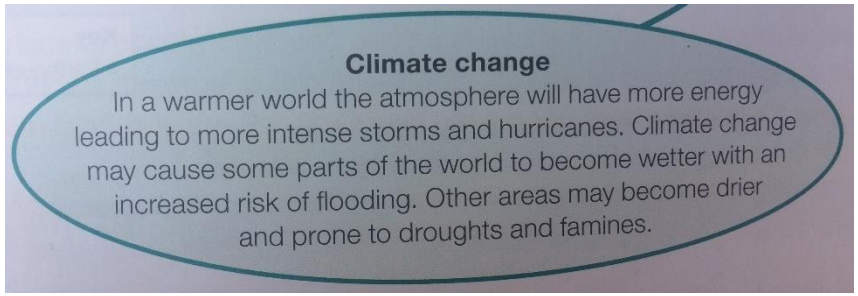
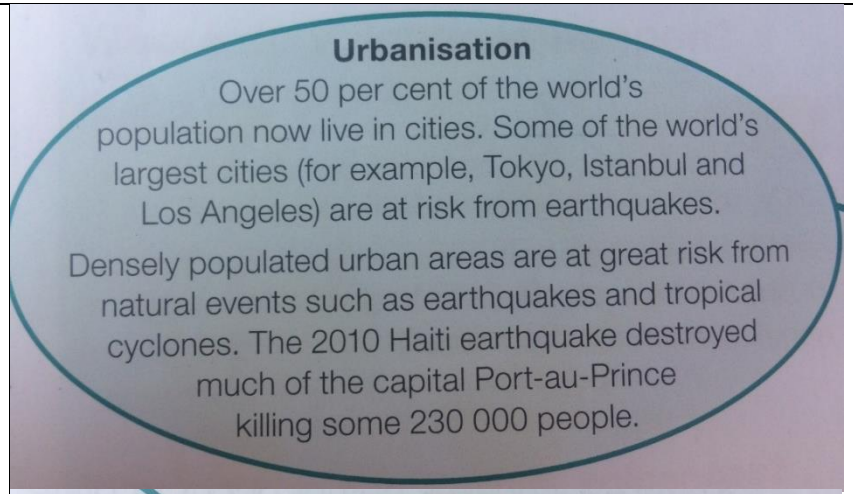
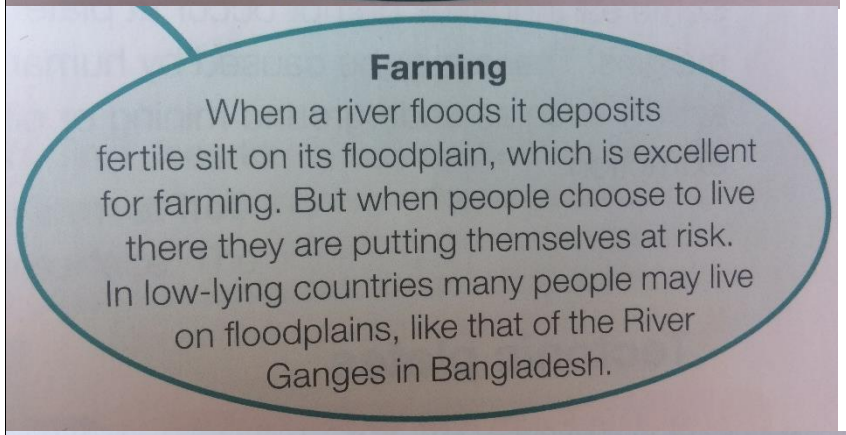
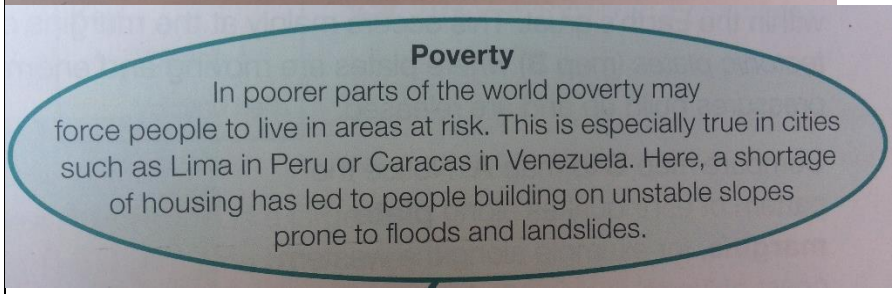
Subject	Geography	Year Group	11	Sequence No.	1	Topic	Natural hazards and climate change

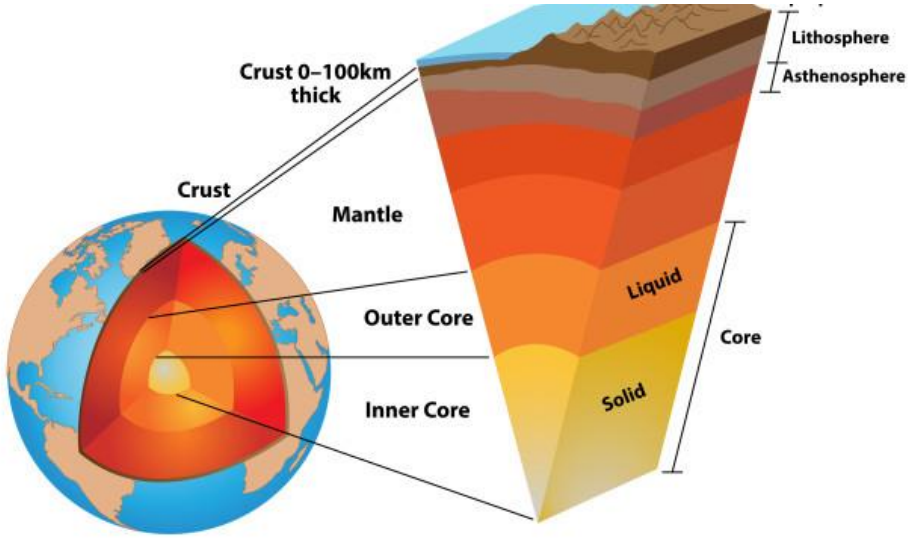
Retrieval	Core Knowledge	Student Thinking
What do teachers need **retrieve** from students before they start teaching **new content**?	What **specific ambitious knowledge** do teachers need teach students in this sequence of learning?	What real life examples can be applied to this sequence of learning to **development of our students thinking, encouraging them to see the inequalities around them** and 'do something about them!'
Links back to the KS3 hazards topic - L1 what is a natural hazard definition and the different types of hazards	What is a hazard? Natural hazards are extreme natural events that can cause loss of life, extreme damage to property and disrupt human activities The types of hazards Tectonic hazards – involve the movement of tectonic plates in the Earth's crust Atmospheric hazards – hazards that are caused by the air and weather Geomorphological hazards – hazards that occur on the Earth's surface Factors that affect hazard risk:  	From the knowledge gained in this topic students will understand how hazards could impact them in their life as well as how hazards can impact less developed countries more. Students will explore how problems linked to hazards can be solved. This will also look into a career they could have linked to the knowledge aquired. They will do this through the following activities: • Examine real life examples of places that have been impacted by hazards in order to have empathy. • Why the world looks the way it does. • How can we impact our climate and what can we do to manage or adapt to this?





