Natural Hazards

You often see natural hazards on the news — but that's not an excuse to watch telly instead of revising.

A Natural Hazard is a Threat to People or Property

1) A natural hazard is a natural process which could cause death, injury or disruption to humans, or destroy property and possessions.
2) A natural disaster is a natural hazard that has actually happened.
3) Extreme events which do not pose any threat to human activity are not counted as hazards (e.g. a drought in an uninhabited desert or an avalanche in Antarctica).

There are Two Main Types of Natural Hazard

Most natural hazards can be divided up into two main categories:

1 Geological Hazards

Geological hazards are caused by land and tectonic processes.

They include volcanoes and earthquakes (see p.3-8), landslides and avalanches.

2 Meteorological Hazards

Meteorological hazards are caused by weather and climate.

Examples include tropical storms (p.10-12) and other extreme weather (p.13-14), e.g. heatwaves and cold spells.

Climate change (p.15-18) may increase the risk of meteorological hazards.

Different Factors Affect the Hazard Risk from Natural Hazards

Hazard risk is the probability of people being affected by a hazard in a particular area. There are several factors that can affect hazard risk:

Vulnerability

1) The more people that are in an area exposed to natural hazards, the greater the probability they will be affected by a natural hazard.
2) For example, an area with high population density on a flood plain (like much of Bangladesh) is very vulnerable to flooding caused by extreme weather, and a city at the base of a volcano (like Naples, Italy) is very vulnerable to volcanic eruptions.

Capacity To Cope

1) The better a population can cope with an extreme event, the lower the risk of them being severely affected.
2) For example, higher income countries (HICs) are better able to cope with flooding because they can afford to build flood defences and evacuate people.

Nature of Natural Hazards

1) Type — the risk from some hazards is greater than others.
   E.g. tropical storms can be predicted and monitored, giving people time to evacuate.
   But earthquakes happen very suddenly, with no warning, so it's much harder to protect people.
2) Frequency — natural hazards that occur more often may carry a higher risk.
3) Magnitude — more severe natural hazards tend to have the greatest effects.
   E.g. a magnitude 9.0 earthquake that struck Japan in 2011 killed over 15 000 people, whereas a 6.3 magnitude earthquake in L'Aquila, Italy, in 2009 killed around 300 people.

EXAM QUESTION

Another natural hazard — forgetting to wear deodorant for PE...

There's more about natural hazards on the way, but before you rush off, have a crack at this question:

1) Outline one factor that can affect the risk from natural hazards. [2]

Natural Hazards — Effects and Responses

Now it's time to find out how natural hazards affect people and how people respond to them.

Natural Hazards Have Primary and Secondary Effects...

1) The primary effects of natural disasters are the immediate impacts caused by the hazard itself:

- Buildings and roads are destroyed by earthquakes, volcanic eruptions or tropical storms.
- People are injured or killed, e.g. when buildings collapse.
- Crops and water supplies can be damaged or contaminated.
- Electricity cables, gas pipes and communication networks can be damaged, cutting off supplies.

2) The secondary effects happen later on, often as a result of the primary effects.

- The initial hazard can trigger other hazards, e.g. earthquakes can trigger tsunamis (enormous waves caused by seawater being displaced).
- Aid and emergency vehicles can't get through because of blocked roads or bridges — this can cause more deaths.
- A shortage of clean water and a lack of proper sanitation makes it easier for disease to spread.
- Food shortages can occur if crops are damaged, livestock are killed or supply lines are blocked.
- The country's economy can be weakened — damage to businesses can cause unemployment, and the reconstruction process can be very expensive.

Examples of the effects and responses to specific hazards can be found on pages 6, 7 and 11.

...Which Also Lead To Immediate And Long-Term Responses

Some effects have to be dealt with before, during or immediately after the natural disaster to stop further loss of life, injuries or damage to property. Others are dealt with in the longer term:

Immediate Responses

1) Evacuate people (before the hazard occurs if possible).
2) Treat the injured and rescue anyone cut off by damage to roads or bridges.
3) Recover dead bodies to prevent disease spreading.
4) Provide temporary supplies of electricity and gas if regular supplies have been damaged.
5) Provide food, drink and shelter to people without homes.
6) Foreign governments or charities may send aid workers, supplies or financial donations.

Long-Term Responses

1) Repair homes or rehouse people who have lost their homes.
2) Repair or rebuild buildings, roads, railways and bridges.
3) Reconnect broken electricity, water, gas and communication connections.
4) Improve forecasting, monitoring and evacuation plans.
5) Improve building regulations so that buildings can withstand similar hazards in the future.
6) Boost economic recovery, e.g. by promoting tourism.

Learning this page will have a positive effect on your marks...

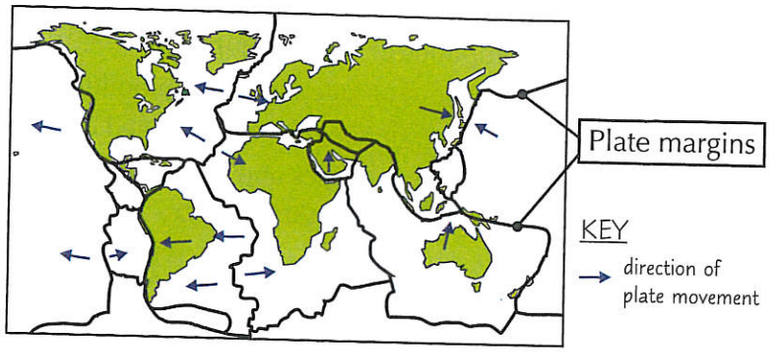
I know, I know... there's quite a lot of stuff you need to learn here. But the better you know this stuff, the better you'll understand the examples coming up. And trust me... there are some humdingers lined up for you.

Tectonic Plates

The Earth's surface is made of huge floating plates that are constantly moving... Rock on.

The Earth's Surface is Separated into Tectonic Plates

1) The Earth's crust (its outer layer) is divided into slabs called tectonic plates that float on the mantle (a layer of semi-molten rock).
2) Plates are made of 2 types of crust:
   - Continental crust is thicker (30-50 km) and less dense.
   - Oceanic crust is thinner (5-10 km) and more dense.
3) The plates are moving because of convection currents in the mantle.
4) The places where plates meet are called plate margins or plate boundaries.



There are Three Types of Plate Margin

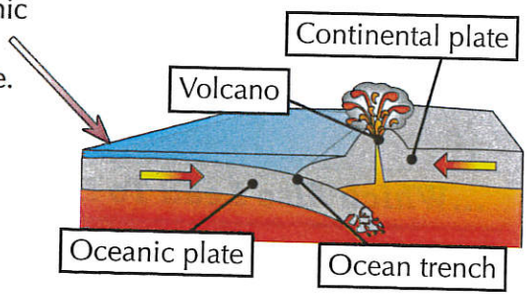
1 Destructive Margins

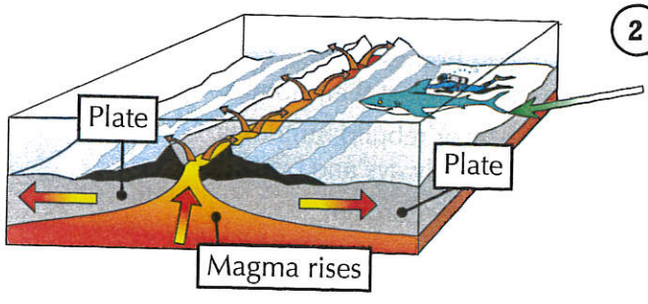
These are where two plates are moving towards each other.

