP is one of the world's largest oil companies. Its headquarters are in the UK.
- 4) BP Oil began increasing operating in Brazil after a huge new oil was discovered off the coast of Brazil in 2007.

### Advantages

- 1) TNCs create employment. BP Brings in 7,000 jobs to Brazil
- 2) Oil TNCs have invested \$150 billion into Brazil
- 3) BP has 21 Oil Exploration Sites in 15 states
- 4) BP Charity foundation has spent \$2 billion since its launch
- 5) BP donated \$2 million to fight Covid 19 in Brazil's rural communities
- 6) Investing in renewable biofuel energy which generated an extra 2,000 jobs through the multiplier effect
- 7) Pays \$108 million in tax to Brazil

### Disadvantages

- 1) Some profits from TNCs leave Brazil as BP is a British company. In 2019 it paid \$2.5 billion in UK tax.
- 2) TNCs can cause environmental problems, e.g. An Oil spill in 2019 devastated 2,500km of coastline in Brazil and killed 800 endangered turtles. Many environmental groups remain unhappy.
- 3) Another Oil spill in 2011 damaged coral reefs after oil companies did not clean up efficiently.
- 4) BP found cheaper oil in Angola and cut 1000 jobs in Brazil as a result as TNCs can relocate at any time.



**GCSE Practice Questions: 'TNCs only bring advantages to the host country.'**  
Do you agree with this statement? (9)



## Brazil's relationship with the WIDER WORLD

Brazil is playing a larger role in regional and global politics as it develops. In recent years the Brazilian government has improved relations with its immediate neighbours and global trading partners. International trade is also growing:

- 1) Brazil is reducing barriers to trade and encouraging foreign direct investment- Russia, China & India are some of the biggest trading partners for Brazil and are collectively known as BRICs.
- 2) BRICs countries represented over 3.1 billion people, or about 41% of the world population and 44% of the world's GDP. They meet annually to discuss trading relationships.
- 3) China alone accounts for 45% of all Brazilian exports.
- 4) Member of the G20 (a group of the 20 largest economies) but increasingly more involved in South America's trading group called Mercosur.
- 5) Brazil is a founding member of the UN and has participated in 33 peacekeeping missions around the world.

## Brazil's relationship with AID

- In this section, you will need to know the different types of aid that Brazil receives, as well as the impacts of economic development. Brazil's government receives \$250 million in aid per year to help with health programs and support businesses.

**Brazil is the 5<sup>th</sup> largest economy in the world.... Why does Brazil still need aid?**

Because the benefits of being an NEE are not spread evenly across Brazil.....

- Over 25% of the population lives on just \$5 per day.
- 6 million live in Slums in Brazil
- 50 million Brazilians live in inadequate housing
- 50% of people living in rural areas do not receive adequate health care

**What aid does Brazil receive?**

**act:onaid**

Action Aid began work in Brazil in 1999. The NGO teaches women and children about their rights to basic services such as healthcare, clean water and education. In 2019 alone, it provided Brazil with \$3 million worth of aid.... The majority of this aid is long-term aid.

### Short-term Aid

- 1) Intended to help recipient countries cope with emergencies. Can come from foreign governments or non-governmental organisation (NGOs)- e.g. Action Aid has helped to set up health centres to tackle diseases.
- 2) Helps with immediate disaster relief, but often not able to help with longer-term recovery efforts, e.g. 2009 & 2011 oil spills.

### Long-term Aid

- 1) Intended to help the recipient countries funded to become more developed.
- 2) The World Bank gave \$250 million to fund an education programme which has seen literacy rates in Brazil increase from 90-94% since 2008.
- 3) The NGO Action Aid has supported rural families living in drought prone areas to grow food, keep animals and protect their environment by installing rainwater collection tanks and providing seeds & fruit tree seeds to become more resilient in droughts.
- 4) Action Aid has given 15,000 microfinance loans to rural communities to fund handpumps

# Economic Development of Brazil

## How has Brazil's economic development improved Brazilian peoples' quality of life?

Brazil becoming more economically developed over the last 40-50 years has improved the residents' of Brazil quality of life dramatically. There are more reliable, better-paid jobs in manufacturing resulting in higher disposable incomes and increased spending on securing access to clean water, higher quality homes and medical care..... look at the evidence.....

<b>Education</b>	<ul style="list-style-type: none"> <li>The government have increased their spending on education so now 19% of GDP is spent on public education.</li> <li>4-7 year olds currently in school in Brazil has increased from 37% in 2000 to 61% in 2011 and 78% of 15-19 are in education.</li> </ul>
<b>Healthcare</b>	<ul style="list-style-type: none"> <li>The government spent 6% of their GDP on healthcare in 1995, by 2012 this only increased to 8.5%.</li> <li>Life expectancy at birth has increased by 10 years since 1980 to 75</li> </ul>
<b>Access to Water</b>	<ul style="list-style-type: none"> <li>Access to clean and safe drinking water has improved across urban Brazil.</li> <li>In 1992, 84% of water was clean and safe to drink, by 2012 this increased to 97%.</li> </ul>
<b>Sanitation</b>	<ul style="list-style-type: none"> <li>Household and communities have now gained improved better access to sanitation, such as showers and clean water.</li> <li>In 1992 the access was 72% by 2012 this changed to 81.5%.</li> <li>Improved sanitation has helped infant mortality rates drop from 75 to 14 (1980-2020)</li> </ul>
<b>Jobs</b>	<ul style="list-style-type: none"> <li>Unemployment in Brazil has risen since 2015 where only 9% of the country were unemployed. In one year, the number of unemployed rose to 12.6%.</li> </ul>

## How has Brazil's economic development impacted the environment?

As Brazil has focused on economic development, many believe it has come at a great cost to the environment.... The TWO main impacts are oil spills and deforestation.....