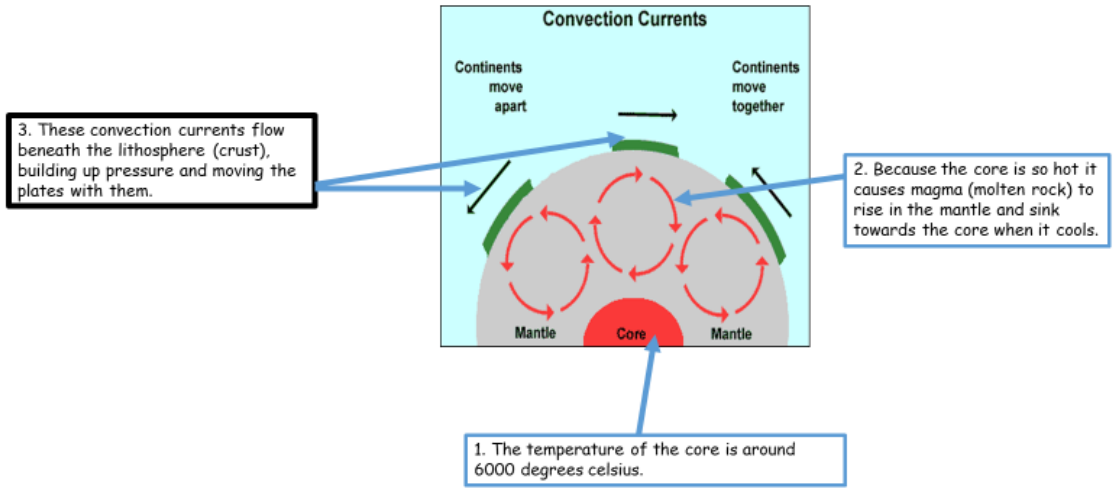


- How could climate change impact us in the UK and across the world
- Do tectonic plates impact us in the UK?
- Considering whether Haiti has ever recovered?
- The topic of weather is linked to what a Meteorologist would need to know
- The topic of climate change and management of the climate is linked to what a Sustainability Consultant would need to know

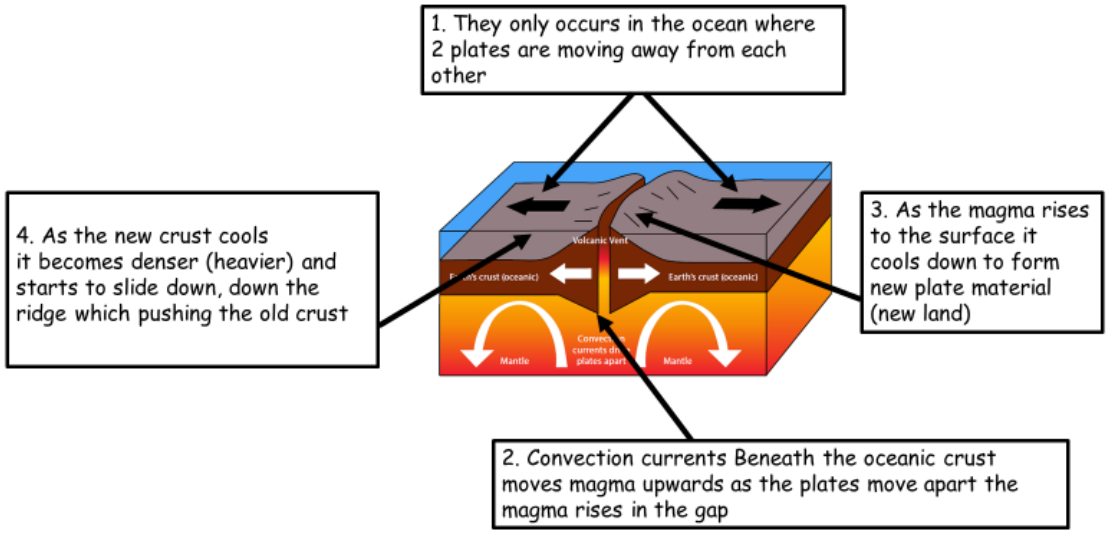
Links to KS3 y8 topic hazards with the layers of the earth	L2 The layers of the earth: Outer core Asthenosphere = the upper portion of the mantle Lithosphere = the crust Oceanic crust-heavy Continental crust-lighter Inner core Mantle  <u>Oceanic crust</u> Denser crust so sinks Younger as it gets destroyed Thinner <u>Continental crust</u> Lighter crust so does not sink Older as it does not get destroyed Thicker The distribution of volcanoes using the maps: Volcanoes are not randomly distributed over the Earth's surface. Most are concentrated on the edges of continents, along island chains, or beneath the sea forming long mountain ranges. The distribution of earthquakes using the maps: Most earthquake zones are found at, or close to, tectonic plate boundaries, often in clusters. How plates move:	

Convection currents in the mantle links to KS3 hazards topic in the plate tectonics lesson.

How do convection currents help the tectonic plates to move?



How does the idea of ridge pull and slab push make the tectonic plates move?