Where an oceanic plate meets a continental plate, the denser oceanic plate is subducted (forced down into the mantle) and destroyed, creating gas-rich magma. Volcanoes and ocean trenches occur here.

Where two continental plates meet, the ground is folded upwards, creating fold mountains.

Example: along the west coast of South America, the oceanic Nazca plate is being subducted beneath the continental South American plate, creating the Atacama Trench.





2 Constructive Margins

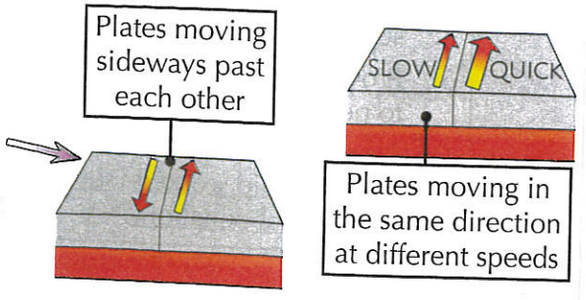
Constructive margins are where two plates are moving away from each other. Magma rises from the mantle to fill the gap and cools, creating new crust.

Example: the movement of the Eurasian plate and the North American plate away from one another is forming the mid-Atlantic ridge.

3 Conservative Margins

Conservative margins are where two plates are moving sideways past each other, or are moving in the same direction but at different speeds. Crust isn't created or destroyed.

Example: at the San Andreas Fault, the Pacific plate is moving in the same direction as the North American plate but faster.



Giant plates whacking into each other — smashing stuff...

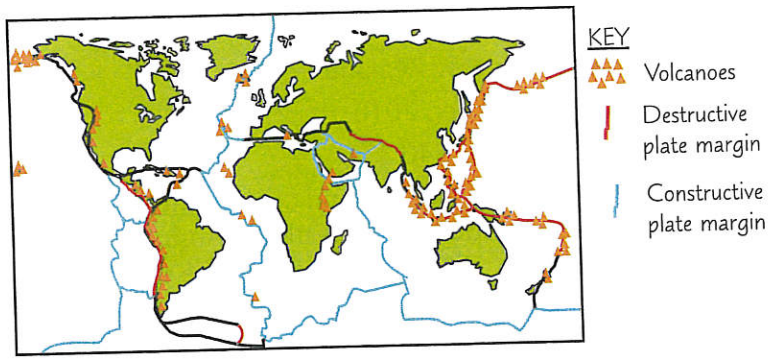
Make sure you understand what tectonic plates are and the different boundaries that they can create, or you'll really struggle to work constructively through the rest of the section. I find sketching diagrams can be useful...

Volcanoes and Earthquakes

Where plates meet, volcanoes and earthquakes occur. If only the waiter would carry them more carefully.

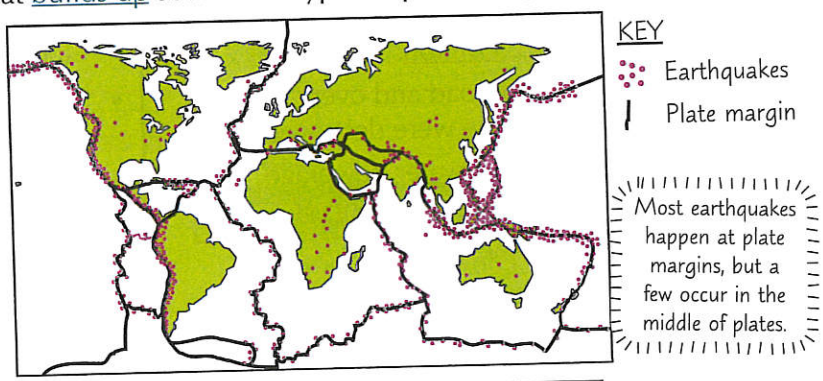
Volcanoes Occur at Destructive and Constructive Plate Margins

1) At destructive margins, the denser oceanic plate moves down into the mantle, where it melts. A pool of magma forms, which then rises through cracks in the crust called vents. The magma (called lava when it reaches the surface) erupts, forming a volcano.
2) At constructive margins, the magma rises up into the gap created by the plates moving apart, forming a volcano.
3) Some volcanoes also form over parts of the mantle that are really hot (called hotspots), e.g. in Hawaii.
4) When a volcano erupts, it emits lava and gases. Some volcanoes emit lots of ash, which can cover land, block out the sun and form pyroclastic flows (super-heated currents of gas, ash and rock).

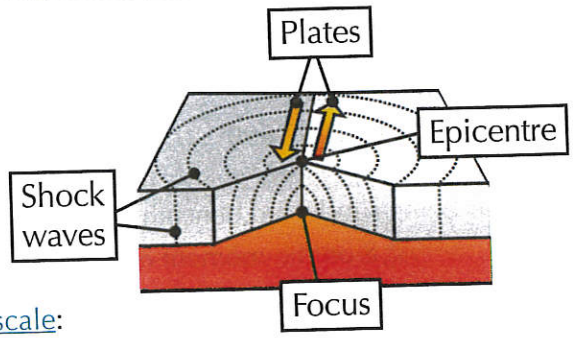


Earthquakes Occur at All Three Types of Plate Margin

1) Earthquakes are caused by the tension that builds up at all three types of plate margin:
   - Destructive margins — tension builds when one plate gets stuck as it moves past the other.
   - Constructive margins — tension builds along cracks in the plates as they move away from each other.
   - Conservative margins — tension builds up when plates that are grinding past each other get stuck.



2) The plates eventually jerk past each other, sending out shock waves. These vibrations are the earthquake.
3) The shock waves spread out from the focus — the point in the Earth where the earthquake starts. The waves are stronger near the focus and cause more damage.
4) The epicentre is the point on the Earth's surface straight above the focus.



5) Earthquakes are measured using the moment magnitude scale:
   - The moment magnitude scale measures the amount of energy released by an earthquake (called the magnitude).
   - It is a logarithmic scale — so a magnitude 7 earthquake would cause ten times as much ground shaking as a magnitude 6 earthquake.
   - Earthquakes of magnitude 6 and below normally only cause slight damage to buildings, although they can be worse in very built up areas.
   - Earthquakes of magnitude 7 and above can cause major damage and deaths.

Damage after a 7.8 magnitude earthquake in Nepal in 2015.

EXAM QUESTION

Tension, jerks, major damage — sounds like my dance moves...

1) Explain how volcanoes form at destructive plate margins. [3]

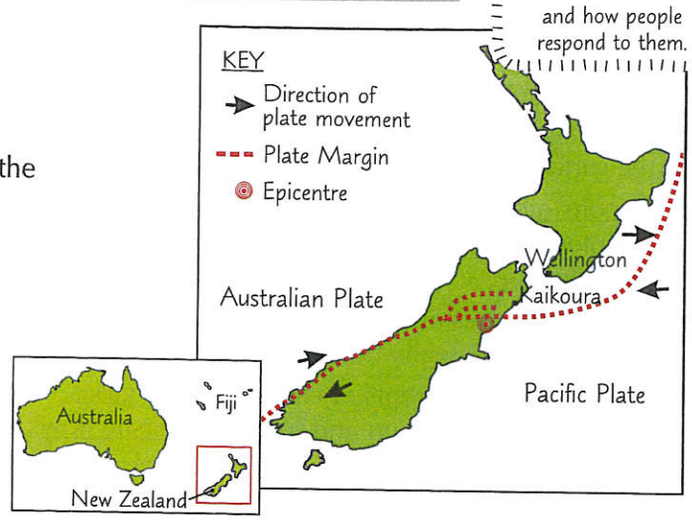
EXAMPLE Tectonic Hazards in Contrasting Countries

The effects of and responses to tectonic hazards can vary depending on a country's wealth. You need to kno about two tectonic hazards in contrasting countries — they could be earthquakes or volcanic eruptions.

