MY REVISION NOTES

HODDER EDUCATION

AQA

GCSE (9–1)

GEOGRAPHY

SECOND EDITION

- Plan and organise your revision
- Reinforce skills and understanding
- Practise exam-style questions

Simon Ross
Rebecca Blackshaw

MY REVISION NOTES
AQA GCSE (9–1)
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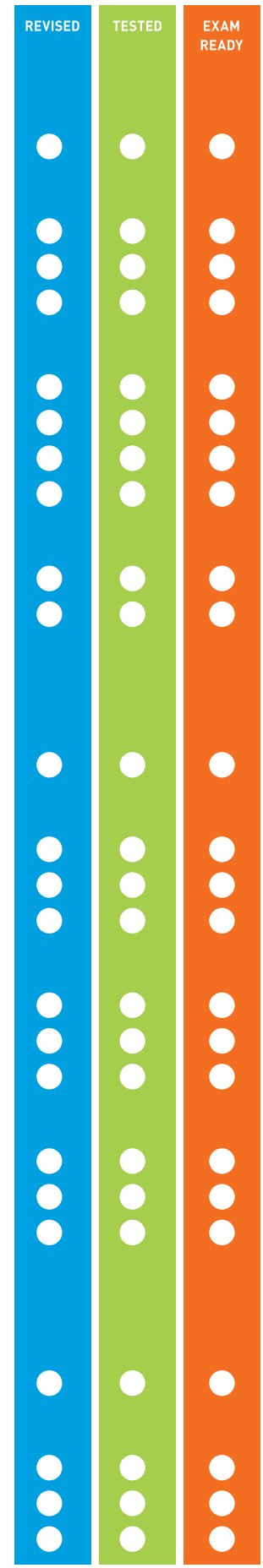
My Revision Planner

Unit 1 Living with the physical environment

Section A: The challenge of natural hazards

Section B: The living world

Section C: Physical landscapes in the UK



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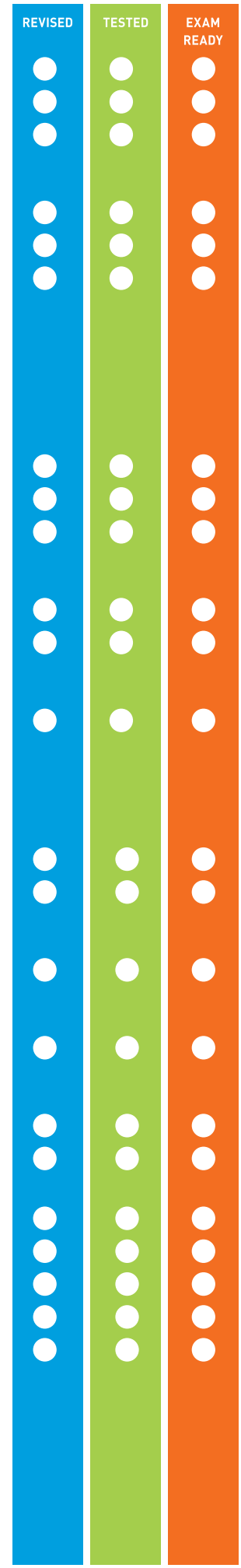

Section C: The challenge of resource management

Unit 3 Geographical applications

REVISED | TESTED | EXAM READY

1 Natural hazards

1.1 Natural hazards

A **natural hazard** is a natural event such as an **earthquake**, volcanic eruption, **tropical storm** or flood. It is caused by 'natural' processes, so would occur even if humans were not on the planet. However, it is a 'hazard' because it has the *potential* to cause damage, destruction and death when it interacts with humans.

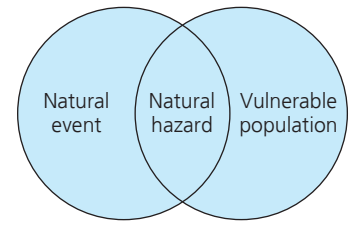

Figure 1.1 A natural hazard

What are types of natural hazard?

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Natural hazards are most commonly classified by the physical processes that caused them:

- Earthquakes and **volcanoes** are classed as **tectonic hazards**.
- Flooding is a geomorphological hazard.
- Tropical storms are classed as atmospheric hazards.
- Forest fires are biological hazards.

However, classifying hazards is made difficult because:

- some may be caused by more than one physical process; for example, a tsunami can be both a tectonic **and** a geomorphological hazard
- some may also be caused or influenced by human processes; for example, forest fires can be a natural biological hazard but can also be caused by human activity such as arson or falling power lines.

Revision activity

List as many different natural hazards as you can, then colour code them to show what type of natural hazard they can be classified as.

Factors affecting hazard risk

Hazard risk is the probability or chance that a natural hazard may take place. The hazard risk will increase when there is an increase in:

1. the number of people vulnerable to the natural hazard; for example:
   - world population has increased
   - more people are living near hazard-prone areas because they cannot move, it's worth staying or simply they don't want to move
2. the a) frequency (how often) and b) magnitude (strength) of the natural hazard; for example:
   - some hazards are more destructive than others
   - the probability of hazards such as flooding because of climate change
   - hazards such as landslides and flooding because of **deforestation** and **urbanisation**
3. people unable to cope with the natural hazard; for example:
   - some hazards are more difficult to predict and it is therefore harder to evacuate people in time
   - some people do not have the money, knowledge or ability to cope with natural hazards when they occur. This is more likely in **low income countries (LICs)** than in **high income countries (HICs)**.

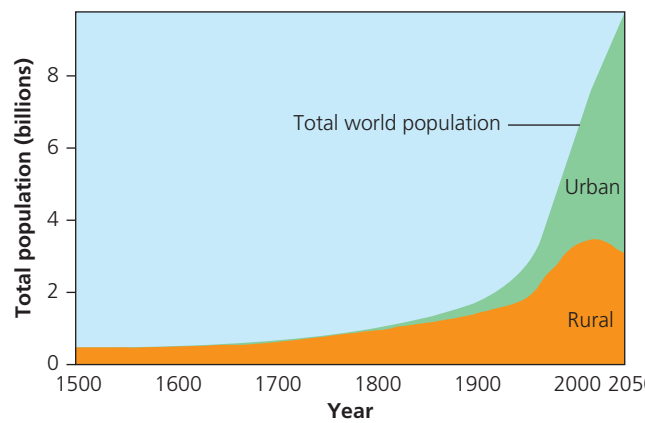

Figure 1.2 World urban and rural population change

Now test yourself TESTED

1. What is hazard risk?
2. List and explain at least two factors which affect hazard risk.
3. How is world population changing over time?
4. How is the proportion of people living in urban areas changing over time?

Exam practice

1. Define natural hazard. (1 mark)
2. Suggest how hazard risk would be affected by an increase in population. (2 marks)

2 Tectonic hazards

2.1 Earthquakes and volcanoes

What is plate tectonics theory?

REVISED

The Earth's structure

The Earth's internal structure is divided into layers: the core, mantle and crust (continental and oceanic). The crust and upper mantle are called the lithosphere. The lithosphere is broken into several major fragments called tectonic plates. Tectonic plates are rigid and can move very slowly, floating across the heavier semi-molten rock in the mantle. Continental plates are less dense but thicker than oceanic plates.

Revision activity

1. Draw a labelled diagram to show the Earth's structure.
2. Time yourself: write out, in four minutes, why tectonic plates move. Now check and correct your answer.

What causes tectonic plates to move?