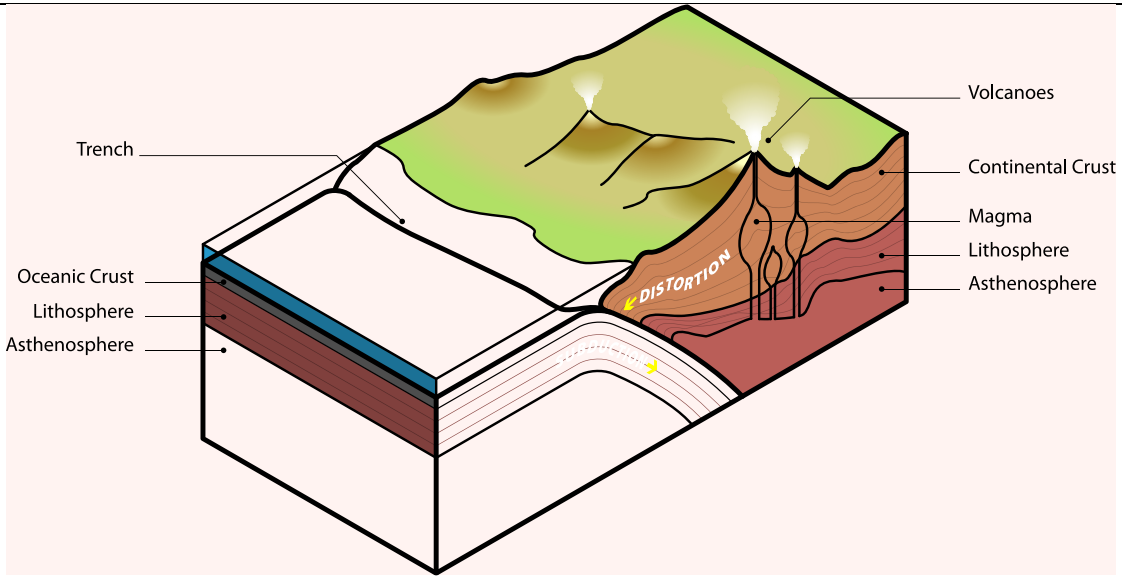


L3 Tectonic theory

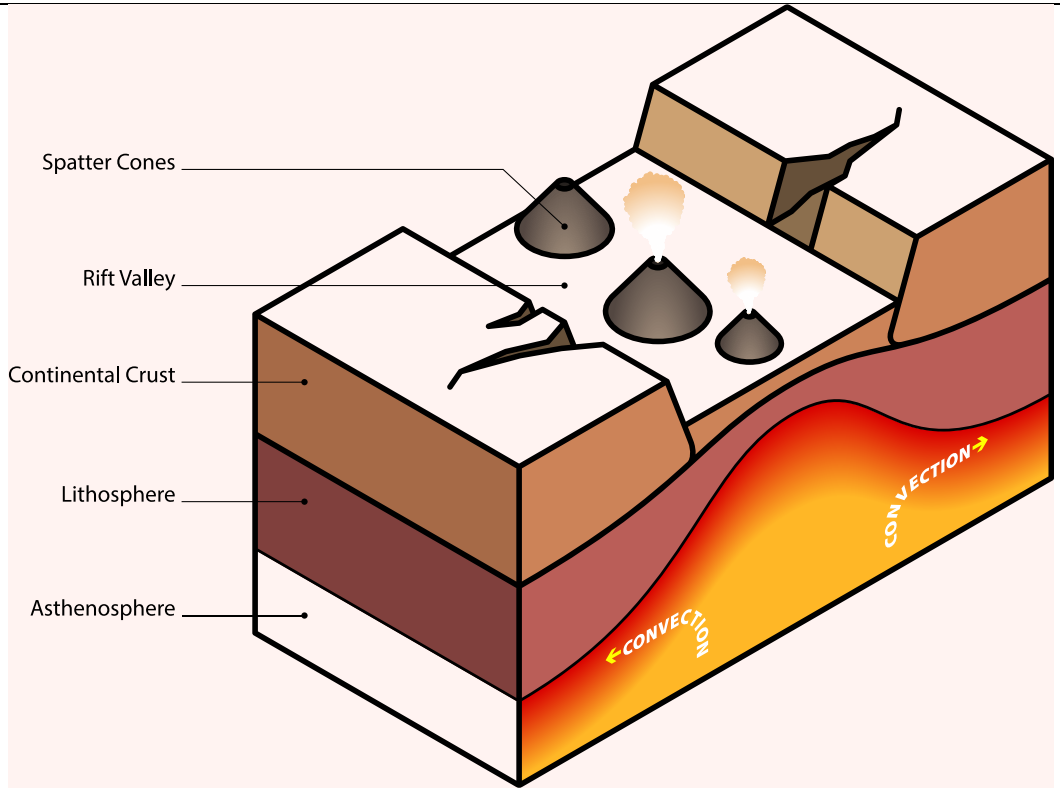
The theory of plate tectonic – who discovered and the evidence for this.

L3 starter task - Why do some parts of the world get more earthquakes and volcanoes than others? Links to L2.	People once thought that the oceans and the continents were formed by shrinkage from when the Earth cooled down after being formed. Alfred Wegener proposed something different. Consider Africa and South America: These continents look like they "fit" together. They also have similar rock patterns and fossil records. These two pieces of evidence led me to believe that there was once a single land mass. This is my TECTONIC THEORY. The formation of mountain ranges can be explained by tectonic theory. As plates move towards each other they crash and form mountains. Consider the Himalayas at the top of India. Evidence from fossils. There are many examples of fossils found on separate continents and nowhere else, suggesting the continents were once joined. If Continental Drift had not occurred, the alternative explanations would be: The species evolved independently on separate continents – contradicting Darwin's theory of evolution. They swam to the other continent/s in breeding pairs to establish a second population. Wegner was not believed at first, however scientists discovered 50 years later that the Earth generates massive amounts of heat through radioactive decay in the core. This heat generated convection currents in the mantle causing the crust to move. We also now know that the sea floor is spreading outwards from plate boundaries, such as at the mid-Atlantic ridge beneath the sea between Europe and north America. Evidence for sea floor spreading: Evidence: alternating polarity of the rocks- polar wandering When rock is molten the iron particles align in the direction of the Earth magnetic field When the rock solidifies it is trapped Series of 'stripes' Known as palaeomagnetism L4 – 5 Types of boundaries: Destructive plate margins – Where two plates are moving towards each other. The denser oceanic plate is forced down into the mantel and destroyed. This often creates volcanoes and ocean trenches.	

L4-5. Plate tectonics theory from L3 links to what happens at plate boundaries.
Types of plates is also studied in KS3 hazards topic.



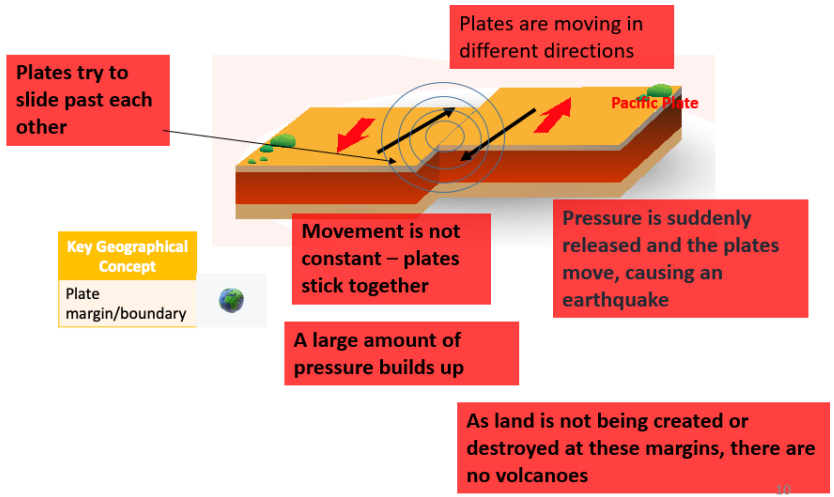
Constructive plate margins – Where two plates are moving away from each other. e.g. The mid Atlantic ridge. Magma rises from the mantle to fill the gap, cools and creates new crust.



Conservative plate margins – Where two plates are moving sideways past each other. E.g. Along the west coast of the USA. Crust is not created or destroyed.

Links to L4 & 5 conservative plate boundary which causes Haiti's earthquakes.

Conservative Plate Margin



Subduction – Where one plate moves under another.