New Zealand Suffered a 7.8 Magnitude Earthquake in 2016...

See p.3 for more on the effects of hazards and how people respond to them.

Place: Kaikoura, New Zealand
Date: 14th November, 2016
GDP per capita: US $40 331
Plate boundary: Destructive and conservative — the Pacific plate is subducting beneath the Australian plate to the north, and sliding past it to the south.
Magnitude: 7.8 on the moment magnitude scale



Primary Effects

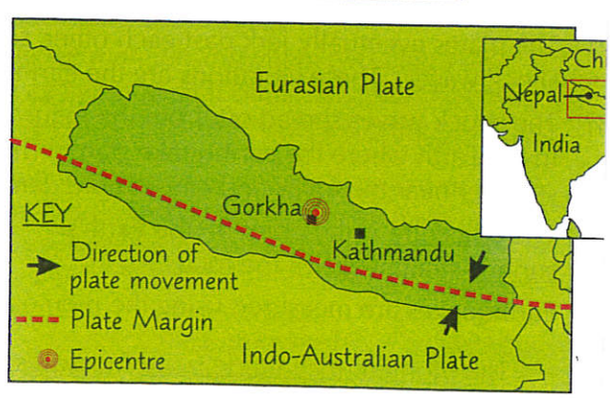
- 2 people died and over 50 people were injured.
- Tens of thousands of homes were damaged, and some were destroyed.
- 60 people needed emergency housing.
- The total cost of damage was around US $8.5 billion.
- Over 200 km of road and over 190 km of rail line were destroyed.
- Communications, water, sewerage and power supplies were cut off.

Secondary Effects

- The earthquake triggered up to 100 000 landslide which blocked major road and rail routes.
- A major landslide blocked the Clarence River, leading to flooding and the evacuation of 10 farm
- The earthquake generated a tsunami with waves o around 5 m, leaving debris up to 250 m inland.

...this was the Same Magnitude as an Earthquake in Nepal in 2015

Place: Gorkha, Nepal
Date: 25th April, 2015
GDP per capita: US $690
Plate boundary: Destructive — the Indo-Australian plate is being subducted beneath the Eurasian plate.
Magnitude: 7.8 on the moment magnitude scale



Primary Effects

- Around 9000 people died and more than 22 000 were injured.
- An estimated 800 000 buildings were damaged or destroyed.
- 4 million people were left homeless.
- The cost of damage was over US $5 billion.
- Roads and bridges were destroyed.
- Water tanks and pipes were destroyed, leaving 2 million people without access to clean water and sanitation.

Secondary Effects

- The earthquake triggered avalanches on Mount Everest which killed 18 people.
- Many mountain roads were blocked by landslides, preventing emergency aid from reaching remote areas.
- A lack of clean water caused outbreaks o typhus, which killed at least 13 people.

Tectonic Hazards in Contrasting Countries

EXAMPLE

Whether you've studied earthquakes or volcanic eruptions, make sure you know the effects and responses.

New Zealand Responded Quickly to the Earthquake

Immediate Responses

- A tsunami warning was issued quickly, and residents of coastal areas were told to move to higher ground.
- Hundreds of people were housed in emergency shelters and community centres.
- 200 of the most vulnerable people were evacuated from Kaikoura by helicopter within 24 hours of the earthquake.
- Power was restored to most places within a few hours. Temporary water supplies were set up.
- International warships were sent to Kaikoura with supplies such as food, medicine and portable toilets.

Long-Term Responses

- $5.3 million of funding was provided by the Kaikoura District Council to help with rebuilding the town's water systems and harbour.
- Most road and rail routes were repaired and reopened within 2 years.
- The Kaikoura Mayoral Earthquake Relief Fund was set up to help residents who couldn't afford basic supplies, and donations were received from around the world.
- By March 2017, a permanent water main had been laid in Kaikoura. The new pipe was designed to move with any future earthquakes so it won't break.

Large cracks in roads needed to be repaired after the earthquake.

Nepal's Response was Slower and Less Effective

Immediate Responses

- India and China sent teams to help residents rescue people trapped by debris, but a lack of tools and machinery slowed down rescue efforts.
- People tried to recover the dead and treat the injured, but damaged roads made it hard for emergency workers and aid to get through.
- Charities such as Oxfam provided medicine, food and temporary water supplies.
- The Red Cross set up emergency shelters for 130 000 families who had lost their homes.

People needed rescuing from collapsed buildings

Long-Term Responses

- The World Bank Group financed $500 million worth of projects to build earthquake-resistant housing, and repair roads and irrigation systems. Some projects are still ongoing.
- The road from Nepal into Tibet was reopened 2 years after the earthquake, but many other routes remain damaged.
- Many heritage sites were reopened in June 2015 to encourage tourists back to the area.
- Water supply is being restored, but two years after the event, many people still didn't have access to clean water.
- NGOs are working with residents to increase their resilience to disasters, for example by providing alternative energy sources.

Money money money — always helpful when responding to hazards...

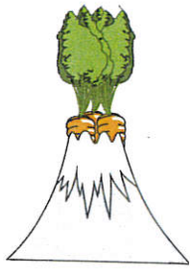
It wasn't just lack of wealth that made Nepal more vulnerable than New Zealand — it also has a much higher population density, so the risk was higher. Whatever examples you've learnt, make sure you know them well.

Living With Tectonic Hazards

Because they keep quiet most of the time, plenty of people live in areas affected by tectonic hazards...

Lots of People Live in Areas at Risk from Tectonic Hazards

1) Many people live close to volcanoes or in areas vulnerable to earthquakes. Some people don't have a choice in this — for example, they may not be able to afford to move, or they may not know the risks.
2) However, many people choose to live in a hazardous region, e.g. around 1 million people live close to Mount Etna in Italy. People may make this choice for many reasons:
   - They've always lived there — moving means leaving their jobs or families.
   - In wealthier countries, effective monitoring and evacuation plans can minimise risk.
   - They're confident that their government will support them after an earthquake or volcanic eruption. In 2001, the Italian government provided financial aid and tax breaks for local residents when Mount Etna erupted.
   - The minerals from volcanic ash makes volcanic soil very fertile, attracting farmers. For example, the mineral-rich soil around Mount Etna is ideal for producing grapes.
   - Volcanoes are tourist attractions, so lots of people live nearby to work in the tourist industry — Mount Etna receives hundred of thousands of visitors when it is erupting.



Management can Reduce the Effects of Tectonic Hazards

Management strategies can reduce the number of people killed, injured, made homeless or left unemployed.

Monitoring

1) Earthquakes — seismometers and lasers monitor earth movements, and can be used in early warning systems to give a small but vital amount of warning before a large earthquake occurs.
2) Volcanic eruptions — scientists can monitor the tell-tale signs that come before an eruption, such as tiny earthquakes, escaping gas, and changes in the shape of a volcano.