### FOSSIL FUEL USE & OIL SPILLS

- 1) Brazil's energy consumption has increased with economic development. Fossil fuels like coal and oil are readily available and affordable fuels, but release lots of air pollution.
- 2) Oil Exploration has caused 2 major oil spills in 2019 and 2011. The 2019 spill affected 2,500km of coastline. 1000 tonnes of oil had leaked onto 150 beaches, causing huge environmental problems, such as killing 800 endangered turtles

### DEFORESTATION

- 3) Demand for resources can lead to the destruction of habitats, e.g. deforestation. Cattle Ranching businesses currently cause of 80% of Brazil's deforestation.
- 4) Farming and increased urbanisation has resulted in deforestation and waste management issues- 70-80% of forests have disappeared.
- 5) Gold Mining in the Amazon leads to contamination and soil erosion. The price of gold increased 300% since 2010 spurring a growth in gold mining causing 2,000 hectares of deforestation in 2019.

**GCSE Practice Questions:** 'To what extent has economic development improved the quality of people's lives in Brazil? (9)

**GCSE Practice Questions:** 'Explain how economic growth can have harmful impacts on the environment.' (6)

# Economic Development in the UK: A post-industrial economy

## Why has the UK's economy changed?

For several decades the UK has been experiencing de-industrialisation. This is the decline of manufacturing (secondary) industry and the subsequent growth in tertiary and quaternary employment. In the UK this has happened because:

- Machines and technology have replaced many people in modern industries, for example car production.
- NEEs like China, Malaysia and Indonesia can produce cheaper goods because labour there is less expensive.
- Lack of investment, high labour costs and outdated machinery made UK products too expensive.

Traditional UK industries- coal mining, engineering and manufacturing - have declined. Instead, the UK is now a world centre for financial services, media, research and creative industries.

The key causes of economic change in the UK are:

### De-industrialisation

De-industrialisation is the decline of the UK's industrial base - de-industrialisation meant fewer jobs were available in manufacturing (secondary jobs such as car manufacturing). These used to be the UK's main source of employment and income.

### Globalisation

Globalisation - a lot of manufacturing has moved overseas, where labour is cheaper. TNC headquarters are often still located in the UK, but production is often in a NEE (such as India)

### Government Policies

Governments make decisions on investment in new infrastructure and technology. Membership to trading groups make it easier for companies to trade across the world.

## What is a Post-Industrial economy?

- A post-industrial economy is one where manufacturing industry has been replaced by the service industry or tertiary jobs. A new sector of the UK economy that is growing rapidly in the twenty-first century is the quaternary industry
- The quaternary sector is sometimes described as the 'knowledge economy' because it involves providing information and the development of ideas. This includes information technology, biotechnology and new creative industries.
- It is estimated that **15%** of the UK workforce now works in the quaternary sector.
- Only about **10 per cent of employment** is in manufacturing compared to 55 per cent in 1900.
- The M4 corridor from London to Bristol, has become home to high tech industry over the past 30 years. Many well known companies such as Microsoft are based there,

# Economic Development in the UK: SCIENCE & BUSINESS PARKS

## Why has the UK seen a rise in business parks and science parks?

Quaternary & tertiary industries are increasingly found in science or business parks.

### Science Parks

- A science park is a group of scientific and technical knowledge based businesses located on a single site.
- Science parks focus on technology so quaternary sector
- Many science parks are located on the edges of towns, near good transport links and always near prestigious universities
- Science parks often contain laboratories as well as offices.
- Low rise buildings with plenty of parking and green spaces.

### Business Parks

- A business park is an area of land occupied by a cluster of businesses located on a single site.
- Business parks focus on commerce and service so tertiary sector
- Business parks are normally located on the edges of town near transport access.
- Business parks contain offices that are low rise with excellent parking and green spaces
- Cheaper land is more of a priority than near universities

### The number of parks has grown because.....

- There is a large and growing demand for high-tech products
- The UK has a high number of strong universities for science parks to form links with. Being close to a university gives companies access to highly skilled workers
- Clusters of related businesses in one place can boost each other
- The quaternary sector is growing, 60,000 people are now employed in the IT sector.



## SCIENCE PARK CASE STUDY - Birmingham Science Park

- Birmingham Science Park is a leading science park in the UK, established in 1983 it is the 3<sup>rd</sup> oldest in the country.
- The science park specialises in 'Life Sciences' which are sciences that have to do with 'organisms', like plants, animals and human beings.
- Specifically, the park is at the forefront of working on drugs to combat diseases and viruses.
- The Science Park was built adjacent to Aston University that provide a highly educated and skilled workforce
- There are currently 22,000 people employed in the sector across the Park and more than 600 companies working in this area.
- The park has excellent transport links - close to M6, New Street Station and Birmingham International airport
- In 2022 the Science Park will move to the suburbs of Selly Oak and reside next to Birmingham University.