Haiti – L9
Primary effects - These happen straight away – buildings falling down, people dying, gas pipes bursting.
Secondary effects
These happen as a result of the primary effects
For example: fires from burst gas pipes or diseases spreading from dead bodies which contaminate the water supply.
Immediate responses
These happen straight after the earthquake – recusing people, first aid, giving drinking water.
Long term responses
These happens months and years after the earthquake
For example: designing new earthquake proof buildings, rebuilding roads and bridges.

What happened in Haiti:

- 12th January 2010 at 16:53 local time, an earthquake measuring 7.0 on the Richter scale struck Haiti.
- The focus was 13km underground
- The epicentre was 25km from the capital Port-au-Prince
- Haiti suffered a huge number of serious aftershocks.

Cause of the earthquake

Haiti lies right on the **boundary** of the Caribbean and North American plates. There was slippage along a **conservative plate boundary** that runs through Haiti.

On 12 January 2010, a magnitude 7 earthquake hit Haiti at 16:53 local time. The earthquake's **epicentre** was 25 km west of Port-au-Prince, the capital. Most people, businesses and services were located in the capital.

Social impacts of the earthquake (effects on people)

- 3 million people affected.
- Over 220,000 deaths.
- 300,000 injured.
- 1.3 million made homeless.
- Several hospitals collapsed.

L4&5 types of plate boundaries in order to understand that New Zealand is on a destructive margin.

Understand the words effect and response from the Haiti lesson.

Economic impacts of the earthquake (effects on money and jobs)

- 30,000 commercial buildings collapsed.
- Businesses destroyed.
- Damage to the main clothing industry.
- Airport and port damaged.

Many of the effects were **immediate** or **primary**, eg injuries from falling buildings. Some **secondary** effects didn't happen until many months later, eg cholera outbreaks. The effects of this earthquake were particularly bad because of the following reasons:

- there were very few earthquake-resistant buildings
- buildings and other structures were poorly built
- the epicentre was near to the capital
- there were few resources to rescue or treat injured people

Y8 hazards topic links to ways to manage earthquakes by designing their own earthquake resistant building.	**Response to the earthquake** Haiti is a very poor country without the money and **resources** to redevelop. It is one of the least developed countries in the world with most Haitians living on $2 or less per day, about £1.30. Because there were few **earthquake-resistant buildings**, the devastation was massive. Many buildings simply collapsed or were damaged beyond repair. Immediate response: Neighbouring Dominican Republic provided emergency water and medical supplies as well as heavy machinery to help with search and rescue underneath the rubble, but most people were left to dig through the rubble by hand. Long term response: Schools are being rebuilt. Long term response: Small farmers are being supported - so crops can be grown. Immediate response: Medical teams began treating the injured - temporary field hospitals were set up by organisations like the International Committee of the Red Cross. Immediate response: United Nations troops and police were sent to help distribute aid and keep order. L10 New Zealand On 22 February 2011, at 12:51 pm, Christchurch was struck by a magnitude 6.3 earthquake. The quake was centred 10km south-east of the city at a depth of 5km. In the ten minutes after it hit, there were 10 aftershocks of magnitude 4 or more. On a destructive plate boundary. New Zealand is at risk from both earthquakes AND volcanoes because of the plate boundary it is on. For this lesson, we will be investigating the 2011 earthquake. Ways to deal the earthquake. • In New Zealand there is an Earthquake Commission which everyone contributes to as part of their insurance cover. This fund stands at billions of dollars. • There is a strict building code which is reviewed every 10 years and is enforced for all new buildings. Recommendations are made to people with older buildings. • With most people living in urban areas, it means that the government can make sure that infrastructure is up to the highest standard and emergency services can be fully organised in case of a disaster.	

- Education is an important part of living in a tectonic area and everyone knows what to do in an earthquake, a tsunami or when a volcano erupts.
- Community is very important, and after an earthquake everyone works together.

Comparison between Haiti and New Zealand:

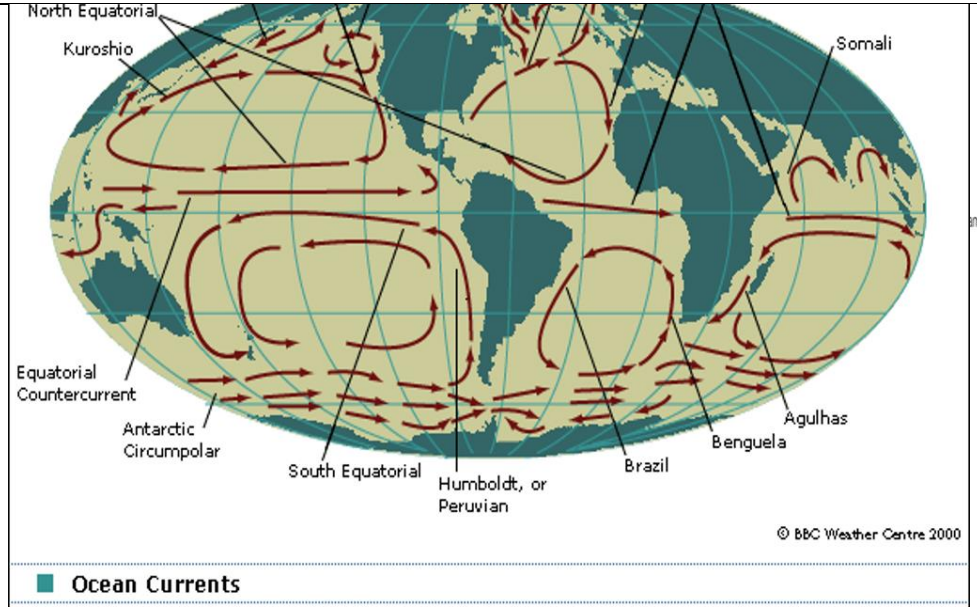
Haiti	New Zealand/ Christchurch
230000 people killed	181 were killed in the earthquake
300,000 people injured	164 people injured
Diseases like Cholera spread	No disease spread
A US ship docked off Haiti was fitted with water- purifying equipment that can make 1.5 million litres of drinking water a day.	3 days later 50% of the city had mains water supplies
Over 500 makeshift camps (made with any material the person can get their hands on) were put up around the country.	450 mobile homes provided for those homeless
Aid agencies from across the globe arrived in Haiti	The military were deployed to help with the rescue effort and there was extra help from Australia

L11
Why would people live in earthquake-prone areas?
They may have no/limited choice
At collision plate boundaries, hills and mountains are created, this attracts tourists, and is nice scenery.