Prediction

1) Earthquakes — cannot be reliably predicted, but scientists can forecast where they may occur by monitoring the movement of tectonic plates.
2) Volcanic eruptions — can be predicted if scientists monitor volcanoes closely.

Protection

1) Earthquakes — new buildings can use reinforced concrete that absorb an earthquake's energy. Existing buildings and bridges can be strengthened with steel frames so they're less likely to collapse. Automatic shut-off switches can turn off gas and electricity supplies to prevent fires.
2) Volcanic eruptions — buildings can be strengthened so that they're less likely to collapse under the weight of ash. Trenches and barriers have been used to try to divert lava away from settlements, but with little success.

Planning

Similar methods are used to plan for earthquakes and volcanic eruptions:

1) Future developments can avoid high-risk areas.
2) Emergency services can prepare, e.g. by practising rescuing people from collapsed buildings.
3) People can be educated so that they know what to do in the event of a hazard.
4) Governments can plan evacuation routes to get people away quickly and safely.
5) Emergency supplies like blankets, clean water and food can be stockpiled.

Volcano? For many people, it's more like volcaYES...

Make sure you know how monitoring, prediction, protection and planning can help to reduce the risks from earthquakes and volcanoes. It's easy to get them muddled up, so try writing out a few points from each box.

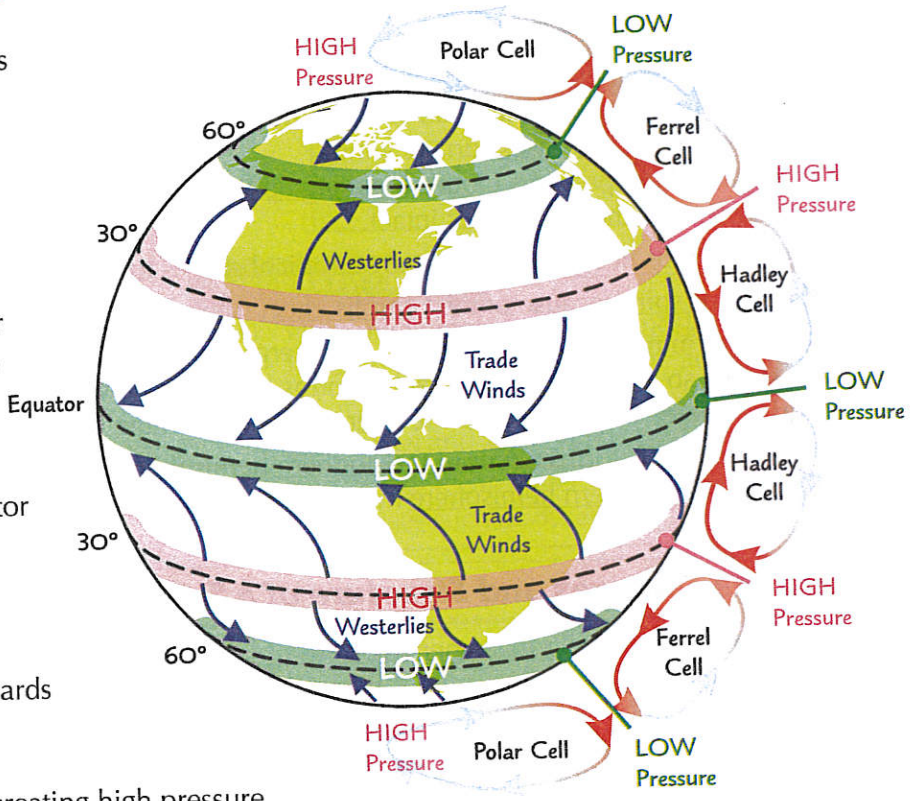
Global Atmospheric Circulation

This might not be as exciting as volcanoes, but it's still important stuff. And what a pretty page it is...

Air Circulates between High and Low Pressure Belts as Surface Winds

1) Global atmospheric circulation is the transfer of heat from the equator to the poles by the movement of air.
2) Air moves due to differences in air pressure — winds blow from high pressure areas to low pressure areas.
3) The global atmospheric circulation system is divided into loops (called cells) — each cell has warm rising air that creates a low pressure belt and cool sinking air that creates a high pressure belt.
4) Each hemisphere has three cells. Here's how air moves in these cells:

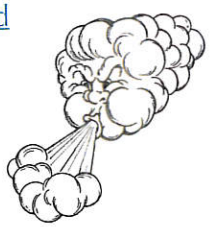
- The sun warms the Earth at the equator, causing the air to rise. This creates a low pressure belt.
- As the air rises it cools and moves away from the equator.
- 30° north and south of the equator, the cool air sinks, creating a high pressure belt.
- At the ground surface, the cool air moves either back to the equator (as trade winds) or towards the poles (as westerlies). These winds curve because of the Earth's rotation — this is called the Coriolis effect.
- 60° north and south of the equator the warmer surface winds meet colder air from the poles. The warmer air rises, creating low pressure.
- Some of the air moves back towards the equator, and the rest moves towards the poles.
- At the poles the cool air sinks, creating high pressure. The high pressure air is then drawn back towards the equator.



Global Atmospheric Circulation Affects Weather Around The World

Global atmospheric circulation influences weather and climate. For example:

1) At the equator, the sun is directly overhead — this means the Earth's surface receives a lot of solar radiation, so it's hot. Warm, moist air rises and forms clouds, so it rains a lot.
2) By the time air reaches 30° north and south of the equator, it has released most of its moisture as rain. The dry air means there are few clouds and little rainfall, so deserts are often found at this latitude.
3) The UK lies close to the low pressure zone at 60° north. Warm rising air brings lots of cloud cover and rainfall, often as low pressure systems carried from the Atlantic by westerly winds.



And I thought baked beans were the main cause of wind patterns...

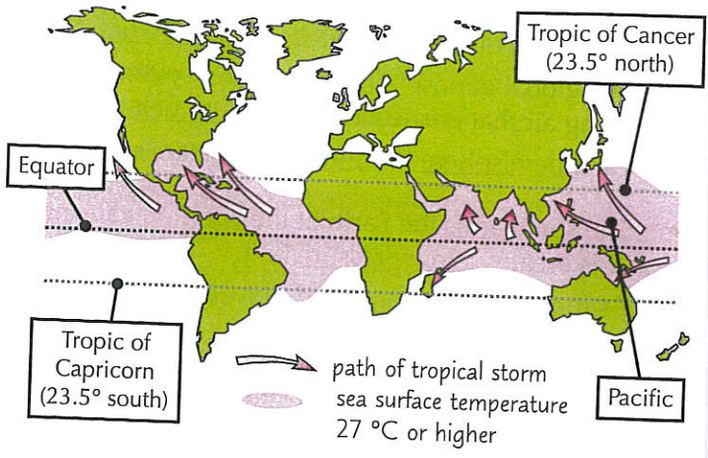
...sorry, that lowered the tone. Best focus on the three air circulation cells between the equator and the poles. You need to know how these cause the wind patterns that give the world its weather and climate.

Tropical Storms

Tropical storms (a.k.a. hurricanes in the North Atlantic and Northeast Pacific, typhoons in the Northwest Pacific, cyclones in the South Pacific and Indian Ocean) are low pressure weather systems with intense rain and winds.

Tropical Storms Develop over Warm Water

1) Tropical storms develop between 5 and 30° north and south of the equator, when:
   - sea temperature is 27 °C or higher.
   - wind shear (the difference in wind speed) between higher and lower parts of the atmosphere is low.
2) The warm surface water evaporates, rises and condenses into clouds. This releases huge amounts of energy, producing powerful storms. The rising air creates an area of low pressure, which increases surface winds. Low wind shear prevents clouds breaking up as they rise, so the storm stays intact.