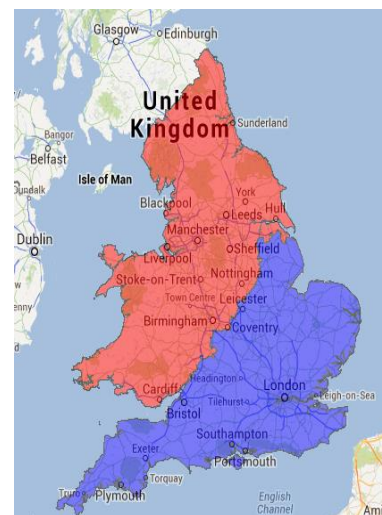
**GCSE Practice Questions:** 'Explain how science and business parks provide opportunities for regional economic growth.' (6)



# Economic Development in the UK: NORTH/SOUTH DIVIDE

## Why does a North / South divide exist?

- Economic investment and jobs are centred inside the capital (London) and places nearby.
- London is a global city and financial services centre which is well connected to the European continent via rail, road and airport links. Therefore the south of England has higher wages, house prices and in general better quality of life indicators.
- Deindustrialisation in the 1970's and 1980's in the northern towns and cities has led to unemployment and weaker economic growth overall.



## Evidence of the divide.....

- Wages are generally lower in the north, for example the average wage in Huddersfield was 40% lower than that of London.
- Health is generally worse in the north than the south; for example life expectancy in Glasgow, Scotland is 72.6 whereas in Dorset on the south coast it is 82.9.
- Education is generally better in the south; for example in London 50% of children go onto higher education, whereas in the north this figure is 35%.

## SOLUTIONS to the North / South divide

**GCSE Practice Questions:** 'Explain how improving transport links can help reduce the UK's north- south divide.' (4)

## Transport Improvements

- -A new high speed rail service (HS2) between London (started in 2017) and the north and the electrification of the Trans-Pennine railway (due to be completed 2018).
- -Upgrade of the M62 cross-Pennine motorway (due to be completed by summer 2018).
- -The new Liverpool2 deep water container port (opened in 2016).
- -The Mersey Gateway (opened Oct 2017) is a new 6 - lane toll bridge over the River Mersey to improve access to the deep- water port.

## Local Enterprise Schemes

In 2015 the government launched a new strategy for a 'Northern Powerhouse' to help balance the wealth and influence of London and the South East by providing....

- A £62 million BT investment will extend superfast broadband across 97% of the north by 2025.
- A new business rate discount of up to £275 000 over a five year period to encourage businesses to move to the north.
- Financial incentives for companies (eg Nissan in Sunderland) to locate in the North

# Economic Development in the UK: CHANGING RURAL LANDSCAPES

- One of the major consequences of industrial change in the UK has been impacts upon rural areas.
- Some rural locations are growing fast and face future economic growth (ECONOMIC) but at the expense of local communities (SOCIAL) and natural habitats (ENVIRONMENTAL).
- Others are declining in terms of working population and the affordability of providing stretched services and links to remoter areas.

## A Rural Area experiencing a BOOM

### South Cambridgeshire

- This area has seen large numbers of highly skilled and educated people move into the area due to its association with Cambridge University and close links to London.
- There is a high level of employment.
- Around 21% of the work force is employed in high-tech industries like computer software and engineering manufacture.
- Migration has increased 25% and the population will grow by 50,000 in the next 10 years
- The population rise has led to house price increases, and the average house is £500,000, twice the UK average.
- 80% of people commute by car so road traffic has increased



Cambridgeshire

## A Rural Area experiencing a DECLINE

### Outer-Hebrides

- This area has seen a huge population decline of 50% since 1900.
- This decline is mainly due to outward migration.
- With limited opportunities, younger people have chosen to move away from the area in search of better-paid employment elsewhere.
- It has left behind a very old and aging population
- The area has high unemployment and has few shops, schools and services as many closed.
- The island lacks high speed internet which discourages people from moving to the area.



Outer Hebrides

**GCSE Practice Questions: 'Contrast the economic challenges associated with rural areas of population growth and decline. (6 marks)**

# Economic Development in the UK: ENVIRONMENTAL IMPACTS

So, we know that the UK has shifted from manufacturing (secondary) to a service (tertiary) based economy..... HOWEVER, the UK still does have industry.... And this industry can still have impacts on our environment.

## How has the UK Car Industry impacted the environment?

- The car industry is one of the few large-scale manufacturing industries left in the UK, whilst providing employment may boost the economic sustainability of the industry, more needs to be done to improve its environmental sustainability

## Environmental Impacts

- Car manufacturing is an energy-intensive business; it has been claimed that the manufacturing process itself uses as much energy as the car will consume in its lifetime on the road.
- The vast majority of cars in the UK run on petrol or diesel. Oil extraction is a dirty process, and can cause many environmental problems, like those seen in Brazil's oil spills
- Cars contain many components; many of these are not biodegradable and leakage from parts such as batteries can even cause contamination.
- Cars account for 20% of CO2 emissions in the UK. This makes them the second biggest producer of total UK CO2 emissions.
- Scientific experts now believe that car emissions causing air pollution can lead to a range of illnesses in humans, including lung cancer and diabetes
- Cars manufacturing uses many resources, from fabric to steel. These resources are produced in multiple-countries. Transporting them generates a large carbon footprint

## How can we make the Car Industry more Sustainable?



## Electric Cars

- The UK's largest auto-manufacturer Jaguar Land Rover (JLR) has announced it will build its first electric car in 2019
- It will build all electric vehicles in the Midlands (UK) and every model it produces will have an electronic option by 2020.
- Batteries for the cars will also be made in the Midlands reducing the carbon footprint

## Sustainable Factories

The NEW Jaguar Land Rover (JLR) Engine Manufacturing Centre is a £900m sustainable factory employing around 1400 staff. What makes the factory sustainable?