1. One theory is called **convection**.
2. A more currently accepted theory is **ridge push and slab pull**.

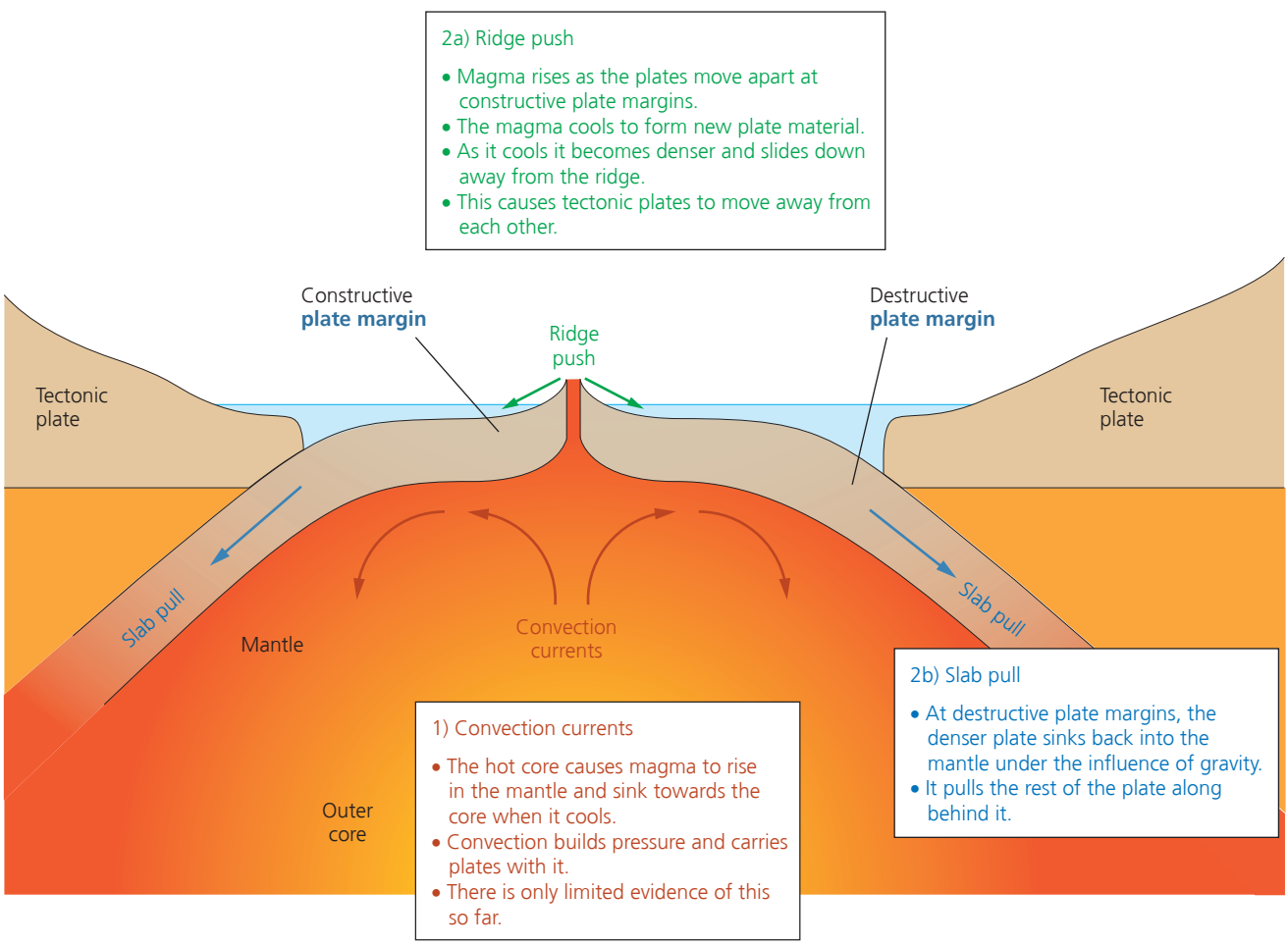

Figure 2.1 Plate tectonics theory

What is the global distribution of earthquakes and volcanoes in relation to plate margins?

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- The distribution is not random.
- They occur in narrow bands along plate margins.
- Found both on land and in sea.
- Earthquakes found at all three types of plate margins: constructive, destructive and conservative.
- Volcanoes found at constructive and destructive plate margins.
- There are anomalies as some occur in the middle of plates in 'hot spots'.

Now test yourself

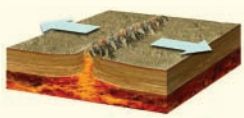
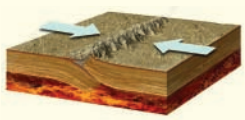
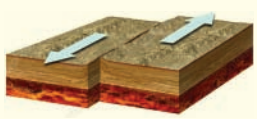
1 Which plate margins experience a) earthquakes and b) volcanoes?

2 How are the plates moving at a) constructive, b) destructive and c) conservative plate margins?

TESTED

What are the physical processes at different plate margins?

There are three types of plate margin: constructive, destructive and conservative.

Plate margin	Direction of plate movement	Physical process	Earthquakes and volcanic eruptions
Constructive 	Diverging away from each other, e.g. the Eurasian and North American plates	+ Hot molten magma rises between the plates. + Tectonic plates move away from each other by ridge push and slab pull. + The magma cools to form a new plate. + On land rift valleys form, such as the East African rift valley.	Yes (usually small, not violent)
Destructive 	Converging towards each other, e.g. the Pacific and Philippine plates	+ When tectonic plates converge, pressure builds between them. The rock eventually fractures, causing earthquakes. + When oceanic and continental plates collide, the denser oceanic plate is subducted under the continental plate into the mantle, where it melts. + Hot magma can rise through the lithosphere and erupt as lava through volcanoes.	Earthquakes (violent) Volcanoes (composite)
Conservative 	Sliding parallel past each other, e.g. Pacific and North American plates	+ Pressure builds at the margin of the tectonic plates as they are pulled along behind a plate being subducted elsewhere (slab pull). + As friction is overcome, the rock fractures in an earthquake.	Earthquakes No volcanoes

Revision activity

Draw three simple sketches of the different plate margins. Annotate the sketches with the information in the table above.

Exam practice

1 Describe the global distribution of earthquakes and volcanoes in relation to plate margins. (3 marks)

2 Outline differences between conservative and destructive plate margins. (2 marks)

3 Explain how volcanoes occur at destructive plate margins. (4 marks)

4 Draw an annotated diagram to explain why earthquakes occur at conservative plate margins. (4 marks)

Exam tip

To describe distributions of data given on a map, give the general overall trend, some specific examples (remembering to use map directions), and identify any anomalies.

2.2 Tectonic hazards

What are the effects of tectonic hazards?

REVISED

There are two types of effects: **primary effects** and **secondary effects**.

Primary effects of an earthquake

- Property, buildings and homes destroyed.
- People injured and killed.
- Ports, bridges, roads and railways damaged.
- Pipes (water and gas) and electric cables broken.

Secondary effects of an earthquake

- Business reduced and money spent repairing damage, so the economy slows.
- Blocked transport infrastructure hinders emergency services, causing further casualties.
- Broken gas pipes and fallen electricity cables can start fires, further destroying property and killing people.
- Burst water pipes lead to a lack of clean water and poor sanitation, increasing the spread of diseases.

Exam tip

As shown in the photograph, always make sure the arrows for your annotations touch the exact point you are referring to.

Figure 2.2 Nepal earthquake, 2015

Primary effects of a volcanic eruption

- Property and farmland destroyed. People and livestock injured and killed. This is due to pyroclastic and lava flows and ash collapsing buildings.
- Air travel halted due to airborne volcanic ash damaging engines.
- Water supplies contaminated.