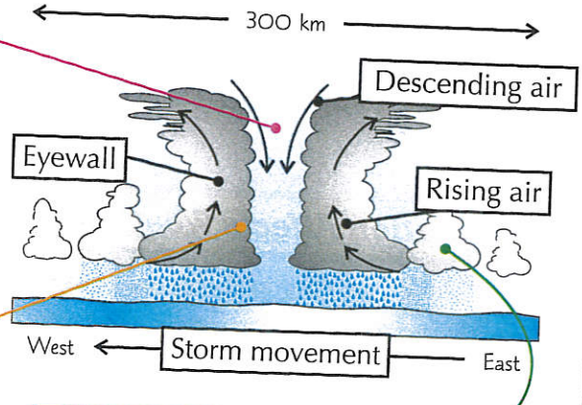
3) Easterly winds near the equator move tropical storms towards the west.
4) The storms spin because of the Coriolis effect (see p.9).
5) As the storm moves over the ocean, the energy from the warm water strengthens the storm, so wind speeds increase. Storms lose strength when they move over land or cooler water, because the energy supply from the warm water is cut off.
6) The majority of storms occur in the northern hemisphere from August to October, while in the southern hemisphere most storms occur from December to April.

Tropical storms occur at different times of year in different areas depending on when sea temperatures are highest.

Learn the Features and Structure of a Tropical Storm

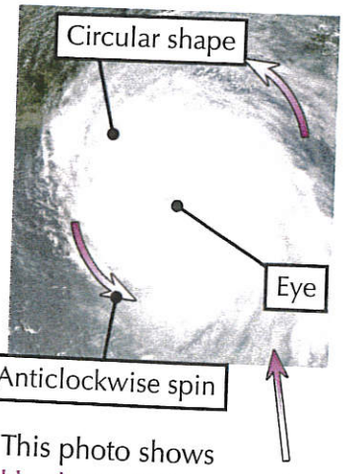
Tropical storms are circular in shape, hundreds of kilometres wide and usually last 7-14 days. They spin anticlockwise in the northern hemisphere, and clockwise in the southern hemisphere.

The centre of the storm is called the eye — it's up to 50 km across and is caused by descending air. There's very low pressure, light winds, no clouds, no rain and a high temperature in the eye.



The eye is surrounded by the eyewall, where there's spiralling rising air, very strong winds (around 160 km per hour), storm clouds, torrential rain and a low temperature.

Towards the edges of the storm the wind speed falls, the clouds become smaller and more scattered, the rain becomes less intense and the temperature increases.



This photo shows Hurricane Katrina passing over the Gulf of Mexico in 2005. It made landfall in the USA on 29th August.

Forget warm water, you're in hot water when one of these turns up...

Make sure you know how storms develop and what their characteristics are. It'll be a whopping great help if you know them inside out and back to front for the exam. And you know that I'd never lie. I pinky promise.

Tropical Storms — Typhoon Haiyan

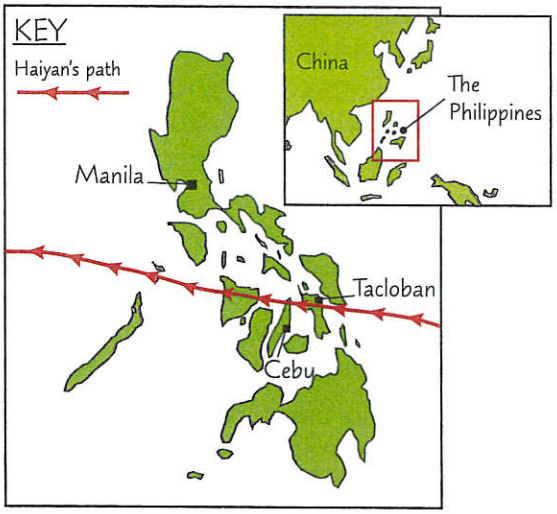
EXAMPLE

It's time to apply what you've learnt to another real-world example. Don't say I don't spoil you.

Typhoon Haiyan was One of the Most Powerful Storms Ever Recorded

1) Typhoon Haiyan made landfall in the Philippines on 8th November 2013.
2) Tacloban and Cebu were among the worst affected areas, with up to 280 mm of rain and winds reaching a maximum of 314 km/hour.
3) A storm surge with waves of up to 2.3 m, combined with a high tide, meant that Tacloban was hit by waves of up to 5 m.

A storm surge is a temporary rise in water level caused by wind pushing waves onshore.



Primary Effects

1) 8000 people were killed.
2) Over 1 million homes were severely damaged or destroyed.
3) 1.9 million people were made homeless.
4) Strong winds damaged electricity lines, and water supplies were contaminated by salt water from the storm surge.
5) The heavy rain and storm surges flooded 600 000 hectares of farmland.
6) The cost of damage was estimated at approximately US $13 million.

Secondary Effects

1) Flooding triggered several landslides, which blocked roads and delayed the arrival of aid.
2) 5.6 million workers lost their jobs after businesses and agricultural land were destroyed.
3) The lack of clean water caused outbreaks of diseases such as dysentery.

The Philippines and the Wider World Responded Quickly

Immediate Responses

1) PAGASA (the Philippines' meteorological agency) broadcast warnings about Typhoon Haiyan two days before it made landfall. This led to the evacuation of 800 000 residents before the storm. Unfortunately, some of these people died when evacuation centres flooded.
2) Fishermen were warned not to go to sea.
3) The Philippines declared a state of emergency, which led to many charities offering aid in the form of food, shelter and clean water.
4) Plan International constructed pit latrines for 100 000 people to help prevent the spread of disease.

Long-Term Responses

1) The UN appealed for over $300 million to help fund rebuilding and relief.
2) Charities built new storm-resistant houses for those who lost their homes.
3) The Philippines' tourism board encouraged people to visit the country after the storm by emphasising that most areas were unaffected and that money from tourism would help with the rebuilding process.

Many homes needed rebuilding after Typhoon Haiyan

The facts on Haiyan make for grim reading, that's no joke.

You might not have studied this exact tropical storm (I'll try not to be too offended), but you still need to know these facts for the one you've studied. Best make sure you've got some effects and responses locked down.

Tropical Storms — Climate Change and Management

Climate change may make tropical storms more severe, so we need to find ways to manage their impacts.

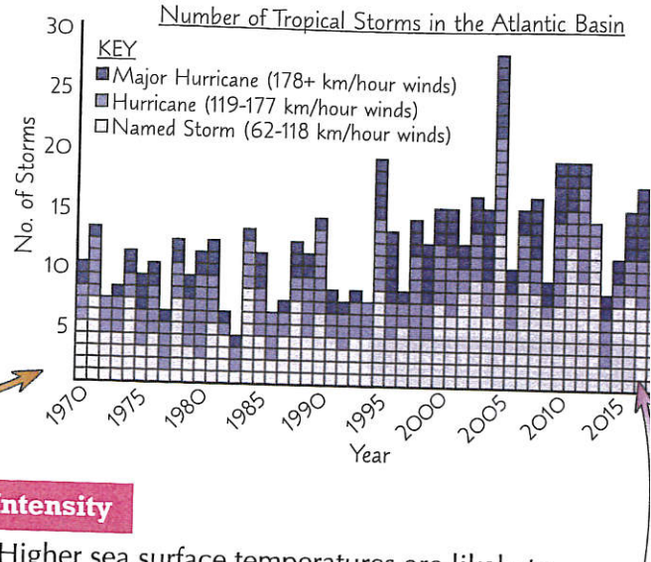
Climate Change May Affect Tropical Storms

Global average sea surface temperatures have risen by 0.9 °C since 1880 and are expected to rise more as a result of climate change. It's hard to predict what effect this will have on tropical storms, but it may affect their distribution, frequency and intensity.