- North skylights provide day lit spaces reducing need for electric lighting which reduced JLR's carbon emissions by 15%
- Extensive grey water recycling (re-using water from machines) which reduced water consumption by 10%
- 21,000 solar panels that power 30% of the factory
- Increased recycling reduced waste to landfill by 37%;
- Landscaped design to create environmental landscapes and aid worker mental health

**GCSE Practice Questions:** 'Use an example to demonstrate how modern industry can be more environmentally sustainable.' (6 marks)

# Economic Development in the UK: LINKS TO THE WIDER WORLD

The UK has formed strong links with other countries as it has developed.....

- **Trade** - The UK trades globally, with strong links to the USA, Europe and Asia. The UK's exports are worth £250 billion per year
- **Transport** - The Channel Tunnel links to UK to France by rail, providing a route for goods and people to travel to mainland Europe. Large airports like Heathrow act as a hub and provide transport links to 100s of countries across the world.
- **Security** - The UK is a highly influential member of international organisations such as the UN, G8 and G20.
- **Commonwealth Founder** - The Commonwealth is a group of 50 countries that exist to improve the well-being of all members and meet every 2 years to discuss human rights and economic development
- **Language** - The global importance of the English language has given the UK strong cultural links with many parts of the world.
- **Culture** - UK literature, music, cinema, sport, television, history and architecture are important globally. Books, such as the Harry Potter series, are sold worldwide. UK sports are showcased through events such as the Olympics, the World Cup, Wimbledon, the Premier League and the London Marathon.
- **Communications** - the UK is linked to the rest of the world via the internet. Internet cables beneath the sea provide a fast connection to countries globally.

## Improving the UKs transport network

### Improving Air Travel

- A **new runway** has been proposed for **Heathrow**.
- The development will generate an estimated **£147 billion over 60 years** and 70,000 new jobs by 2050.
- Flights will run to 40 new destinations. The cost of the scheme is estimated to be £18.6 billion.

### Improving Ports

- A new Port, called **London Gateway**, is operating at the mouth of the River Thames.
- It is capable of handling the world's largest container ships that many UK Ports struggled to fit.

### Improving Rail

- **High Speed (HS1)** is a fast train link between London and Paris.
- **HS2** is a planned fast train link between London and Birmingham. HS2 is planned to be completed in 2026, at an estimated cost of at least **£43 billion**.

### Improving Roads

- In December 2014, the government announced that they would be spending **£15 billion** on **improving** and expanding **UK roads**.
- This money involves building **smart motorways** that use technology to manage congestion



## Paper 2 Part C: Resource Management: GLOBAL DISTRIBUTION

Resources are all the things that we use - in this case we are talking about food, water & energy.

### Why do we need food, water & energy?

Water food and energy are key for human wellbeing. All lead to social and economic benefits, which all increase the standard of living and quality of life.

#### Food

- Calories provide energy.
- Availability of food depends on climate, soil and level of technology.
- Malnourishment leads to disease and death. In children it can lead to underperforming at school which decreases economic wellbeing in life. In adults they will be less productive (less able to work).
- Globally more than 1 billion people are malnourished.
- 2 billion are undernourished (poor diet).
- Obesity is an issue in some areas, mainly HICs.

#### Water

- Used for survival, washing, food production, industry.
- Clean, safe water enables development and allows people to break free from the cycle of poverty.
- Globally 2 billion people drink from contaminated water sources. Over 500,000 people a year die because of diseases linked to contaminated water supplies (e.g. Cholera)
- Having to walk long distances for water can impact on the economy as people spend time collecting water not working.

#### Energy

- Traditionally we get energy from oil, coal and wood.
- Many different sources are generated by changing technology.
- Used for electricity production, heating, transport and for water supply (e.g. providing power for pumps for wells).
- Supports industrialisation and development. HICs depend on electricity for their way of life.
- Without electricity people would burn wood for cooking or heating. This can lead to deforestation.

### The global supply of energy is uneven...

- Resource demand is to increase by 56% as the population of the world rises
- The global distribution of resources is very uneven. Some countries don't have their own energy reserves. Others have dry climates or environments that are not suitable to grow crops.
- To access the resources many countries need, they have to import them or find technological solution to produce more - these can be very expensive
- SO..... Resource consumption depends on a country's wealth - with consumption far higher in more developed HIC countries because they can afford to buy resources.
- Consumption is rapidly increasing in NEEs as their industry starts to develop
- Consumption is low in LICs as they can't afford to exploit the resources they have or import.

# Resource Management: FOOD IN THE UK

## Why is demand for food in the UK growing?

The growing demand for high value food exports from LICs and all year demands for seasonal food and organic produce.