To know the types of hazards from lesson 1 as L13 begins to look at atmospheric hazards.	Fertile soil - new soil is produced, richer in minerals and nutrients and plants grow better there. For example, Japan is very prone to earthquakes. However, people still want to live there as it is a wealthy country. And good jobs can be found there. Economic interests is one of the consideration for people when choosing places to live. How to prepare the house for an earthquake. 1. Secure heavy appliances to studs in the wall so that they are less likely to move 2. Take all heavy objects of shelves, to prevent things from falling on your head 3. Put latches on cupboards to prevent doors from swinging open 4. Make sure all pictures, clocks, e.t.c hanging on the wall are securely screwed in, so there is no chance of them falling 5. Have safety film put over your windows, glass can break easily in a severe earthquake 6. Make sure all flammable liquids are placed on the lowest shelves of cupboards, or in a garage or garden shed. 7. Move away from windows 8. Arrange a meeting point with family 9. Protect your head 10. Turn off electricity 11. Check for fires 12. Hang onto door frame 13. Keep away from power cables 14. Keep away from trees 15. Stop driving 16. Get outside it possible 17. Turn off gas 18. Listen to the radio Match up task, answers below: 	

1. Protection	Developing infrastructure that will withstand a hazard
2. Prediction	Using historical data to try and find out when or when a hazard could occur
3. Monitoring	Using scientific equipment to detect warning signs
4. Planning	Identifying and avoid places most at risk

Names of the three atmospheric cells from L13.	L13. Global atmospheric circulation is the movement of air in the atmosphere across the world. It is responsible for the location of world climate zone. Latitude is one of the most important reasons why some places are warmer than others. Latitude refers to the position on the Earth north and south of the Equator. Lines of latitude move up from the equator horizontally (side to side). The further away from the equator you are the colder it becomes. Because of the curved surface of the Earth, the Equator receives much higher insolation than the polar latitudes Insolation is heating from the sun. <u>Understanding insolation</u> • Input is received in the form of short-wave solar energy. This is called insolation. • Insolation is **<u>solar radiation</u>** received in the Earth's atmosphere or at its surface. • Only approximately 52 per cent of this insolation reaches the earth's surface. The rest is absorbed by water vapour, dust and clouds, or is reflected by the Earth's surface and scattered by particles in the air. • Reflected heat, in the form of long-wave radiation, is trapped in our atmosphere and keeps our planet warm. This is known as the natural greenhouse effect. What is global circulation? The movement of air across the planet occurs in a specific pattern. The whole system is driven by the equator, which is the hottest part of the Earth. Air rises at the equator, leading to low pressure and rainfall. When the air reaches the edge of the atmosphere, it cannot go any further and so it travels to the north and south. The air becomes colder and denser, and falls, creating high pressure and dry conditions at around 30° north and south of the equator. Large cells of air are created in this way. High pressure at the north pole and low pressure at the equator make a simple convection cell. There is a three cell pattern - In each hemisphere there are three cells (Hadley cell, Ferrel cell and Polar cell) in which air circulates through the entire depth of the troposphere. L14 What influences our weather? The different 3 different cell patterns that exist in our atmosphere: <u>Hadley cell</u> The largest cells extend from the equator to between 30 and 40 degrees north and south of it. Within the Hadley cells, the trade winds blow towards the equator, then rise near the equator forming a broken line of thunderstorms, which creates the Inter-Tropical-Convergence Zone (ITCZ). The air from these storms flows towards higher latitudes, where it sinks to produce high-pressure (calm settled weather) regions over the subtropical oceans and the world's hot deserts, such as the Sahara desert in North Africa. <u>Ferrel cell</u> These are the middle cells, which are known as the Ferrel cells, cold air from polar areas and warm subtropical air meet around the latitude of the UK which gives us our unsettled weather.	



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L16 -17
Describe the distribution of tropical storms across the world.
Tropical storms usually form between approximately 5° and 30° latitude and move westward due to easterly winds.
Which parts of the world experience the most tropical storms per year?
Parts of east Asia and the east pacific coast.

<u>How the Coriolis effect has an influence on tropical storms.</u>

<u>Background to the Coriolis effect.</u>
The Coriolis effect is caused by our planet's rotation. Earth is constantly rotating, or spinning, from west to east. Every 24 hours, Earth makes a full rotation. Different points on Earth move at different speeds, though. Points near the Equator rotate faster than points near the poles.
Earth is wider at the Equator. So points along the Equator have to cover a longer distance in order to make a full rotation in 24 hours. These points move at nearly 1,600 kilometers (1,000 miles) an hour. Near the poles, however, things are very different. Earth is rotating extremely slowly there.

Links to tropical storms:
Cyclones are shaped by the Coriolis effect. Cyclones are large air masses that rotate around a center. As they rotate, cyclones pull air into their center, or "eye." These air currents are pulled in from all directions. In the Northern Hemisphere, they bend to the

		hurricane winds and rain warm moist air	,
Air rises faster and draws in more warm air from the sea surface whilst sucking cooler air downwards.	As the storm moves over the ocean, it picks up more warm moist air. The speed of its winds increase as more air is sucked in.	It can take hours or days to fully form a hurricane. The eye has calm winds which are surrounded by a spinning vortex of high winds and heavy rain.	

Starter task and main task for lesson 18 – needs to know what a tropical storm looks like. Links to L6/17.

<u>Climate change</u>

L19 How is climate change linked to tropical storms?

Causes of climate change:

A natural function of the Earth's atmosphere is to keep in some of the heat that is lost from the Earth. This is known as the greenhouse effect.

Human factors increasing global warming:

Some human activities increase the greenhouse gases in the atmosphere:

Burning fossil fuels, eg coal, gas and oil - these release carbon dioxide into the atmosphere.

Deforestation - trees absorb carbon dioxide during photosynthesis. If they are cut down, there will be higher amounts of carbon dioxide in the atmosphere.

Dumping waste in landfill - when the waste decomposes it produces methane.

Agriculture - agricultural practices lead to the release of nitrogen oxides into the atmosphere.

Natural factors increasing global warming:

There are also natural factors which contribute to increased global warming:

Orbital changes - the Earth has natural warming and cooling periods caused by Milankovitch cycles or variations in the tilt and/or orbit of the Earth around the Sun (Wobble, roll and stretch theory).

Volcanic activity - during a volcanic eruption carbon dioxide is released into the atmosphere.