Frequency

Oceans will stay at 27 °C or higher for longer each year, so there's a longer period when tropical storms can form. This may mean that there are more storms each year.

In the Atlantic, the number of tropical storms each decade seems to have increased. 16 of the last 24 years have had a higher than average number of hurricanes.



Distribution

As the average ocean temperature rises, more of the world's oceans could be above 27 °C — this may mean that tropical storms can form in areas that haven't experienced them before, e.g. at higher latitudes.

Intensity

Higher sea surface temperatures are likely to result in more evaporation and increased cloud formation, so more energy is released. This could mean storms become more powerful.

In the Atlantic, the number of major hurricanes has increased since 1970. 2014-2018 had almost twice as many major hurricanes as 1970-1975.

There Are Many Ways To Reduce The Effects Of Tropical Storms

Prediction and Monitoring

1) Storms can be monitored using radar, satellites and aircraft. Computer models can then be used to calculate a storm's predicted path.
2) Predicting where and when a tropical storm is going to happen gives people time to evacuate and protect their homes and businesses.

Example: during Typhoon Haiyan, predicting the storm's path helped authorities decide which areas needed to be evacuated.

Planning

1) Future developments, e.g. new houses, can avoid high-risk areas, such as low-lying coastal zones.
2) Governments can plan evacuation routes to ensure people can get away quickly.
3) Emergency services can prepare for disasters by practising rescuing people from flooded areas.

Example: after Typhoon Haiyan, volunteers started rescue simulations so they were better prepared for future storms.

Protection

1) Buildings can be designed to withstand tropical storms. Buildings can also be put on stilts so they're safe from floodwater.
2) Flood defences can be built along rivers (e.g. levees) and coasts (e.g. sea walls).

Example: mangrove forests are being planted in the Philippines to act as a natural flood defence.

EXAM QUESTION

Prediction, planning and protection prevent poor performance...

Check you're clear on how the impacts of tropical storms can be reduced, then try this exam question:

1) Explain how effective planning can reduce the impacts of a tropical storm. [4]

UK Weather Hazards

Weather hazards are quite common in the UK — and it's not just about rain, either...

The UK Experiences Lots of Different Weather Hazards

Hazard	Impacts	Example
Strong Winds	• Strong winds (gales) can damage properties and disrupt transport. • Uprooted trees and debris can injure or kill people.	In 2018, Storm Ali killed two people when 100 mph winds blew over several trees.
Heavy Rainfall	• Too much rain can cause flooding, which can damage homes, disrupt transport networks and drown people. • Recovering from flooding can cost millions of pounds.	Parts of South Wales flooded in 2018 after over 180 mm of rain fell in 48 hours during Storm Callum.
Snow and Ice	• Snow and ice can cause injuries due to slipping and deaths due to the cold. • Schools and businesses can be forced to shut, and disruption to travel can have economic impacts.	In March 2018, the 'Beast from the East' brought up to 50 cm of snow, causing major disruption to traffic and schools.
Drought (a lack of precipitation)	• Water supplies can run low, causing economic impacts such as crop failures. • Rules to conserve water (like banning hosepipes) have to be introduced.	From April 2010 to March 2012, southern and eastern England only received 75% of their average monthly rainfall. By spring 2012, groundwater levels were very low.
Thunderstorms	• Heavy rain, strong winds and lightning can all occur during thunderstorms. • Lightning can cause fires, which can damage property and the environment, and can occasionally kill people.	In July 2014, a series of thunderstorms struck southern and central England, with lightning strikes causing power cuts and delaying flights.
Heat Waves	• During long periods of hot weather, pollution builds up in the air. This can cause heat exhaustion or breathing difficulties, which can kill people. • Disruption to transport from rails buckling or roads melting can cause economic impacts — but the tourism industry may benefit from the better weather.	2018 was one of the hottest summers on record, with temperatures reaching 35 °C in Kent. 

Weather in the UK is Becoming More Extreme

The UK's weather is naturally variable, but extreme events seem to be becoming more common and severe:

1) Temperature: The UK's ten warmest years have all occurred since 1990, and 2018 was the joint hottest summer on record. Extreme cold events seem to be more frequent too — seven of the UK's eleven coldest recorded temperatures have occurred since 1980 and December 2010 was the coldest month for over 100 years.

2) Rainfall: More rainfall records were broken between 2010 and 2014 than in any decade on record. Major flooding events have become more frequent over the past ten years — December 2015 was the wettest month ever recorded, and severe flooding occurred in many areas of the UK.

Many roads were impassable after the 2015 floods.

Heat waves, thunderstorms, snow — just a regular day in Cumbria...

The weather hazards affecting the UK probably don't seem as bad as volcanoes, earthquakes or hurricanes. But when your sofa's bobbing around in three feet of water, or a tree crashes into your roof, it's still pretty rough.

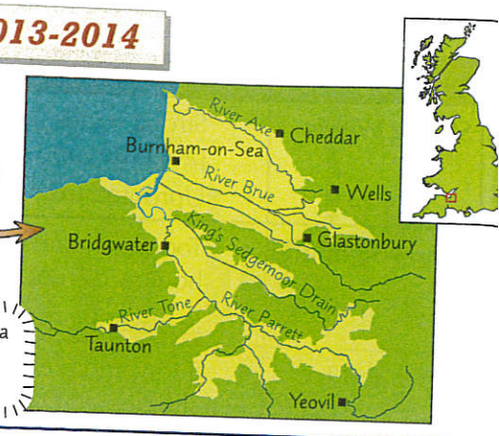
EXAMPLE

UK Weather — Somerset Levels Flooding

On the whole, UK weather isn't THAT extreme, but it has its moments. You need to know an example of an extreme weather event, and how management strategies reduced the risk from it.

Storms Flooded the Somerset Levels in Winter 2013-2014

1) From December 2013 to February 2014, Somerset experienced three times the average amount of rainfall for those months.
2) Lots of rain fell on already saturated ground, and coincided with high tides and storm surges. This caused extensive flooding of the Levels, an area of low-lying land criss-crossed by rivers.
3) Human activities also played a part — the rivers hadn't been dredged (cleared of sediment) regularly for 20 years, which reduced their capacity.



Much of the area is a flood plain (see p.53).

Social Impacts

- More than 600 homes were flooded, and many people were forced to evacuate.
- Villages such as Muchelney were cut off by road, and the only way in or out was by boat.
- Major transport links, including the A361 and some train lines, were closed or disrupted.
- Insurance prices soared, and some residents were unable to insure their homes against future flooding.

Environmental Impacts

- 11 500 hectares were flooded, including farmland — this destroyed many crops.
- Standing water made the ground toxic and unproductive for over a year. Loss of nutrients and damage to soil structure decreased the long-term fertility of land.
- Tonnes of mud and debris were left by the floods, damaging vegetation.

Economic Impacts

- The total cost of damage to the Somerset Levels was estimated at over £80 million.
- Local companies lost more than £1.2 million in business.
- Loss of tourism cost the county £200 million.