## Why do we import so much food?

Food used to be seasonally and locally sourced. Now we eat globally sourced foods all year. In 2013 47% of UK food was imported. **Why?**

- More disposable income has led to an increased demand for greater quantities & more choice.
- Not all foods can be grown the UK, and some foods can only be grown at certain times e.g. strawberries in July and August.
- It is cheaper to import because poor harvests and cost of animal feed makes UK food expensive.
- UK climate is unsuitable for growing foods such as cocoa, tea and bananas
- Supermarkets are big and able to stock a wide range of foods

## Farming is getting more industrialised - called 'Agribusiness'

- Recently, there has been a growth in agribusiness in the UK.
- Agribusiness is a large-scale farm where the whole process (from growing to packaging) is controlled by large firms.

This has meant farms can produce more food, but at a cost....

- Agribusiness has significant impacts on the environment as they are associated with heavy use of pesticides and fertilizers leading to reduction in wildlife and eutrophication.
- Small farms and farmers have been taken over by large TNC companies
- The number of jobs in farming has decreased as machinery can do a lot of the work
- As the TNC's want larger fields, many hedgerows have been destroyed leading to a loss of biodiversity in our rural areas.
- East Anglia in the East of the UK is an example of a place that has a lot of agribusinesses.

## The effects of consuming more food is a growing CARBON

- A carbon footprint is a measure of the impact that human activities have on the environment in terms of greenhouse gases produced
- The growing, processing and packaging of food produces CO<sub>2</sub>, currently 17% of the UK's carbon footprint is due to food.
- The transport of food also produces CO<sub>2</sub>. The distance items travel from where they are grown to where they are eaten is called Food miles. Annual food miles travelled by UK food imports is 18.8 billion miles.
- 68% of food imported to the UK is from within the EU, 32% from the rest of the world.
- To try and reduce our carbon footprint, the UK govt. are now encouraging buying local, organic and having an allotment.

## How can we make our food usage more sustainable?

- Organic foods are produced to strict codes with no pesticides or fertilisers used. Since the 1990s there has been an increase in demand. Now worth £2 billion a year in the UK and it is far better for the environment

# Resource Management: WATER IN THE UK

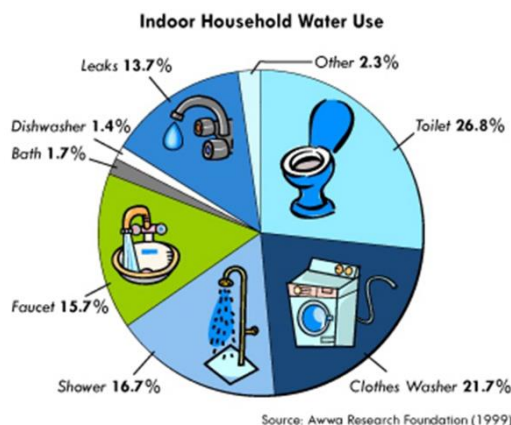
## The demand for water varies across the UK

In the UK, places with a good supply of water aren't the same as the places with highest demand

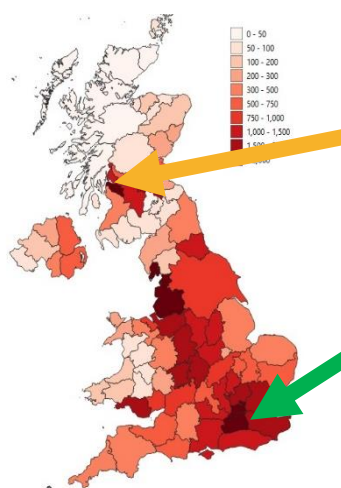
The Environment Agency estimates that the demand for water in the UK will rise by 5% by 2025 because of.

- **The growing population**
- **More houses being built**
- **An increase in the use of domestic appliances (washing machines, dishwashers)**

Since 1975, the amount of water used by households has also gone up by 70%

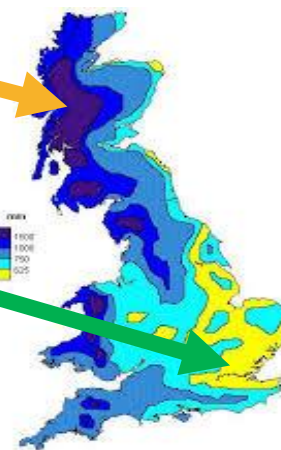


The average person in the UK uses 150 liters of water per day compared with the average person in Africa who uses just 47 liters a day.



- 1) The north and west have high rainfall (dark blue) and a good supply of water BUT
- 2) Less people (light red) live here so demand for water is low
- 3) This means they have a water surplus

- 4) The south and east have less rainfall (light blue) and a poor supply of water AND
- 5) More people (dark red) live here so demand for water is high
- 6) This means they have a water deficit



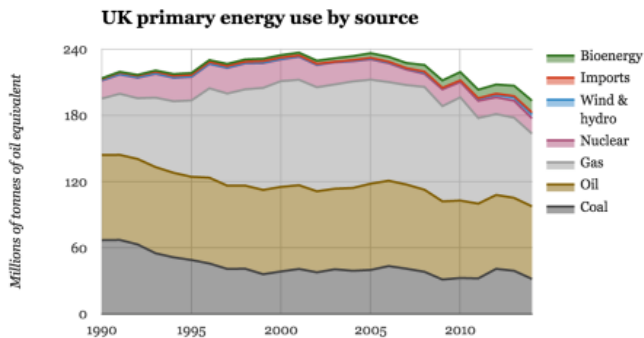
The main sources of water in the UK are rivers, reservoirs and groundwater aquifers. The UK receives currently enough rain to supply the demand. But the rainfall is not evenly spread, and is lacking in some areas that most need it, these areas are in water deficit.