Links to tropical storms from L16-17.	Solar output - there can be fluctuations in the amount of radiation from the sun. If there is high amount emitted there will be an increase in Earth's temperatures. Frequency and intensity of storms and climate change: The overall frequency of tropical storms occurring is expected to either remain the same, or decrease, as a result of climate change. However, the number of more severe tropical storms (categories 4 and 5) is expected to increase, while category 1–3 storms will decrease (see Figure 3.9). The regions where tropical storms are experienced are not expected to change significantly as a result of climate change. People do not know exactly what the impact of climate change on tropical storms will be. However, there is evidence of a link between warmer oceans and the intensity (destructive power) of tropical storms. Tropical storms are expected to become more intense, by 2–11 per cent, by 2100. The number of the most severe category 4 or 5 tropical storms (see Section 3.5) has increased since the 1970s (Figure 3.9). Predictions suggest that every one degree Celsius increase in tropical sea surface temperatures will mean a 3–5 per cent increase in wind speed. L20 Typhoon Haiyan Typhoon Haiyan was a tropical cyclone that affected the Philippines in South East Asia in November 2013. It was one of the strongest tropical cyclones ever recorded with winds of 313 km/h. In some areas, 281.9 mm of rainfall was recorded, much of which fell in under 12 hours. Waves of up to 7 m in height battered the coast. The Philippines is a fairly poor part of the world with minimal investment in prediction, planning and protection schemes. <u>Typhoon Haiyan effects and responses</u> Responses	

L20 links to L16/17 (tropical storms)	Immediate: Cyclone shelters built US helicopters assisted search and rescue Overseas aid Field hospitals set up to help injured 1200 evacuation centres Long term responses: Rebuilding of infrastructure Effects: Primary: Loss of forests, trees and widespread flooding It killed approximately 7400 people (6,340 confirmed, 1,061 missing) Five million people saw their homes severely damaged or destroyed (550,000 houses destroyed and an additional 580,000 houses were severely damaged). Tacloban airport terminal building was also completely destroyed by a 5m storm surge. Secondary: The major rice and sugar producing areas for the Philippines were destroyed. A total of 131,611 tons of rice was lost Outbreaks of disease Landslides Looting and violence The economy was affected, with estimated losses at $2.9billion L21 Monitor – Observing and checking the progress of a storm over a period of time. Satellite data Doppler Radar Reconnaissance Aircraft Good: • Gives a warning prior to hitting land • Informs when to evacuate • Predicts the type of storm (how intense) • Can help future management Bad:	

	• Error is still large • Sometimes it can't predict early enough. • Expensive • Images aren't clear Mitigation – is an attempt to keep hazards from turning into disasters, or to reduce the effects of disasters when they occur. Mitigation efforts focus on taking long-term actions to reduce or remove the risk. Moving your family inland away from the coast Building costal barriers Insuring against economic losses Strengthening your home Good: • Less at risk from the storms • Can reduce the damage caused Bad: • Can be expensive • People may not want to move • Resources may not be there • Some might not be educated. Preparedness – includes developing specific action plans to be followed when the hazard strikes. Develop evacuation plan Secure home Create an emergency supply kit Good: • Can do it yourself • There is less panic amongst the public Bad: • Reliant on monitoring and predicting, not everyone can do this. • May give false sense of security	

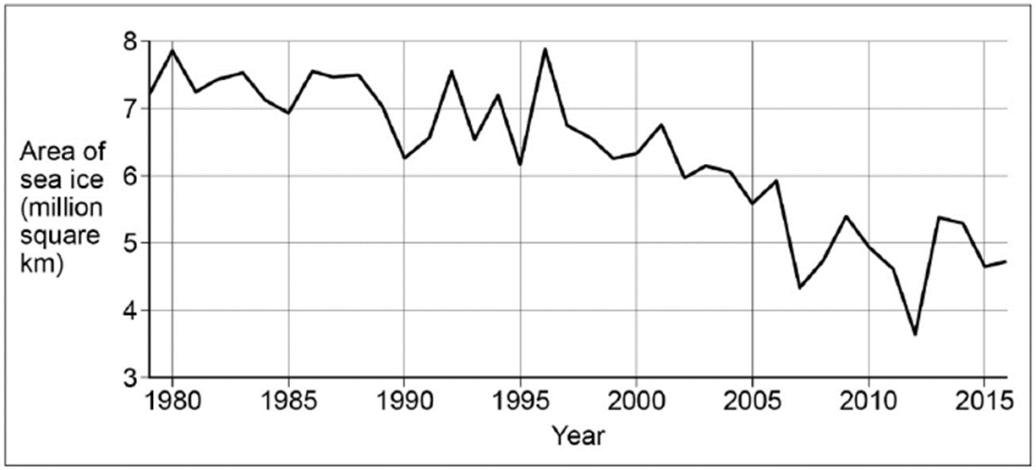
Climate change links to the KS3 topic which is focussed on climate change	• Can be expensive to carry out changes Respond – includes moving the necessary emergency services and first responders to the potential disaster area as the hazard threatens to change into a disaster. Issuing storm specific forecast to the public Implementing action plans Mobilizing the emergency services Good: Can help to save lives Can help to prevent further secondary effects Bad: Can be costly Won't impact on damage to buildings and businesses. Recovery – attempts to restore the affected area and bring things back to normal. The recovery phase begins once the immediate threat to human life has passed. Recovery efforts that reduce or eliminate future risk are also mitigation efforts. Giving medical aid Providing relief Cleaning up the area Rebuilding damaged structures Good: Can help to save lives Can help to support people rebuild Can provide people with food when they might have nothing. Bad: Not always accessible Lack of understanding to the extent of damage L22	

The Beast from the East was a storm that began on 22 February 2018, and brought a cold wave to Great Britain and Ireland. The Beast from the East also brought widespread unusually low temperatures and heavy snowfall to large areas.

Primary effects
Rural areas experienced temperature lows of -12°C
Snow drifts were as high as 7m in places
A man died in London after being pulled from a frozen lake, whilst there were 3 other reported deaths

Secondary effects
Thousands of schools were closed
Scottish Premiership postponed its games
Hundreds of people were trapped in their vehicles for hours, on the A31 for example
8. The weather cost the UK millions. The AA estimated that there were 8,260 collisions on Britain's roads from the snow chaos in just three days, with the insurance cost above £10m. Two thirds of them due to snow and ice.

L23



The area of Arctic sea ice overtime has reduced significantly overtime. The area of Arctic sea ice has reduced from 8.9 million square km in 1980 to around 4.7 million square km in 2015, which is a reduction of 4.2 million square km in 35 years. Despite the reduction

	there are many fluctuations where sea ice increased, especially from around 2012 to 2013 as seen in the graph. Line graphs are useful to show patterns overtime Climate change over the quaternary period. The quaternary period is the most recent geological time period spanning from around 2.6 million years to today. This is a very recent time period when you compare the age of the earth which is 4600 million years (4.6 billion years old) Earth's average surface air temperature has increased by approximately 1 degree Celsius over the last 100 years. Sea-levels have risen by 19cm since 1900 – due to thermal expansion and ice sheets melting. Ocean temperatures are the warmest they have been since 1850. World's glaciers and ice sheets are decreasing in size. Antarctica loses 134 billion tonnes per year. How can proxies help to prove climate change? Before we could keep records, we had to use clues form proxy data (natural recorders) such as: Tree rings As a tree grows it forms a new ring each year The tree rings are thicker in warm, wet conditions Scientists take cores and count the rings to find the age of a tree. The thickness of each ring show what the climate is like Tree rings are a reliable (trustworthy) source of evidence of climate change for the past 10,000 years Fossil pollen Pollen from plants gets preserved in sediment, e.g. at the bottom of lakes Scientists can identify and date the preserved pollen to show which species were living at that time	