Secondary effects of a volcanic eruption

- Economy slows. Emergency services struggle to arrive.
- Ice melts, causing flooding. Flood water or rain mixes with volcanic ash, causing lahars (mudflows), destroying property and killing people.

Figure 2.3 Tourists visit White Island, New Zealand, months prior to its eruption in December 2019

- Tourism increases with those interested in visiting volcanoes.
- The ash breaks down, forming fertile farmland.

Now test yourself TESTED

1. What is the difference between a primary and a secondary effect?
2. Which effects in the annotated photograph of Nepal are a) primary and b) secondary?
3. What are the positive effects of tectonic hazards?

What are the responses to tectonic hazards?

REVISED

Responses can be immediate or long-term.

Immediate	Long-term
+ Issue warnings (volcanic eruptions if possible). + Rescue teams search for survivors. + Treatment given to those injured. + Provide shelter, food and drink. + Recover bodies. + Extinguish fires.	+ Repair and rebuild properties and transport infrastructure. + Improve building regulations. + Restore utilities (water, gas, electricity). + Resettle locals elsewhere (Montserrat still has an exclusion zone over two decades later). + Develop opportunities for recovery of the economy. + Install increased monitoring technology.

Comparing earthquakes

REVISED

You are required to study named examples of a tectonic hazard to show how the effects and responses vary depending on their contrasting levels of wealth. Italy and Chile are higher income countries (HICs) with a gross national income (GNI) per capita (2016) of US$31,950 and US$13,370 respectively, whereas Nepal is a lower income country (LIC) with a GNI per capita of US$770.

Varying effects and responses

	Amatrice, Italy (2016)	Maule, Chile (2010)	Gorka, Nepal (2015)
			
Effects	**Primary** + 299 killed and 400 injured. + US$25.4 billion damage. + 4,454 homeless. + Over half the buildings in Amatrice collapsed, including 80% of the old historic town and Amatrice hospital. + 293 historic buildings collapsed. **Secondary** + Landslides blocked roads and reduced access. + Farmers struggled as 90% of barns were destroyed. + Looters arrested. + Centre of Amatrice town cordoned off, reducing business. + Residents suffered psychological damage.	**Primary** + 500 killed and 12,000 injured. + Around US$30 billion damage. + 220,000 homes, 4,500 schools, 56 hospitals and 53 ports destroyed, including Port of Talcahuano. + Santiago airport severely damaged. **Secondary** + 1,500 kilometres of roads damaged, mainly by landslides. + Several coastal towns devastated by tsunami waves. + A fire at a chemical plant near Santiago.	**Primary** + 8,841 died and 16,800 injured. + US$5 billion damage. + 1 million homeless. + 7,000 schools, 26 hospitals and Dharahara Tower (UNESCO World Heritage Site) destroyed. + International airport congested as aid arrived. **Secondary** + Landslides and avalanches killed 19 on Mount Everest. Landslide blocked the Kali Gandaki River so people evacuated in case of flooding. Blocked roads slowed aid. + Tourism employment and income declined. + Rice seed ruined, causing food shortages and income loss.

	Amatrice, Italy (2016)	Maule, Chile (2010)	Gorka, Nepal (2015)
			
Responses	**Immediate** + 10,000 accommodated in 58 tent camps and 4,000 in hotels and sports halls. + Rescue effort involved 12 helicopters and 70 dog teams. + A temporary hospital was set up. + US$58 million announced by Italian government for the emergency response. + Rescue hampered by blocked roads, damaged bridge, mountainous terrain and over 2,000 aftershocks. **Long-term** + Students attended neighbouring schools. + US$49 million initiative 'Italian Homes' to rebuild earthquake-proof houses. + Tax breaks for 65% of renovation costs. + In 2017 people moved from tents to wooden houses.	**Immediate** + Emergency services arrived quickly. + Within 24 hours temporary repairs made to the Route 5 north–south highway. + 90% of homes had power and water restored within ten days. + US$60 million raised. **Long-term** + Government housing reconstruction plan to help 200,000 households launched one month later. + Potential for economy to be rebuilt without foreign aid. + Possibly up to four years to recover from damage to buildings and ports.	**Immediate** + International help requested. + Rescues from avalanches on Mount Everest made by helicopter. + 500,000 tents provided. + Field hospitals set up. The UN and World Health Organization sent medical supplies to worst affected districts. + Facebook launched a safety feature for users to indicate they were safe. Free telephone calls. **Long-term** + US$274 million aid money committed to recovery. + Lakes and river valleys cleared of landslide material to avoid flooding. + Stricter building controls enforced. + New trekking routes on Everest opened by August 2015 and permits extended by two years. + 34% of those affected were reported to still be in temporary or unrepaired homes in 2018.

Reasons for variations

The table below shows how effects and responses vary depending on certain factors:

	Causes differences in:		Influenced by wealth
Reasons for variations	**Effects**	**Responses**	
Building density	✓		
Construction standards	✓		✓
Corruption		✓	✓
Hazard-prone area	✓		
Magnitude or scale	✓		
Monitoring/prediction		✓	✓
Medical facilities		✓	✓
Population density	✓		
Resources/finance		✓	✓
Secondary effects (e.g. tsunamis)	✓	✓	
Time of day/year	✓		
Trained emergency services		✓	✓
Transport infrastructure		✓	✓
Type of plate margin	✓		

Now test yourself

1 Compare the wealth of Italy or Chile with that of Nepal.

2 Identify two differences and similarities between the a) effects of and b) responses to the earthquakes.

TESTED

Exam tip

Use phrases such as 'to a greater extent' and 'to a lesser extent' to answer 'To what extent' questions. Suggest different views or sides of the argument. Make sure you come to a conclusion.

Exam practice

To what extent does a country's ability to respond to the effects of a tectonic hazard depend on its level of wealth? Use examples to support your answer. (9 marks)

2.3 Management of tectonic hazards

Why do people live at risk from tectonic hazards?

REVISED

Eight per cent of the world's population live near volcanoes. Fifty per cent of the population of the United States of America live in earthquake-prone areas.

Economic reasons for living at risk	Social reasons for living at risk
+ **Geothermal energy** provides energy for the area. + Farming the nutrient-rich soils helps agriculture. + Mining provides energy and income. + Tourism creates jobs and provides income. + It may be cheaper to stay than to move.	+ People want to stay near friends and family. + The threat may not be great enough, or people don't understand the risk. + People are confident that the buildings will keep them safe.

How can the risks from tectonic hazards be reduced?

REVISED

Volcanologists and seismologists use **monitoring**, **prediction**, **protection** and **planning** to aim to reduce the death and destruction caused by earthquakes and volcanic eruptions.

Technique	Volcanic eruption	Earthquake
Monitoring	+ Changes in shape of ground and volcano using tiltmeters and Global Positioning System (GPS) satellites. + Earthquakes near magma chamber using seismometers. + Ground surface and river temperatures using thermal heat sensors. + Radon and sulphur gas using gas-trapping bottles.	More difficult to monitor than volcanoes, but these can be monitored: + Foreshocks using seismometers and GPS. + Radon using radon detection devices.
Prediction	+ Easier to predict than earthquakes as they usually give advance warning signals before erupting.	+ Extremely difficult to predict time, date or exact location.
Protection	+ Buildings cannot be designed to completely protect against eruption impacts. + Evacuation instructed by authorities.	+ Building and transport infrastructure design (e.g. foundations with rubber shock absorbers), although this is expensive. + Sea walls in case of tsunamis.
Planning	+ Evacuation. + Exclusion zones. + Education to know what to do. + First-aid training.	+ Practice drills. + Preparing emergency supplies and location of evacuation centres. + Securing objects/furniture.