Management Strategies Have Been Used to Reduce Flood Risk

1) Before the flood, individuals and organisations took action to limit its impacts:
   - Warning systems gave people time to prepare, e.g. the Met Office warned people to find emergency accommodation in case they had to leave their homes.
   - Individuals and local authorities used sandbags and flood boards to try and limit flood damage to homes.
2) Since the flood, the government has set up the 'Somerset Levels and Moors Flood Action Plan' — a 20-year plan which aims to limit the risk of future flooding. £100 million will be spent on:
   - Turning temporary pumping stations into permanent ones.
   - Regular dredging of the rivers Parrett and Tone.
   - Building a tidal barrage at Bridgwater.
   - Widening the River Sowy's channel and King's Sedgemoor Drain.

Dredging of the River Parrett started in March 2014

EXAM QUESTION

Manage your revision strategies — have a go at this question...

1) With reference to a named example, explain how management strategies can reduce the impacts of extreme weather in the UK. [6]

Climate Change — The Evidence

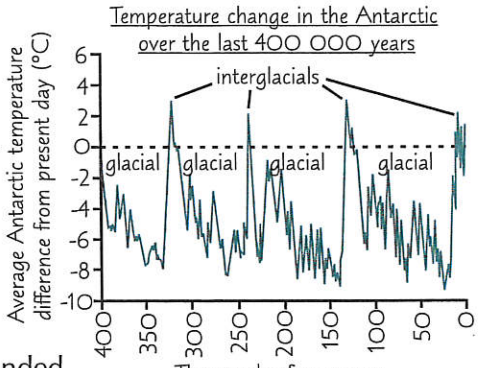
We British like to talk about the weather, so global climate change should give us plenty to go on...

The Earth is Getting Warmer

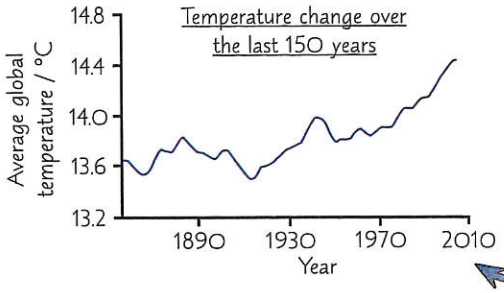
Climate change is any significant change in the Earth's climate over a long period. The climate constantly changes, it always has, and it always will.

1) The Quaternary period is the most recent geological time period, spanning from about 2.6 million years ago to the present day.
2) In the period before the Quaternary, the Earth's climate was warmer and quite stable. Then things changed a lot.
3) During the Quaternary, global temperature has shifted between cold glacial periods that last for around 100 000 years, and warmer interglacial periods that last for around 10 000 years.

The Quaternary period includes the whole of human history.



This graph shows the last 400 000 years but the glacial-interglacial cycles have been repeating throughout the Quaternary period — there have been at least 20.



4) The last glacial period ended around 15 000 years ago. Since then the climate has been warming.
5) Global warming is the term used to describe the sharp rise in global temperatures over the last century. It's a type of climate change.

Evidence for Climate Change Comes from Many Sources

Scientists can work out how the climate has changed over time using a range of methods. For example:

Ice and Sediment 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 the gases trapped in the layers of ice, they can tell what the temperature was each year.
4) One ice core from Antarctica shows the temperature changes over the last 400 000 years (see graph above).
5) The remains of organisms found in cores taken from ocean sediments can also be analysed. These can extend the temperature record back at least 5 million years.

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.

Pollen Analysis

1) Pollen from plants gets preserved in sediment, e.g. at the bottom of lakes or in peat bogs.
2) Scientists can identify and date 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.

Temperature Records

1) Since the 1850s, global temperatures have been measured accurately using thermometers. This gives a reliable but short-term record of temperature change.
2) Historical records, like harvest dates or newspaper weather reports can extend the record of climate change further back.

Glacial cycles — as used by the polar bears in the Tour de Greenland...

Climate change is a really hot topic (sorry), so make sure you learn this stuff inside and out before your exam.

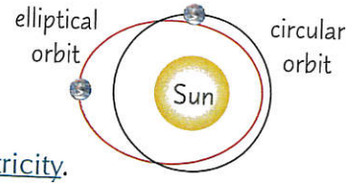
Climate Change — Causes

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.

Some Natural Factors are Possible Causes of Climate Change...

1 Orbital Changes

1) Orbital changes affect how much solar radiation (energy) the Earth receives — more energy means more warming.
2) There are variations in the way the Earth orbits the Sun:
   - Stretch —the Earth's orbit around the Sun varies from circular to elliptical (oval-shaped). This is also called eccentricity.
   - Tilt — the Earth's axis is tilted at an angle as it orbits the Sun.
   - Wobble — the Earth's axis wobbles like a spinning top (this is also known as precession).
3) These changes may have caused the glacial and interglacial cycles of the Quaternary period.



2 Volcanic Activity

1) Major volcanic eruptions eject large quantities of material into the atmosphere.
2) Some of these particles reflect the Sun's rays back out to space, so the Earth's surface cools.
3) Volcanic activity may cause short-term changes in climate, e.g. the Earth cooled by about 0.5 °C after Mount Pinatubo erupted in 1991.

3 Solar Output

1) The Sun's energy output isn't constant — it changes in short cycles of about 11 years, an possibly cycles hundreds of years long as we
2) Reduced solar output means that the Earth's climate may become cooler in some areas.
3) Solar output isn't thought to have a major effect on global climate change.

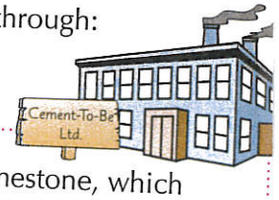
... and so are Human Activities

1) In recent years, global temperature has risen sharply. This is called global warming.
2) There's a scientific consensus that human activity is causing global warming through the greenhouse effe
3) The greenhouse effect takes place when greenhouse gases, such as carbon dioxide (CO_2) and methane, absorb outgoing heat from the Earth, so less is lost to space. It's essential for keeping the planet warm.
4) However, if greenhouse gas levels increase, more energy is trapped and the planet warms up even more
5) Humans are increasing the concentration of greenhouse gases in the atmosphere through:

Burning Fossil Fuels

CO_2 is released into the atmosphere when fossil fuels like coal, oil, natural gas and petrol are burnt, e.g. in thermal power stations or cars.

Cement Production



Cement is made from limestone, which contains carbon. When cement is produced, lots of CO_2 is released into the atmosphere.

Farming

1) Farming livestock produces a lot of methane — cows love to fart...
2) Rice paddies contribute to global warming, because flooded fields emit methane.

Deforestation

1) Plants remove CO_2 from the atmosphere and convert it into organic matter using photosynthesis.
2) When trees are cut down, they stop taking in CO_2.
3) CO_2 is also released into the atmosphere when trees are burnt as fuel or to make way for agriculture.

EXAM QUESTION

The greenhouse effect — an irresistible urge to throw stones...

1) Explain how deforestation contributes to the greenhouse effect. [2]

Effects of Climate Change

Whether it's human or natural factors to blame, climate change seems to be having an impact...

Climate Change Affects the Environment...