	Scientists know the conditions that plants live in now, so preserved pollen form similar plants shows that climate conditions were similar Ice cores Ice sheets are made up of layers of ice One layer is formed each year Scientists drill into ice sheets to get long cores of ice By analysing (looking in detail) the gases trapped in the layers of ice they can tell what the temperature was each year One ice core from Antarctica shows the temperature changes over the last 400,000 years Ocean sediments The remains of organisms (an individual animal, plant, or single-celled life form) found in cores taken from ocean sediments can also be analysed (looked at in detail). These can extend the temperature record back at least 5 million years Plankton can reveal information such as past surface water temperatures and levels of oxygen and nutrients These allow us to estimate what the climate was like. However, not always reliable as they only indicate climate change rather than providing direct evidence of accurate temperatures. L24 What are the natural causes of climate change? Milankovitch cycles: • This is all about how the Earth circles the sun-the Earths orbit. • The amount of energy reaching the Earth changes due to changes in the way that the Earth orbits the sun. • The Earth's orbit changes shape every 100,000 years. This means the distance between the Earth and the Sun changes as the Earth orbits. • As the Earth gets closer to the Sun, the climate becomes warmer and vise-versa. • The Earth's axis is tilted on an angle. • The angle of the tilt changes due to gravitational pull of the Moon. • When the angle of the tilt increases, this can exaggerate the climate, so summers get warmer, and winters get colder. • The angle of the tilt moves back and forward every 41,000 years.	

Solar output - suns energy:

- The output/energy of the sun is measured by observing sunspots on the Sun's surface
- They are caused by magnetic activity inside the Sun – results in dark patches
- More sunspots = warmer climate
- Less sunspots = colder climate
- Decreased – last 50 years – not responsible for recent climate change

Volcanic activity

- Volcanic eruptions can temporarily cause climate change
- 1991 Mount Pinatubo erupted - large ash cloud = 0.5 degree Celsius drop in temperatures
- Sulphur dioxide mixes with water and forms a mist/vapour
- This reflects the sunlight away and reduces the Sun's heat energy entering the Earth's atmosphere

L25 – Human causes of climate change

Fossil fuels

Fossil fuels account for the majority of global greenhouse gas emissions – over 50%. Burning these releases carbon dioxide into the atmosphere. Fossil fuels are used in transportation, building, heating homes and the manufacturing industry. Additionally, they are burnt on power stations to generate electricity. As the world's population grows and wealth increases, people are demanding more and more energy, which increases the level of fossil fuels and carbon dioxide.

Agriculture/Farming

Agriculture contributes to approximately 20% of global greenhouse gas emissions. It also produces large volumes of methane: cattle produce it during digestion, and microbes produce it as they decay organic matter under the water of flood rice paddy fields.
As the world's population increases more food is required, especially in areas such as Asia where rice is the staple diet. When countries increase their standard of life, there is almost always an increasing demand for meat. If current population rates continue it is inevitable that large-scale agriculture's contribution to climate change will continue to grow.

Deforestation

Deforestation is the clearing of forests on a huge scale. If deforestation continues at the current rate, the world's forests could disappear completely within a hundred years. During the process of photosynthesis, trees absorb carbon dioxide, which reduces the amount of carbon dioxide in the atmosphere. The process of deforestation leaves fewer trees to absorb carbon dioxide. Therefore, the enhanced greenhouse gas contribute to rapid climate change. When trees are burnt to clear an area, such as slash and burn, the carbon dioxide that has been sorted is also released which again contributes to climate change.

WHAT CAUSES CLIMATE CHANGE?

The atmosphere traps some of the heat reflected from the Earth's surface. This natural process is known as the greenhouse effect. Without this natural process, temperatures would be much colder on Earth. For example, without naturally occurring greenhouse gases, Earth's average temperature would be near -18°C instead of the much warmer 15°C.

The greenhouse effect works by the atmosphere allowing heat from the Sun (short-wave infrared radiation) to pass through to heat the Earth's surface. The surface of the heat then gives off heat as longwave radiation. Some of this heat is trapped by natural greenhouse gases, such as carbon dioxide, methane and nitrous oxide, radiating the heat back towards Earth heating the Earth.

The difference between the natural and enhanced greenhouse effects is:

the enhanced greenhouse effect is additional to the natural greenhouse effect and is due to human activity changing the make-up of the atmosphere. (The enhanced greenhouse effect is often referred to as global warming.)

How could climate change impact us?

<u>How could climate change impact England?</u>

Hotter weather

In 2009 the state-funded UK Climate Projections report predicted that mean annual temperatures would rise by 2C to 5C by 2080. This was based on a "medium emissions scenario".

	The effects would be largest in the UK's southern areas and smallest in northern areas. Hot summers and heat waves would be more common and cold winters rarer. Challenges for the NHS Increased temperatures will mean a rise in heat-related deaths by 70% by the 2020s, compared with the 2000s, the Health Protection Agency (HPA) projects. This could increase to 540% by the 2080s, it adds. In the 2003 heatwave 2,139 deaths in England and Wales. But cold kills people more people than heat in the UK. With winters becoming milder, the level of cold-related mortality is estimated to fall by 2% by the 2050s and 12% by the 2080s, the HPA says. Rising sea levels The UK Climate Projections of 2009 estimated a sea-level rise of between 13cm and 76cm for the UK by 2095. The report also suggested the number of "extreme high sea-level events" - caused by storm swells - on the south coast of England could become between 10 and 1,800 times more common by 2100, depending on different scenarios involving emissions. The government acknowledges there's "lively scientific debate" over the issue. Areas that have been identified as particularly vulnerable to coastal flood risk include South Wales, north-west Scotland, Yorkshire, Lincolnshire, East Anglia and the Thames estuary. Heavier rain Summer rainfall has fallen, while winter rainfall has increased. It is expected that these trends will continue - meaning drier summers and wetter winters. "There is potentially a role" for climate change to cause flooding that would affect large parts of England, Scotland and Wales. <u>How could climate change impact Ethiopia?</u> Farming A large proportion of industry in Ethiopia relies on farming. It is already a country that suffers from poor harvests leading to drought and famine due to extremely high temperatures and a lack of rainfall. Climate change will make this problem worse. Farmers will not be able to produce enough to sell and in most cases they won’t be able to produce enough to feed themselves and their families. This will lead to widespread famine and poverty!	

	Spreading of the desert As temperatures rise and less rain falls the quality of the soil in Ethiopia will decrease. Overtime it will turn to desert, this means that plants and animals will struggle to survive. The whole look of the place will change, the lack of plants and animals will have a huge negative impact on the food webs/chains. Mass migration The people of Ethiopia will be forced to move as their country becomes too difficult to live in. However, its surrounding countries will be suffering from similar impacts and will not be able to re-home people. This could lead to conflict and the development of illegal housing in areas. It could also mean people illegally migrate to countries like England. Increase in aid Ethiopia already relies on aid (help from other countries), it can't support itself! Climate change will mean that other countries will have to send more money, food, water and medical support to help the people there. <u>How could climate change impact the Maldives?</u> Homelessness Local islanders from the Maldives ae not rich, once land starts to flood they will not be able to afford protection schemes. They will become homeless and could become climate change refugees Tourism The Maldives main income relies on tourism Due to climate change the marine ecosystems could change. Chemicals in the water released as a result of acid rain caused by greenhouse gases will mean that the water is more acidic. The acid in the water will damage the ecosystems that people come to visit. Also the food webs will be altered and less of the fish an animal species will exist. These are big attractions for tourists. Going under The highest point on most Maldivian islands is just 1 metre above sea level. If sea levels continue to rise many of the islands will be completely covered by water In most scenarios most of the islands will be flooded all year round. This could lead to the wipe out of a whole civilisation.	