Revision activity

1 Draw a spider diagram with four legs: monitoring, prediction, protection, planning.

2 Using two different-coloured pens (one for earthquakes and one for volcanic eruptions), list different methods on each leg.

Exam practice

1 Describe how protection can reduce the risk caused by an earthquake. (4 marks)

2 Explain why reducing the risks from a tectonic hazard is challenging. (4 marks)

Now test yourself

1 Give examples of how people can plan for earthquakes and volcanic eruptions.

2 State four reasons why people live near volcanoes.

3 Name two pieces of equipment that are used to monitor tectonic hazards.

TESTED

3 Weather hazards

3.1 Global atmospheric circulation

Global atmospheric circulation helps to explain the location of world climate zones and the distribution of weather hazards.

What is the influence of latitude?

REVISED

When the Sun's rays strike the Earth, they are concentrated differently on areas of land depending on latitude. At the Equator the Sun's rays are concentrated (higher insolation) so it is much hotter than at the Poles where the rays are more spread out (lower insolation).

Now test yourself TESTED

1 Why does air rise at the Equator and sink at the Poles?
2 What global patterns do you notice about surface winds?

How does global atmospheric circulation work?

REVISED

Pressure belts

- Air at the Equator is heated strongly so it rises in **low-pressure** conditions. The air flows towards the North and South Poles. As warm air rises it cools and condenses. Low pressure therefore brings cloud and rain.
- The air sinks at 30 degrees north and south of the Equator under **high-pressure**. High-pressure weather brings dry and clear skies. This forms a convection cell known as the Hadley Cell.
- Air at the polar latitudes is colder and denser and so the air sinks towards the ground surface under **high-pressure** conditions. The air flows towards the Equator. The air warms as it reaches about 60 degrees and again rises under **low-pressure** conditions. This forms the Polar Cell. Located between the Hadley and Polar Cells is the Ferrel Cell.

Surface winds

Winds on the surface of the Earth are experienced as air moves from high- to low-pressure areas in the convection cells. On the surface of the Earth these winds bend due to the Coriolis effect as the Earth spins. The surface winds bend to the right in the northern hemisphere and to the left in the southern hemisphere.

Exam practice

1 Describe the weather experienced under low-pressure conditions. (2 marks)
2 Explain the apparent association between surface winds and atmospheric pressure. (4 marks)

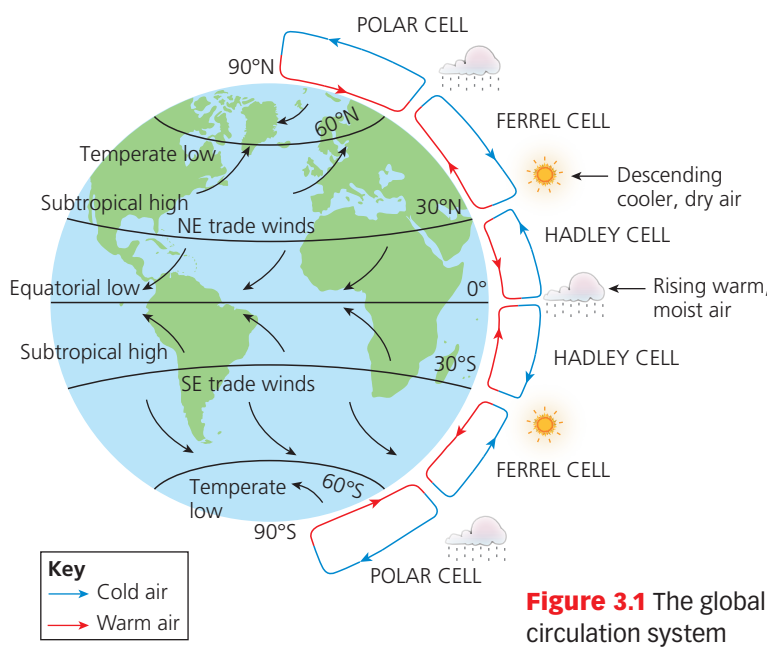


Figure 3.1 The global circulation system

Check your understanding and progress at www.hoddereducation.co.uk/myrevisionnotes

3.2 Tropical storms

What is the global distribution of tropical storms?

REVISED

Tropical storms are a natural hazard. They have different names depending on their location. They occur between 5 and 30 degrees north and south of the Equator. This provides areas of intense low pressure (see page 8) so that warm, moist air is able to rise rapidly to reach high altitudes.

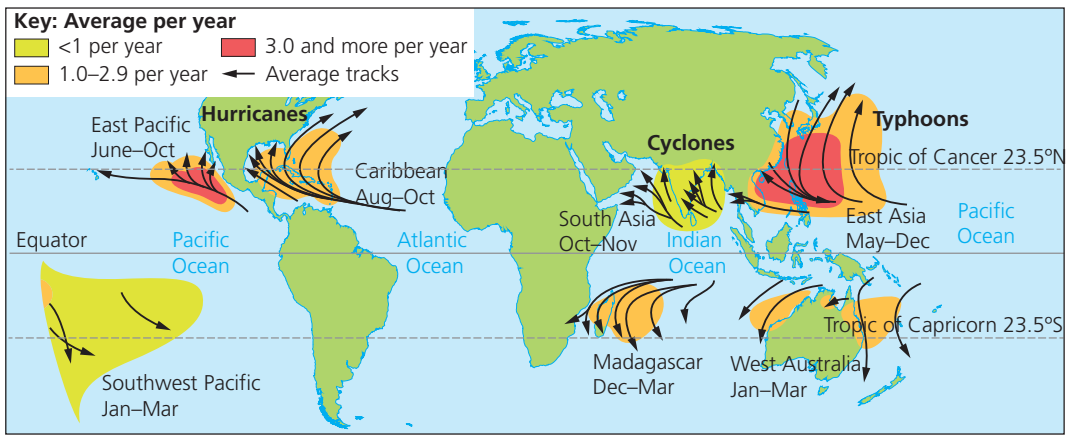


Figure 3.2 The global distribution of tropical storms

Conditions which cause tropical storms	How does this contribute to their formation?
Low latitudes Between 5–30 degrees north and south of the Equator	Temperatures are higher here than at the Poles so the sea and air are heated more quickly, to higher temperatures. Air pressure is low, and air rises. The Coriolis effect is strong enough for tropical storms to spin.
Originate in oceans with temperatures above 27°C at a depth of 60–70m	Provides heat and moisture so warm air rises rapidly.
Between summer and autumn	Typically the warmest seasons to encourage warmer air to rise rapidly, on account of low pressure.
Low wind shear	Wind is constant and doesn't vary with height so clouds rise to high altitudes without being torn apart.

What is the sequence of the formation of tropical storms?

REVISED

1. Air is heated above the surface of warm tropical oceans.
2. Warm air rises rapidly under low-pressure conditions.
3. Strong winds form as rising air draws up more air and moisture.
4. The rising air spins around a calm central eye of the storm due to the Coriolis effect.
5. The rising air cools and condenses, forming large cumulonimbus clouds and torrential rainfall.
6. Heat is given off as it cools, powering the tropical storm.
7. Cold air sinks in the eye so it is clear, dry and calmer.
8. The tropical storm travels across the ocean with the prevailing wind.
9. On meeting land, it loses its source of heat and moisture so loses power. Storms track north in the northern hemisphere and south in the southern hemisphere.

Exam tip

When describing formations, try to make your answer as sequential as possible rather than jumping around. The order is important in a clear description.

What are the structure and features of a tropical storm?

REVISED

The way in which tropical storms form gives them a distinctive structure. Their circular shape, swirling around the clear, cloudless central 'eye', is visible on a satellite image. They spin anticlockwise in the northern hemisphere, but clockwise in the southern hemisphere.