## How can the UK save water?

1. **Water transfers**: a nation-wide water grid to transfer water from areas of surplus to areas of deficit, but it will be expensive and may damage wildlife
2. **Reducing usage and increase efficiency**: install water meters at eye-level to increase awareness of usage; introduce hosepipe bans at times of water shortage
3. **Recycle 'grey' water**: use waste water from sinks and showers to water plants and crops
4. **Waste water treatment**: removes silt, soil, bacteria, algae, and chemicals from used water to produce clean water for new use
5. **Educate people**: inform public about how to save water and how to safely dispose of difficult items (i.e. not down a toilet!)
6. **Legislation**: UK and EU have strict laws that ensure factories and farms limit their runoff into rivers; water companies also have clear regulations and penalties
7. **Green roofs**: often in cities to filter out pollutants in rainwater; also absorb excess water to prevent flooding; also help combat climate change

# Resource Management: ENERGY IN THE UK

Despite increasing demand for electricity in the UK, energy consumption has fallen in recent years. This is mainly due to the decline of heavy industry and improved energy conservation. **Low-energy usage appliances, better building and more fuel efficient and hybrid cars have resulted in a 60% fall in energy use by industry and a 12% fall in domestic usage.**



Wind, tidal and hydroelectric power are the most common renewable energy sources in the UK

Traditionally the UK has relied on **oil and gas** for energy. In **1970**, these two provided **91%** of the UK's energy

The discovery of large **gas** reserves in the North Sea meant by **1980**, **22%** of our energy was supplied by gas

The use of **nuclear energy** to produce electricity also increased in the **1990s**

Recently, there has been a shift towards using renewable energy. ALL coal power stations in the UK will close by 2025. In **2020 25% of UK's energy was supplied by renewables.**

## Why are we using less fossil fuels?

- North Sea oil and gas reserves are rapidly running out and production has **declined since 2000**
- The UK still has coal reserves, but as they produce greenhouse gases and cost a lot to mine, the UK **shut down its last coal mine in 2015**
- The cost of North Sea oil is very high. It can cost more to produce than it can be sold for.
- Accidents such as **oil spills** can leak toxic chemicals into water sources and soils.
- All fossil fuels release greenhouse gases which contribute to global warming & climate change

## Why can't we just use renewable energy?

- The **cost** of the technology behind renewable energy is very **high**
- At the moment, **renewable energy** sources **aren't reliable** enough for the UK to stop using fossil fuels altogether.
- More money is needed for **research** into renewable energy such as tides to check they don't have a **negative impact** on ecosystems
- **Wind farms are noisy** and are considered eye sores and cost a lot to maintain.

## Will fracking help?

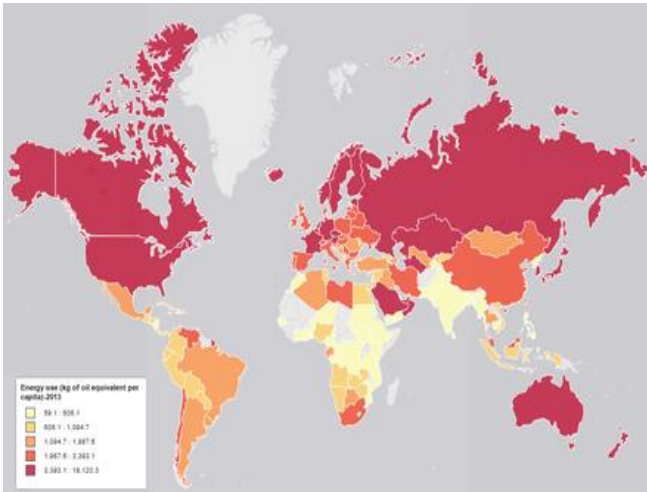
- Looking into the future, the use of fracking to access the vast amounts of **shale gas** in the UK from underground is being considered.
- Fracking is the process of **drilling down** into the earth before a high-pressure water mixture is directed at the rock to release the gas inside. **HOWEVER....**
- **Contaminated water** is pumped back into the ground and this can affect water supplies, it uses a lot of energy and **releases** methane, a greenhouse gas.

**GCSE Practice Questions:** 'Explain why the UK's energy mix will include both renewable and non-renewable sources in the future.' (6 marks)



# Resource Management: GLOBAL DEMAND FOR ENERGY

Energy is produced (supplied) and used (consumed) at different rates and in different amounts around the world.



Energy security means having a reliable, uninterrupted and affordable supply of energy

Energy insecurity means having an unreliable or irregular supply of energy

Energy gap means the difference between energy produced and energy required

Energy Surplus means more than enough energy; can sell some on

Energy Deficit means not enough; relies on imported energy

The map above shows the total amount of energy used per country. As the world's population is rising and as people are getting wealthier more energy is being consumed.

There is a strong relationship between a country's wealth and its energy consumption

- Wealthy, developed countries (dark red) tend to consume a lot of energy as they can afford to. Most people in these countries have access to electricity and heating and use energy intensive devices (computers/TVs)
- Less developed countries (light orange) tend to consume less energy and poorer people's lifestyles tend to rely on electricity less and they are less able to afford it.