	Migration Local islanders from the Maldives ae not rich, once land starts to flood they will not be able to afford protection schemes. They will become homeless and could become climate change refugees! This will put pressure on neighbouring countries such as India and Sri Lanka. This could lead to conflict in the future, especially over access resources and services. <u>How could climate change impact the USA?</u> Population pressure The USA already has issues linked to population. With climate change southern states are expected to be worse hit, this could lead to migration of people towards the northern states. This will put lots of extra pressure on those areas. In addition, there will be thousands of people hoping to move to the USA from South and Central America. This will lead to conflict and issues between people from these places. Tropical storms The USA already suffers from lots of hurricanes, climate change could increase the number of hurricanes that occur and increase the number of major hurricanes too. This will mean widespread devastation to areas, high repair costs and businesses will not want to set up there. Food In some areas of the USA they will be able to grow crops that they might not have been able to grow before! However, in other areas they will struggle to grow crops, this will mean there will be in increase in food prices. The USA might have to buy in food from other countries, this could be unreliable and depends on the relationship the USA has with other countries. Coastal flooding Many major cities and tourists destinations are in low lying coastal areas of the USA, these areas will be at risk of being flooded on a regular basis or in some cases they could be completely covered by water in the future. This would impact on tourism and business, meaning that the USA would not make as much money as it currently is. This would mean that the government would have to support people financially, again this would reduce the amount of money the country has L27 How can we mitigate against the impacts of climate change?	

Mitigation = deal with the cause of the problem. They reduce or prevent the greenhouse gases which cause climate change and protect carbon sinks (forests & oceans).

Adaptation = responds to the impacts of climate change and tries to make population less vulnerable.

Mitigation techniques to reduce climate change:

- Alternative energy production

As world population and incomes grow, the demand for energy also increases. The energy needed to power more consumer goods such as refrigeration, computers and car to travel around the world and to produce food, especially meat, causes a high challenge in mitigating climate change. Renewable energy sources (such as wind, solar, geothermal, wane and tidal and biomass) offer a solution to reduce the volume of greenhouse gases contributing to climate change.
The United Nations Environment Programme states: 'In 2010, new investments in renewable energies reached a record high of US$211 billion, with noticeable growth in emerging economies'. Renewable energy sources such as solar energy are more expensive than fossil fuels, but are becoming cheaper and more competitive, especially as they do not produce CO2.

- Solar energy

In 2013, 14.9% of the UK's electricity was generated by renewable energy sources. Photovoltaic solar energy generated 3.8% of renewable energy sources. When light shines on solar panels it creates an electrical field. The stronger the sunshine on solar panels the more electricity that is produced. A typical homes saves over a tonne of Co2 per year as there are no greenhouse gas emissions to contribute to climate change, However, at time when there is no sunshine such as at night, solar energy cannot be relied onto generate electricity.

- Carbon capture

Technological advances can replicate the way the Earth stores carbon dioxide (underground in rock formations and the oceans) in a process known as carbon capture and storage (CCS). CCS can be used with existing and new power plants. The IPCC estimates that CCS could provide 10 to 55% of the world's total carbon mitigation until

L26 – Need to understand what climate change is, in order to understand how to manage it.	2100. It works be capturing CO2 from emission sources and safely storing it. CCS can also remove CO2 from the open atmosphere by converting it into a liquid 'supercritical CO2' which is then injected into sedimentary rock. An impermeable 'cap rock' prevent it from escaping. The UK is a world leader in CCS. The Department of Energy & Climate Change reports that 'By 2050, CCS could provide more than 20% of the UK's electricity and save the UK more than £30 billion a year in meeting our climate targets'. Unfortunately, the process of CCS is expensive, and it is unclear whether the CO2 would remain trapped in the long term. Additionally, it does not promote renewable energy, which prevents CO2 emissions in the first place. • Planting trees Deforestation is a global problem as it is a major driver of climate change. According to the United Nations Environment Programme, deforestation and forest degradation occurs at a rate of 13 million hectares per year. A US$40 billion investment in reforestation, and payments to landholders for conversation each year from 2010 to 2050, could increase forest carbon storage by 28%. The UK has a £24.9 million project (funded by the Department for Environment, Food and Rural Affairs) to reduce deforestation and increase forest and land restoration in Brazil. It aims to tackle climate change by reducing 10.71 million tonnes of CO2 emissions over 20 years by recovering 1,560 hectares of degraded forests. • International agreements The UN negotiated a new international climate change agreement for all countries at the 2015 Paris climate conference. It will be implemented from 202. The European Commissions has sell the EU's visions for a new agreement that will reduce global emissions by at least 40% below 2010 levels by 2030 and by 60% by 2050. It was a challenge for countries to agree on targets that will go far enough to manage climate change. Some countries can afford to mitigate climate change more than others, and some are considered more responsible for causing climate change than others. L28 How can we adapt to climate change? Adaptation	

	Adaption strategies do not aim to reduce the impact of climate change but respond to it by reducing its negative effects. CHANGE IN AGRICULTURAL SYSTEMS Farmers respond to climate change by adapting their farming practices. This can include changing the type of crops they grow to those better suited to a warm climate e.g. grapes. Areas at risk of desertification will need to change approaches to farming. Low technology solutions to this include the use of stone lines. You can find out more about managing areas at risk of desertification in the Sahel case study. MANAGING WATER SUPPLY There may be a greater need for developing water transfer schemes. This involves moving water from areas of surplus (more water than is used) to areas of water deficit (not enough water). This can be achieved by building water transfer pipelines. An example of this is the Kielder water transfer scheme in the north-east of England REDUCING RISK FROM RISING SEA LEVELS This involves developing coastal defences to protect areas at risk of coastal flooding. The purpose of these is to reduce the risk of further land being eroded away. It is estimated that sea levels will rise between 28 and 43cm by 2100 putting settlements and valuable agricultural land at risk. This will have a knock-on effect in terms of increasing costs of insuring properties and protecting areas at risk. Environment Agency and local councils are developing Shoreline Management Plans to manage the threat of coastal change. They identify the most sustainable approach to managing the flood and coastal erosion risks to the coastline in the: short-term (0 to 20 years) medium term (20 to 50 years) long-term (50 to 100 years)	

L28 – Recap of the definition of adaptation from L27		