A cross section of a tropical storm is symmetrical in shape.

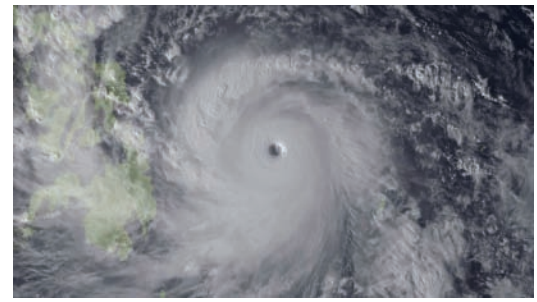


Figure 3.4 The eye of the storm

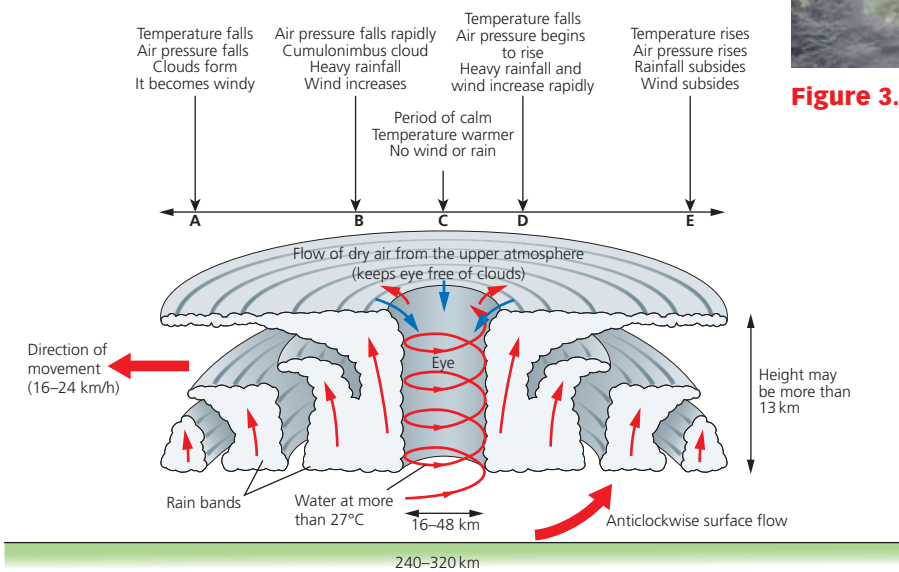


Figure 3.3 A cross section of a tropical storm

How might climate change affect tropical storms?

REVISED

Climate change is expected to increase atmosphere and sea surface temperatures, and affect tropical storms in the following ways:

- **Frequency:** The overall frequency of tropical storms is expected to remain the same or decrease. However, the frequency of category 4 and 5 storms is expected to increase, while category 1–3 storms will decrease.
- **Intensity:** Since the 1970s the number of the most severe category 4 or 5 tropical storms has increased. Every 1 degree Celsius increase in sea surface temperatures will mean a 3–5 per cent increase in wind speed. A warmer atmosphere will mean heavier rainfall and flooding.
- **Distribution**: The location of tropical storms is not expected to change significantly.

Exam tip

Circle any plurals in the exam questions. This will help ensure you notice when you need to consider more than one factor. You cannot gain full marks unless you have obeyed this in questions.

Now test yourself TESTED

1 Where are tropical storms called a) hurricanes, b) typhoons and c) cyclones?
2 What type of air pressure do tropical storms form in?
3 What is the typical height and width of a tropical storm?
4 How do rainfall and wind change as a tropical storm passes over?
5 Name the conditions which cause tropical storms to form and which climate change may affect.

Exam practice

1 Outline two conditions in which tropical storms form. (2 marks)
2 Describe the sequence of formation of a tropical storm. (4 marks)
3 Explain the relationship between tropical storms and global atmospheric circulation. (4 marks)

3.3 Effects of tropical storms

Typhoon Haiyan struck the Philippines on 8 November 2013. It was a category 5 on the Saffir–Simpson scale (a wind scale, with categories 1–5, used for measuring tropical storms). This was one of the most powerful ever to hit the Philippines.

What were the primary effects of Typhoon Haiyan?

REVISED

The tropical storm brought wind speeds of up to 314 kilometres per hour, waves as high as 15 metres, and 400 millimetres of heavy rainfall flooded 1 kilometre inland. Ninety per cent of the city of Tacloban was destroyed. Some effects caused directly as a result of the tropical storm are given in the table below.

Social	+ 50% of houses destroyed. + 4.1 million made homeless. + 6,190 people died.
Economic	+ US$12 billion of damage. + Damage to rice cost US$53 million. + The United Nations stated 75% of farmers and fishermen had lost their income.
Environmental	+ An oil barge ran aground at Estancia, causing an 800,000-litre oil leak. + 400 millimetres of rainfall caused flooding. + 1.1 million tonnes of crops were destroyed.

Figure 3.5 Primary effects: Tacloban city following Typhoon Haiyan, 2013

Figure 3.6 Secondary effects: residents loot water-damaged sacks of rice from a rice warehouse in Tacloban

Revision activity

Get someone to read out each effect from the two tables in a random order. Answer whether it is 1) a primary or secondary effect, and 2) a social, economic or environmental effect.

Now test yourself

1 What were two economic effects of Typhoon Haiyan?
2 What were two environmental effects of Typhoon Haiyan?
3 What were two social effects of Typhoon Haiyan?

TESTED

What were the secondary effects of Typhoon Haiyan?

REVISED

The after-effects caused indirectly by the tropical storm are listed in the table below.

Social	+ Infection and diseases spread, due to contaminated surface and groundwater. + There were eight deaths in a stampede as survivors fought for rice supplies. + Power supplies were cut off for a month in some areas. + Many schools were destroyed, affecting people's education.
Economic	+ The fishing industry was disrupted as the leaked oil from the grounded barge contaminated fishing waters. + The airport was badly damaged and roads were blocked by trees and debris. + Looting was rife, due to a lack of food and supplies. + By 2014, rice prices had risen by nearly 12%.
Environmental	+ Ten hectares of mangroves were contaminated by the oil barge leak. + Flooding caused landslides and contamination of surface and groundwater.

What was the response to Typhoon Haiyan?

REVISED

The Philippine government, charities and non-governmental organisations (NGOs) responded in varying ways to reduce the effects of Typhoon Haiyan. **Immediate responses** occurred as the disaster happened, with **long-term responses** in the following weeks, months and years.

Immediate responses to Typhoon Haiyan

- The government televised a warning for people to prepare and evacuate.
- Authorities evacuated 800,000 people. Many went to Tacloban indoor stadium, which had a reinforced roof to withstand typhoon winds; however, unfortunately it flooded.
- Over 1,200 evacuation centres were set up to help the homeless.
- The Philippine government ensured essential equipment and medical supplies were sent out, but in one region medical supplies and equipment were washed away.
- Emergency aid supplies arrived three days later by plane. Within two weeks, over 1 million food packs and 250,000 litres of water were distributed.
- The government imposed a curfew two days after the typhoon to reduce looting.
- The celebrity couple the Beckhams, the *X Factor* TV show, and brands such as Coca-Cola, FIFA and Apple used their status to raise awareness and encourage public donations.