## Why is energy demand increasing?

There are three main reasons.....

- 1) The world's population is increasing - in 2020 the world population was just over 7.5 billion and it's predicted to increase to over 9 billion by 2040. More people means more energy consumed
- 2) Recent economic development has increased the wealth of some poorer countries so people have more energy consuming devices, such as TVs, cars, fridges etc.
- 3) Technological advances have created loads of new devices that all need energy (iPads, laptops etc.) These are becoming more popular so more energy is needed to power them

## Global Energy Production is unevenly distributed

Some countries produce lots of energy because they have large energy reserves and the money to exploit them. E.g.

- Iran & Saudi Arabia (large oil reserves)
- China, Australia (large coal reserves)
- Russia (large gas reserves)

Some countries produce little energy because they have few reserves and are too poor to exploit them. For example

- Sudan (politically unstable to exploit its resources)
- Ireland (few resources)

# Resource Management: WHAT AFFECTS ENERGY SUPPLY?

We've just discussed that energy supply varies around the world, here are the reasons why....

## Physical Factors

- Variations in climate and geography affect the potential for solar, wind, tidal, HEP and wave power
- Potential for natural disasters could affect what energy is developed, e.g. earthquakes could damage infrastructure
- There is an unequal distribution of fossil fuels in the world; some countries will have more than others; some may run out more quickly than others; some are more accessible than others

## Technological Factors

- Some oil reserves are trapped in rocks and need specialist technology and equipment to be accessed
- Some countries have energy resources but not the technology to exploit them, e.g. large uranium reserves in Niger

## Economic Factors

- Prices of fossil fuels are volatile; they can go up or down due to availability or conflict
- Cost of building new infrastructure such as power stations, wind farms, can be very high
- Some LICs have a lot of resources but not enough money to access and exploit them
- Fossil fuels are becoming more scarce and are therefore more expensive to extract

## Political Factors

- Climate change has resulted in international agreements to cut greenhouse gas emissions, e.g. Kyoto Protocol
- Wars and political instability can affect a country's ability to export resources, e.g. during the Gulf War oil exports dramatically decreased
- Concerns over safety, e.g. nuclear power stations and nuclear waste disposal, has meant it's harder now to build power stations because of tighter regulations

**GCSE Practice Questions: 'Explain why many countries are experiencing energy insecurity.'**  
(6 marks)

## Non-Renewable energy sources

Fossil fuels have traditionally supplied most of our energy, but the supply will eventually run out.

### Fossil Fuels

- Fossil fuels are formed from organic matter millions of years ago. Include COAL/ GAS / OIL.
- Although limited there are still plenty of these resources left.
- They remain an important fuel despite CO2 levels increasing.
- Carbon capture can reduce the environmental impact (putting carbon back in ground)

### Nuclear Power

- Nuclear power stations are expensive to build.
- However the cost of the raw material uranium is relatively low because small amounts are used.
- **BUT** nuclear waste disposal is dangerous and takes 1000s of years to become safe.
- There is also a risk of disasters like Fukushima in Japan in 2011.

# Resource Management: INCREASING ENERGY SUPPLY?

Finding ways to increase energy supply is really important, given all the problems we've already looked at...

Strategy	Problem
<b>Wind</b> - Turbines are turned by the wind to generate power. Wind currently supplies 10% of the UK's energy.	BUT can look ugly and <u>wind is variable</u> , so sometimes they don't provide any energy at all
<b>Solar</b> - Photovoltaic cells mounted on solar panels convert sunlight into energy.	BUT solar power is <u>seasonal</u> and farms need a lot of space
<b>Geothermal</b> - Damming a river allows water to be stored in a reservoir and controls river flow.	This is a long term solution, BUT only works in areas that are <u>tectonically active</u> .
<b>Wave</b> - waves force air into a chamber where it turns a turbine linked to a generator.	BUT <u>costs are high</u> . Portugal built the first wave farm in 2008. They don't work very well in calm conditions.
<b>Hydro</b> - large scale dams create enough water to turn turbines to generate electricity. They currently supply 85% of the world's renewables	BUT Large dams are <u>expensive</u> and can destroy communities and wildlife as the area behind the dam is flooded.
<b>Tidal</b> - turbines in barrages built across rivers use rising and falling tides to generate electricity.	BUT as tides happen only a <u>few times</u> per 24 hours, they can't provide energy all day
<b>Biomass</b> - Energy produced from organic matter. -	BUT burning organic matter can create <u>smoky conditions</u> and fuelwood is limited

## What are the impacts of being energy insecure?

### Social Effects

- **Energy insecurity** may increase the incidence of power cuts; this will inconvenience people and reduce their quality of life
- Demand for cleaner, **cheaper energy increases demand** for biofuels; growing crops for biofuels uses land that could be used for growing food to feed people; this puts a strain on food supply
- People in LICs have to spend **lots of time walking** to collect firewood as there is no other fuel; this will impact on their quality of life and ability to work or go to school

### Economic Effects

- **Cost of food production will rise**; agriculture often needs large amounts of energy
- Lack of oil will mean some **companies shut down** if they rely on it as a resource to make their product
- A **rise in the cost of energy** will increase the cost of living, e.g. running a home, buying food, travelling

### Environmental Effects

- As fossil fuels are used up, **reserves** in more difficult and environmentally sensitive areas are **exploited**, e.g. Arctic and Alaska; this **increases the cost** of producing energy and damages the environment

### Conflict

- Countries with **energy deficit** may become involved in **conflict** with countries that have **energy surplus**, e.g. conflict between Russia and Ukraine over oil supplies

## Resource Management: EXTRACTING NATURAL GAS?

Fossil fuels have helped to develop nations and economies and have, up until now, been a vital part of the energy mix. Coal, oil and gas have helped countries develop and allowed industries to grow and manufacture products. Fossil fuel use has both its positives and negatives when it is extracted and this can be seen in the North Sea off the East Coast of the UK.