Temperatures are expected to rise by 0.3 to 4.8 °C between 2005 and 2100.
This is already causing some major effects on the environment, and will continue to do so:

1) Warmer temperatures are causing glaciers to shrink and ice sheets to melt. Melting land ice, like the Greenland and Antarctic ice sheets, means that water stored on land is returning to the oceans, causing sea levels to rise.
2) Sea ice is also shrinking, leading to the loss of polar habitats.
3) Rising sea levels mean low-lying and coastal areas, like Miami in the USA, will flood more regularly. Coastal erosion will increase with sea level rise and some coastal areas will be submerged, so habitats will be lost.
4) Other species are declining due to warming, e.g. coral reefs, like the Great Barrier Reef in Australia, are suffering from bleaching (rising sea temperatures make coral expel the algae that lives in them, causing them to starve and die).
5) Precipitation patterns are changing — global warming is affecting how much rain areas get.
6) The distribution and quantity of some species could change and biodiversity could decrease:
   - Some species now live at higher latitudes (further from the equator) due to warming temperatures.
   - Some habitats are being damaged or destroyed because of climate change — species that are adapted to these areas may become extinct, e.g. climate change may limit bamboo growth, leading to the decline in numbers of giant pandas that rely on bamboo as a food source.

...and it Affects People Too

Rising temperatures and climate change don't only affect the environment — there are impacts on people too.

1) In some places, deaths due to heat have increased — but deaths due to cold have decreased.
2) Some areas could become so hot and dry that they're difficult or impossible to inhabit. Low-lying coastal areas, e.g. the Maldives, could be lost to the sea or flood so often that they also become uninhabitable. This may lead to migration and overcrowding in other areas.
3) Some areas are struggling to supply enough water for their residents due to problems with water availability caused by changing rainfall patterns. This can lead to political tensions, especially where rivers cross borders.
4) Climate change is affecting farming in different ways around the world:
   - Globally, some crops have suffered from climate change (e.g. warming in recent years has caused smaller yields in Argentina's wheat crops).
   - But some farmers in high-latitude countries are finding that their crops benefit from the warmer conditions and produce higher yields.
5) Lower crop yields could increase malnutrition, ill health and death from starvation, particularly in lower latitudes.
6) Climate change means the weather is getting more extreme. This means more money has to be spent on predicting extreme weather events, reducing their impacts and rebuilding after they take place.

The effects of not learning this page include declining mark availability...

Well, that was a cheerful read — loads of ways that climate change can affect people and the environment. But these are exactly the sorts of things that might turn up in your exam, so you'd better learn them. Hop to it.

Managing Climate Change

People have come up with lots of ways of coping with climate change, and you need to know about them.

Mitigation Strategies aim to Reduce the Causes of Climate Change

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

Carbon Capture

1) Carbon Capture and Storage (CCS) is designed to reduce emissions from power stations burning fossil fuels.
2) CCS involves capturing CO_2 and transporting it to safe places where it can be stored, e.g. deep underground.

Planting Trees

Planting trees increases the amount of CO_2 that is absorbed from the atmosphere through photosynthesis.

Alternative Energy Production

1) Replacing fossil fuels with nuclear or renewable energy can help reduce greenhouse gas emissions.
2) In the UK, more offshore wind farms are being built, e.g. in East Anglia, and several wave, tidal and nuclear power projects have been planned.

International Agreements

1) The Paris Agreement aims to reduce greenhouse gas emissions and limit global warming. It came into force on 4th November 2016 and has been signed by 195 parties, including the European Union (EU). It encourages developed countries to help developing countries put mitigation strategies into place.
2) Each country has submitted a pledge which indicates how much they will try to reduce their greenhouse gas emissions by. The EU and the UK agreed to reduce their emissions by at least 40% from their 1990 levels by 2030.

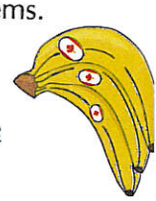
Adaptation Means Responding to the Effects of Climate Change

Here are some of the ways that people are adjusting to the effects of climate change:

Changing Agricultural Systems

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

1) It may be necessary to plant new crop types that are more suited to the new climate conditions in an area, e.g. soya, peaches and grapes may be grown in southern England.
2) In some regions, biotechnology is being used to create new crop varieties which are more resistant to extreme weather events, e.g. drought-resistant millet is being grown in Kenya.



Managing Water Supply

Dry areas are predicted to get drier, leading to more water shortages — so people need to use water resources more efficiently.

1) Water meters can be installed in homes to discourage excessive water use.
2) Rainwater and waste water can be collected and recycled.

Coping with Rising Sea Levels

At current rates, sea levels are predicted to rise about 65 cm by 2100 — this would flood many islands and coastal areas.

1) Better flood warning systems are being put in place, and physical defences such as flood barriers are being built. E.g. the Thames Barrier in London can be closed to prevent sea water flooding the city.
2) In areas that can't afford expensive flood defences, e.g. Bangladesh, people are building raised flood shelters and building houses on embankments.

When I need alternative energy, I reach for the cookie jar...

Make sure you know the difference between mitigation and adaptation and you'll be flying come exam day. Mitigation means taking action to reduce the risk, and adaptation means trying to adjust to new conditions.

Revision Summary

Well, you just survived a very hazardous section. It may be all about disasters, but get a load of these questions down you and there won't be any kind of disaster in the exam. I know it looks like there's a lot of stuff here, but you'll be surprised how much you just learned. Try them out a few at a time, then check the answers on the pages. Once you can answer them all standing on your head and juggling five balls, move on to the next section. You'll enjoy the view when you get there...

Natural Hazards (p.2-3) ☐

1) What is a natural hazard?
2) How does the magnitude of a hazard affect the risk to people?
3) What's the difference between a primary and a secondary effect? Give an example for each.
4) Give one immediate and one long-term response to a natural hazard.

Tectonic Plates (p.4-5) ☐

5) Name the type of plate margin where two plates are moving towards each other.
6) Name the type of plate margin where two plates are moving sideways past each other.
7) Why do volcanoes form at destructive plate margins?
8) At which types of plate margins can earthquakes occur?

Tectonic Hazards (p.6-8) ☐

9) a) Give an example of an earthquake in a wealthier part of the world.
   b) Describe two effects of the earthquake and two responses to it.
10) a) Give an example of an earthquake in a less wealthy part of the world.
   b) Describe two effects of the earthquake and two responses to it.
11) Why do people live in areas prone to tectonic hazards?
12) Briefly describe the four management strategies that can reduce the effects of tectonic hazards.

Global Atmospheric Circulation and Tropical Storms (p.9-12) ☐

13) How does global atmospheric circulation lead to high and low pressure belts?
14) Describe the distribution of tropical storms.
15) What conditions are required for a tropical storm to develop?
16) Describe two characteristics of the eye of a tropical storm.
17) Using an example, describe three effects of and three responses to a tropical storm.
18) How might climate change affect tropical storms?
19) How can a city be protected against a tropical storm?

Weather Hazards in the UK (p.13-14) ☐

20) List the types of weather hazard that can be experienced in the UK.
21) Give two pieces of evidence for the weather becoming more extreme in the UK.
22) a) Give an example of one extreme UK weather event and explain what caused it.
   b) Describe the social, economic and environmental impacts of the extreme weather event.

Climate Change (p.15-18) ☐

23) What is the Quaternary period?
24) Give four sources of evidence for climate change over the Quaternary period.
25) What are the natural factors that can cause climate change?
26) What is the greenhouse effect?
27) Give four ways that human activities can increase the concentration of greenhouse gases in the atmosphere.
28) Give one effect of climate change on the environment.
29) How might alternative energy production reduce the causes of climate change?