Figure 3.7 Humanitarian aid workers distribute ShelterBox emergency aid supplies

Long-term responses to Typhoon Haiyan

- Thirty-three countries and international organisations pledged help. More than US$1.5 billion was pledged in foreign aid.
- A 'cash for work' programme paid people to clear debris and rebuild the city.
- Oxfam replaced fishing boats.
- In July 2014, the Philippine government declared a long-term recovery plan 'Build Back Better'. Buildings would not just be rebuilt but upgraded to protect against future disasters.
- Rebuilding was slow – 100,000 families were still in temporary accommodation in 2015!
- A 'no-build zone' was established in the Eastern Visayas, which later changed to a 'no dwelling zone' so commercial buildings could be built. Homes were rebuilt away from flood-risk areas.
- Mangroves (saltwater-adapted trees or shrubs) were replanted.
- A new storm surge warning system was installed.
- Coconut trees were replanted, but they were expected to take 5–10 years to bear fruit.

Revision activity

1. Draw a symbol to represent each immediate and long-term response to Typhoon Haiyan.
2. Cover up your completed symbols and try to redraw them all.
3. Check how many responses you remembered.

Now test yourself

1. State two immediate responses.
2. Which long-term responses helped the economy?
3. Name a long-term response which would help people cope better when another tropical storm hits the Philippines.

TESTED

How can the effects of tropical storms be reduced?

REVISED

There are four management strategies to cope with tropical storms:

Monitoring

- Satellites monitor cloud patterns associated with tropical storms.
- The Global Precipitation Measurement satellite monitors high-altitude rainclouds every three hours, which indicate whether a tropical storm will intensify within 24 hours.
- The National Aeronautics and Space Administration (NASA) monitors weather patterns across the Atlantic in two unmanned aircraft called Global Hawk drones.

Prediction

- Supercomputers give five days' warning and predict a location within 400 kilometres.
- Track forecast cones plot the tropical storm's predicted path. Approximately 70 per cent occur within the cone.
- Early warnings are issued by national hurricane centres around the world.

Protection

- Reinforce buildings (Figure 3.8 shows how damage to a house can be mitigated, i.e. prevented).
- Develop coastal flood defences.
- Create 'no-build zones' in low-lying areas.

Planning

Those who still live in tropical storm-prone areas can make plans and prepare what they require to deal with the effects of the tropical storm (see also Figure 3.9). They can:

- prepare disaster supply kits
- ensure vehicles are fuelled
- know where evacuation shelters are
- plan what their family will do.

Now test yourself

1. Define a) monitoring, b) prediction, c) protection, d) planning.
2. How does a satellite help to predict tropical storms?
3. What is a forecast cone?
4. Why would it be helpful when preparing for a tropical storm to a) store loose objects, and b) have fuel in vehicles?

TESTED

Exam tips

Look at exam practice question 1. Make sure you answer all of the question by stating which effects are reduced.

Use facts and figures that you have learnt in case-study and examples questions to prove you are writing specifically about this place and not any other.

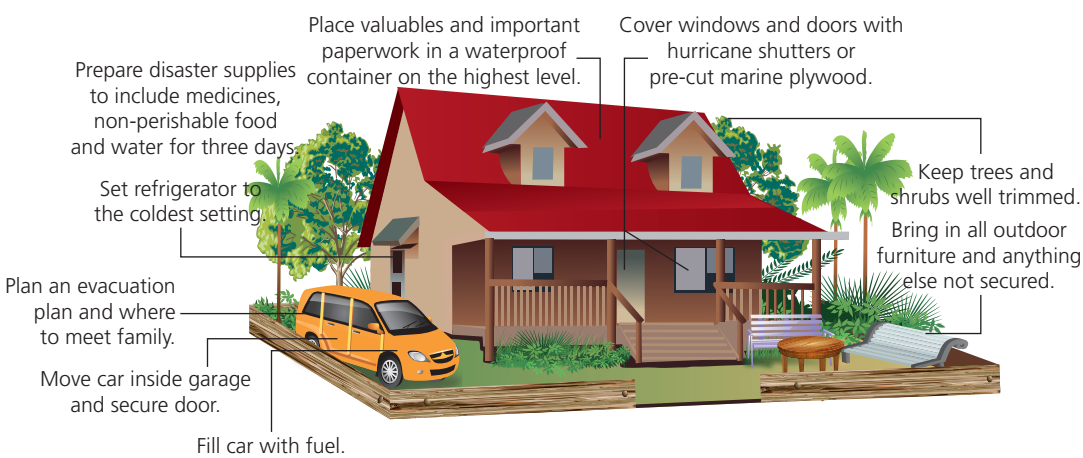


Figure 3.8 How planning can help reduce hazard risk

Exam practice

1. Suggest how protection against tropical storms can reduce their effects. (4 marks)
2. The effects of a tropical storm are more significant for people than for the environment. Do you agree? Using a named example, explain your answer. (9 marks)

3.4 Weather hazards in the UK

What are weather hazards in the UK?

REVISED

Extreme weather is when the weather is especially severe or out of season, and is clearly different to the usual weather pattern. Most parts of the UK are at risk from one or more types of extreme weather. Different air masses crossing the UK bring a variety of weather.

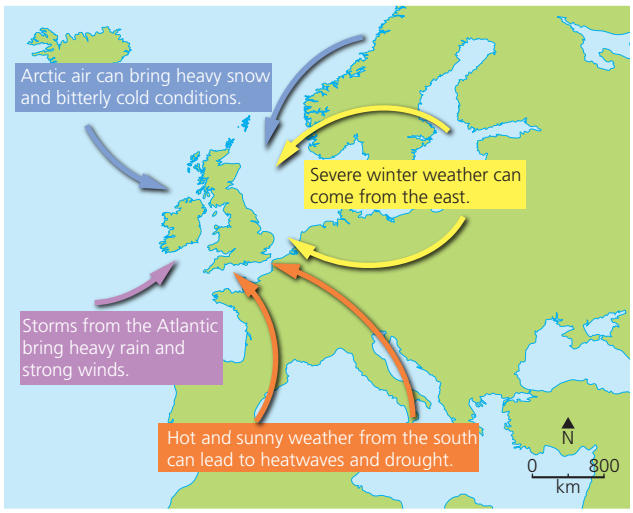


Figure 3.9 Map of UK air masses

Storm events

Depressions (low-pressure systems) bring heavy rain and strong winds to the UK, as happened in Scotland in 2018. Possible impacts include:

- flood and wind damage to business and properties
- trees uprooted, causing further damage
- power supplies down
- disruption to transport
- death.

Now test yourself TESTED

1. Describe why the UK experiences a variety of weather.
2. What is extreme weather?
3. Name four types of extreme weather that the UK experiences.
4. How could extreme weather affect a) agriculture, b) transport, c) people's health?
5. Why might extreme weather be of benefit to the UK?

Flooding

Floods are often caused by heavy rainfall or storm waves. Torrential rainstorms and thunderstorms can cause flash flooding. Prolonged rainfall also leads to flooding; for example, several UK rivers burst their banks in autumn 2019. Possible impacts include:

- crops ruined
- damage to homes, businesses and possessions
- transport disrupted or even washed away
- death by drowning
- recovery is often expensive
- landslides.

Droughts and heatwaves

Droughts and heatwaves are typically long periods with little or no rainfall. In the UK a drought is defined as 15 or more consecutive days with less than 0.2 millimetres of rain on any one day, such as in summer 2019. Possible impacts include:

- crop production fails and wildlife is affected
- reservoirs run low, reducing water supplies
- hosepipe bans enforced
- elderly vulnerable to heat exhaustion – possible death
- roads can melt and railway lines can buckle.

However, the tourism industry may benefit.

Extremes of cold weather

Cold conditions take over if the usual depressions (low-pressure systems) are not passing over the UK, as happened during winter 2014–15. Possible impacts include:

- crops fail and cattle may not survive at –10°C
- roads, railways and airlines shut
- increased injuries caused by falling in snow and ice
- businesses and schools shut.