### How do we extract Natural Gas?

The North Sea has reserves of Oil and natural gas, and a long history of exploitation. The first North Sea oil came ashore in June 1975 and is thought to have peaked in 1999, with more than 40 billion barrels extracted so far

The reserves of oil and gas are starting to dwindle (more than 50% has been extracted) and the oil and gas is tougher to extract. However, the remaining reserves are still substantial - between 15 billion and 24 billion barrels of oil equivalent - meaning possibly another 30 to 40 years of production

To date, it is estimated that the UK government has benefitted to the tune of £300billion since 1975. So, there are positive and negative views to extracting gas...

#### Positives

- Less risk of environmental accidents than oil.
- Employs 1.2 million people
- Easy to transport (pipes / tankers)
- Plentiful in supply
- Cleanest of the fossil fuels - 45% less CO<sub>2</sub> than oil.

#### Negatives

- Dangerous if handled poorly
- Produces CO<sub>2</sub> and methane
- Pipelines are expensive to build and maintain
- Fracking is controversial and lots of water is needed. Chemicals used could contaminate ground water

### How can we make energy more sustainable?

#### Energy Conservation

New homes built in the UK have lots of energy-saving measures, like loft and wall insulation, radiator thermostats and smart energy meters that monitor energy use. This is because any homes that are built or rented out must have an energy rating, where A-rated homes use the least energy.

BedZed is an example of a sustainable development in the UK. BedZED comprises homes with no central heating or air conditioning but instead makes full use of natural heating and lighting. The buildings are able to capture rainwater which is then used for flushing toilet

Businesses and organisations like to be energy efficient because it saves money. Public buildings like schools and hospitals have to display an energy certificate to show how much energy they use.

Local councils encourage people to use sustainable methods of transport. This could be through providing public transport, creating cycle lanes or introducing congestion charging. London has all of these measures, plus an underground train network and a cycle hire scheme.



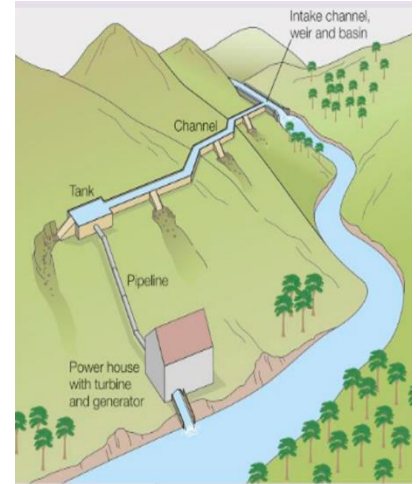
# Resource Management: SUSTAINABLE ENERGY

## CHAMBAMONTERA: A SUSTAINABLE ENERGY CASE STUDY

Approaches to managing energy in low and medium income countries (LICs and MICs) must be sustainable. One such example is the Chambamontera Micro-hydro scheme in Peru.

### What is it?

- Chambamontera is a micro-hydro scheme that uses water to generate electricity on a small scale to power rural villages.
- The scheme takes water from high in the mountains and then uses gravity to allow the water to run quickly down the steep slopes, powering a generator



**GCSE Practice Questions:** 'What makes the micro-hydro scheme in Peru a sustainable way of providing energy? (4)

### Why was it needed?

- Chambamontera is an isolated community in the Andes Mountains of Peru.
- It is more than two hours' drive on a rough track to the nearest town.
- Most people are dependent on subsistence farming with small-scale coffee growing and rearing of livestock.
- Nearly half of the population survive on just US\$2 a day.
- Until recently the community had no electricity to supply power for equipment, lighting or heating, so development has been severely restricted.

### How was it paid for?

- The scheme was supported by the charity Practical Action.
- The cost was \$51,000 which was partly funded by Japan but the community had to pay for part of it.
- The average cost per family was US\$750 which they funded by credit and microfinance loans
- High rainfall, steep slopes & fast flowing rivers make this area ideal for exploiting water power as a renewable source of energy.

### SOCIAL

- Local people involved at all stages
- Healthcare improved as electricity allows storage of medicines
- Electricity for schools & Training of local people to operate the technology gives them skills

### ECONOMIC

- Cheaper electricity than a large HEP scheme
- Uses local skills and cheap technology
- 60% of people said their income had increased

### ENVIRONMENTAL

- Avoids flooding large areas, which takes away farmland
- Avoids burning wood from local trees for fuel
- Replaces fossil fuel use

### Positives

### SOCIAL

- Poor people have to pay for metered electricity
- Some villages have doubled in size, creating population pressures

### ECONOMIC

- Demand for electricity is variable
- Initial capital cost is high for a small village; £500 per household
- Some specialist equipment had to be imported

### ENVIRONMENTAL

- Small storage dam is needed which alters the flow of the river and spoils the scenery and displaces wildlife

### Negatives