Revision activity

Practise sketching a simple map of the UK and label it with where different types of weather come from.

What have been the recent extreme weather events in the UK?

REVISED

Both Cumbria and the Somerset Levels are examples in the UK which experienced an extreme weather event leading to widespread flooding.

You are required to study **one** example of an extreme weather event in the UK.

	Somerset Levels, UK	Cumbria, UK
When	December 2013 to February 2014	December 2015
Causes	+ Several depressions moving across the Atlantic Ocean caused weeks of wet weather. + Saturated soil. + Wettest January on record. + High tides and storm surges came up the rivers from the Bristol Channel. + Reduced river capacity (lots of sediment) due to not being dredged for over 20 years.	+ 341 mm rain fell in 24 hours in Borrowdale (new UK record). + Deep Atlantic depression called Storm Desmond moving northeast over Cumbria. + Over one month's worth of precipitation in two days. + Wind speeds reached 200 km/hour. + Saturated soil. + Steep slopes of the Lake District.
Social impacts	+ More than 600 homes flooded. + Sixteen farms evacuated. + Temporary accommodation for residents needed for several months. + Some villages cut off. + Power supplies disrupted.	+ More than 4,000 homes flooded in Kendal, Carlisle, Appleby, Keswick and Cockermouth. + Over 700 families unable to return to homes for two years. + Reduced mental wellbeing due to life-changing losses. + Some communities strengthened by shared experience of struggles and recovery.
Economic impacts	+ Over 14,000 hectares of agricultural land flooded for weeks. + Over 1,000 livestock evacuated. + Roads cut off. + Railway line closed. + £10 million damage estimated.	+ Rail and road networks disrupted meant people could not work. + Businesses in Allerdale and Carlisle remained closed for more than a year. + £500 million recovery cost. + Insurance bill reached £1.3 million.
Environmental impacts	+ Contaminated river water with sewage, oils and chemicals. + Large volume of debris deposited across land. + Stagnant water had to be reoxygenated then pumped back into river.	+ Over 100 bridges damaged, including Eamont Bridge. + Slopes of Helvellyn collapsed, damaging the A591 road. + Landslides and riverbank erosion led to deaths of many cattle in rural areas.
Management strategies to reduce risk	+ River banks raised and strengthened. + Somerset County Council launched a £20 million Flood Action Plan. + Rivers Tone and Parratt were dredged in March 2014. + Road levels raised. + Flood defences for communities at risk. + Pumping stations built. + Plans for a tidal barrage at Bridgwater on track for 2024.	+ Since 2016, the UK government has provided £150 million to support recovery. + Flood embankments raised in Carlisle. + £24 million on flood defences in Kendal. + Affordable flood insurance for households across Cumbria. + £5,000 grant for every flooded household to protect home better.

Now test yourself

TESTED

1 State three factors that caused flooding.
2 Name two social, economic or environmental impacts.
3 Who was involved in reducing the risk of future floods?

Revision activity

Write a series of quiz questions about your case study. Test yourself over and over until you consistently remember the answers correctly.

Is the UK's weather getting more extreme?

REVISED

Extreme weather is not new to the UK. There are many examples of extreme weather in the past. However, the frequency of extreme weather in the UK is increasing. Since the 1980s, UK temperatures have increased by about 1°C and winter rainfall has increased. There have been more weather records broken recently than ever before.

Extreme weather records

Temperature	Rainfall
+ December 2010 coldest on record for 100 years. Warmest April was 2011. + Highest temperature (38.7°C) was July 2019. + The hottest day in February ever recorded was 21.2°C in 2019. + Lowest temperature (–27°C) was in Scotland in 1995. + The coldest March on record was in 2018 with the 'Beast from the East'.	+ Highest two-day record of rainfall (405 millimetres) was in 2015. + Highest three- and four-day rainfall records were both in 2009. + Highest monthly total of rainfall (1,396.4 millimetres) was in 2015. + Serious flooding has become more frequent in the winter, for example in Cumbria 2015.

What are the predictions for future UK weather?

REVISED

+ Precipitation is expected to become even more seasonal.
+ Some rivers are expected to flood more frequently in winter.
+ Air temperature is expected to increase, causing more drought.

Is climate change responsible?

REVISED

Climate change cannot be responsible for individual extreme weather events. Yet scientists suggest that the increasing frequency of extreme weather events can be blamed on climate change. Evidence suggests that climate change is warming the planet. The Atlantic Ocean is increasing in temperature. This can explain the UK's changing rainfall pattern. Rain-bearing depressions will gain more energy and moisture, due to the warmer ocean. The frequency of rain-bearing storms has increased in line with climate change predictions since the 1980s.

Research also shows that the Atlantic Ocean was relatively warm between 1931 and 1960, before cooling from 1961 to 1990 and then warming again. The increase in ocean temperature may simply be a long-term cycle or due to the position of the jet stream and not due to climate change.

Now test yourself

TESTED

1 What has happened to the frequency of extreme weather events in the UK?
2 By how much have temperatures increased since the 1980s?
3 Name two examples of UK weather records that have been broken since 2000.
4 Describe how a) precipitation, b) flooding, and c) air temperature are expected to change in the future.
5 Give one reason why climate change is not responsible for the UK's extreme weather.

Exam practice

1 The highest recorded UK temperature was 38.5°C in 2019. The lowest temperature recorded was –27°C in 1995. Calculate the range of temperature extremes. (1 mark)
2 Suggest why the UK's extreme weather events might be increasing. (4 marks)
3 Discuss to what extent climate change is responsible for extreme weather in the UK. (6 marks)
4 Using an example of a recent extreme weather event in the UK, suggest how management strategies can reduce risk. (4 marks)

4 Climate change

4.1 Causes and effects of climate change

What are the possible causes?

REVISED

Evidence of climate change occurring before humans existed means climate change must be natural. However, natural causes cannot account for the unprecedented temperature increase since the 1970s. A thicker layer of greenhouse gases (carbon dioxide 77 per cent, methane 14 per cent, nitrous oxide 8 per cent and CFCs 1 per cent) caused by human activity means less of the Sun's energy is able to escape the Earth's atmosphere, so the temperature increases.

Natural factors

Orbital changes

The Sun's energy on the Earth's surface changes as the Earth's orbit is elliptical, its axis is tilted on an angle and the Earth isn't spherical.

Solar output

Sunspots increase from a minimum to maximum every 11 years. Fewer sunspots were observed during the coldest period ('Little Ice Age' in 1645–1715). However, solar output has barely changed in the past 50 years.

Volcanic activity

Volcanic aerosols reflect sunlight away, reducing global temperatures temporarily.

Human factors

Fossil fuels

Burning fossil fuels releases carbon dioxide. This accounts for 50 per cent of greenhouse gases.

Agriculture

This accounts for 20 per cent of greenhouse gases. Larger populations and demand for meat and rice will increase its contribution.

Deforestation

Logging and clearing land for agriculture/roads increase the amount of CO_2 in the atmosphere, as less photosynthesis occurs.

Revision activity

1. Draw a pie chart to show the proportions of each of the greenhouse gases.
2. Draw a symbol to represent each cause of climate change. Then cover up your completed symbols and try to redraw them all. Check how many causes you remembered.

What is the evidence for climate change?

REVISED

Since 1914 the Met Office has had reliable climate-change data using weather stations, satellites, weather balloons, radar and ocean buoys. Evidence includes:

- an increase in average surface air temperature by 1°C over the last 100 years
- the warmest ocean temperatures since 1850
- a 19-centimetre rise in sea levels since 1900.

Natural recorders, such as tree rings, ice cores (spanning 800,000 years) and ocean sediments (spanning beyond the Quaternary period), help estimate past temperatures by comparing oxygen, carbon dioxide and methane in ice cores and also organisms in ocean sediments with present levels.

The Quaternary period has over 20 cycles of cold glacial periods (lasting about 100,000 years) and warmer interglacial periods (lasting about 10,000 years). The current interglacial period has lasted 15,000 years.

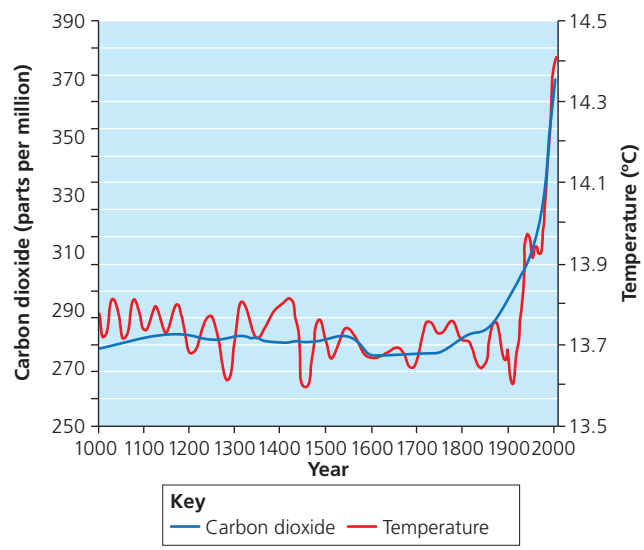


Figure 4.1 Global temperature change

What are the effects of climate change?

REVISED

The effects of climate change are not certain. They are likely to be unevenly distributed across the world and will depend on the human and physical circumstances of the location. For example, low-lying coastal countries will be more vulnerable to flooding and poorer countries have less ability to invest in prediction and protection strategies.

Social effects (effects on people)

- Increased risk of diseases such as skin cancers and heat stroke as temperatures increase.
- Winter-related deaths decrease with milder winters.
- Crop yields affected; maize will decrease by up to 12 per cent in South America, yet will increase in northern Europe and require more irrigation.
- Less ice in the Arctic Ocean increases shipping and extraction of gas and oil reserves.
- Drought reduces food and water supplies in sub-Saharan Africa. Water scarcity in the south and southeast of the UK.
- Flood risk increases repair and insurance costs. Seventy per cent of Asia at increased risk of flooding, causing migration and overcrowding in low-risk areas.
- Declining fishing in the Lower Mekong delta would affect 40 million, due to changing water quality because of reduced water flow and sea-level rise.
- Extreme weather increases investment in prediction and protection.
- Skiing industry may decline in Alps as less snow.

Figure 4.2 Skiing industry may decline in Alps as less snow

Environmental effects

- Increased drought in areas such as Mediterranean region.
- Lower rainfall causes food shortages for orang-utans in Borneo and Indonesia.
- Sea-level rise increases flooding and coastal erosion, so defences are under increasing strain.
- Ice melts, so wildlife declines, such as Adélie penguins on the Antarctic Peninsula and polar bears and seals in the Arctic.
- Warmer rivers affect marine wildlife; for example, the food supply will decrease for the Ganges river dolphin.
- Increase in forest growth in northern Europe.
- Forests in North America may experience more pests, disease and forest fires.
- Coral bleaching, and decline in biodiversity such as at the Great Barrier Reef.

Now test yourself

TESTED

1. Where is evidence about climate change collected from?
2. What is the problem with using natural recorders as evidence for climate change?
3. Identify two natural and two human factors causing climate change.
4. Are the effects of climate change expected to be evenly or unevenly distributed across the globe?
5. Name four social effects of climate change.
6. Name four environmental effects of climate change.
7. Give one positive and two negative effects of climate change.

Exam practice

1. To what extent is human activity the cause of climate change? (6 marks)
2. 'The effects of climate change are greater on the environment than on people.' Do you agree with this statement? Justify your decision. (9 marks)

4.2 Managing climate change

How can climate change be mitigated?

REVISED

Mitigation strategies deal with the causes of climate change. They try to reduce or prevent greenhouse gases and protect carbon sinks.

1 Alternative energy production
Alternative energy production (such as wind, solar, geothermal, wave and tidal, and biomass) reduces greenhouse gases compared to burning fossil fuels (coal, oil and gas). They will last longer. However, despite becoming cheaper and more competitive, they are expensive and cannot be relied upon to generate electricity if, for example, there is no wind, sun or waves.

2 Carbon capture
Carbon capture takes carbon dioxide (CO_2) from emission sources and safely stores it underground. An impermeable 'cap rock' prevents it escaping. It could provide 10–50 per cent of the world's total carbon mitigation until 2100. However, it is expensive, it is unclear if CO_2 would remain captured long term, and it doesn't promote renewable energy.

3 Planting trees
Planting trees helps to remove CO_2 from the atmosphere through photosynthesis. It could increase forest carbon storage by 28 per cent. Oxygen is produced during photosynthesis, and trees provide habitats. However, land may be limited and biodiversity is reduced if only one tree species is planted.

4 International agreements
International agreements encourage countries to take responsibility for reducing CO_2 emissions. Targets are more likely to be met if legally binding (Paris 2015 agreement). Financial support may be provided for LICs. However, some countries are considered more responsible, it is hard to agree targets that go far enough, and they may not be achieved.

Figure 4.3 Mitigation can help climate change

How can we adapt to climate change?

REVISED

Adaptation strategies respond to the impacts of climate change.

1 Changes in agricultural systems
Changes in agricultural systems are required to deal with changing rainfall and temperature patterns, weather becoming more extreme and the changing distribution of pests and diseases. Production may need to move location to suit climates, irrigation may be necessary and changes to crops and varieties may be required. These adaptations are most difficult for poorer farmers, who are most likely to be affected.

2 Managing water supplies
Managing water supplies ensures populations can face the challenge of changing rainfall patterns. In London, this involves reducing demand (such as installing water-efficient devices) and increasing supply (such as opening a desalination plant). In addition to water supplies being under strain, security may be threatened in areas of deficit, especially where there is less political stability.

3 Reducing risk
Reducing risk from rising sea levels could involve constructing defences (such as the Thames Barrier or restoring mangrove forests), raising properties on stilts or relocating people at risk. There are economic, social and environmental implications of these strategies.

Figure 4.4 Adaptation can help climate change

Revision activity

Write a mnemonic to remember the four mitigation strategies and the three adaptation strategies.

Now test yourself TESTED

1 Define mitigation.
2 Define adaptation.
3 Name two methods of mitigation and adaptation.
4 Describe how water supply can be managed to reduce climate change.

Exam practice

1 Compare mitigation and adaptation. (2 marks)
2 Outline one possible method of climate change mitigation. (2 marks)

5 Ecosystems

5.1 Ecosystems

What is an ecosystem?

REVISED

An **ecosystem** is a natural system that is made up of plants, animals and the environment in which they live. The various components of an ecosystem – climate, water, soil, plants, animals and people – are closely interlinked and depend on one another for survival. If one component changes, there will be knock-on effects within the ecosystem.

It is possible to identify two types of component in an ecosystem:

- **Biotic** – such as plants and animals, bacteria and fungi.
- **Abiotic** – such as climate, water and soils.

A small-scale ecosystem: a freshwater pond

Figure 5.1 is an example of a small-scale ecosystem in the UK. Notice that there are examples of **producers**, **consumers** and **decomposers**. All three are vital components in a healthy and sustainable ecosystem.

Now test yourself TESTED

Identify the producers, consumers and decomposers in Figure 5.1.

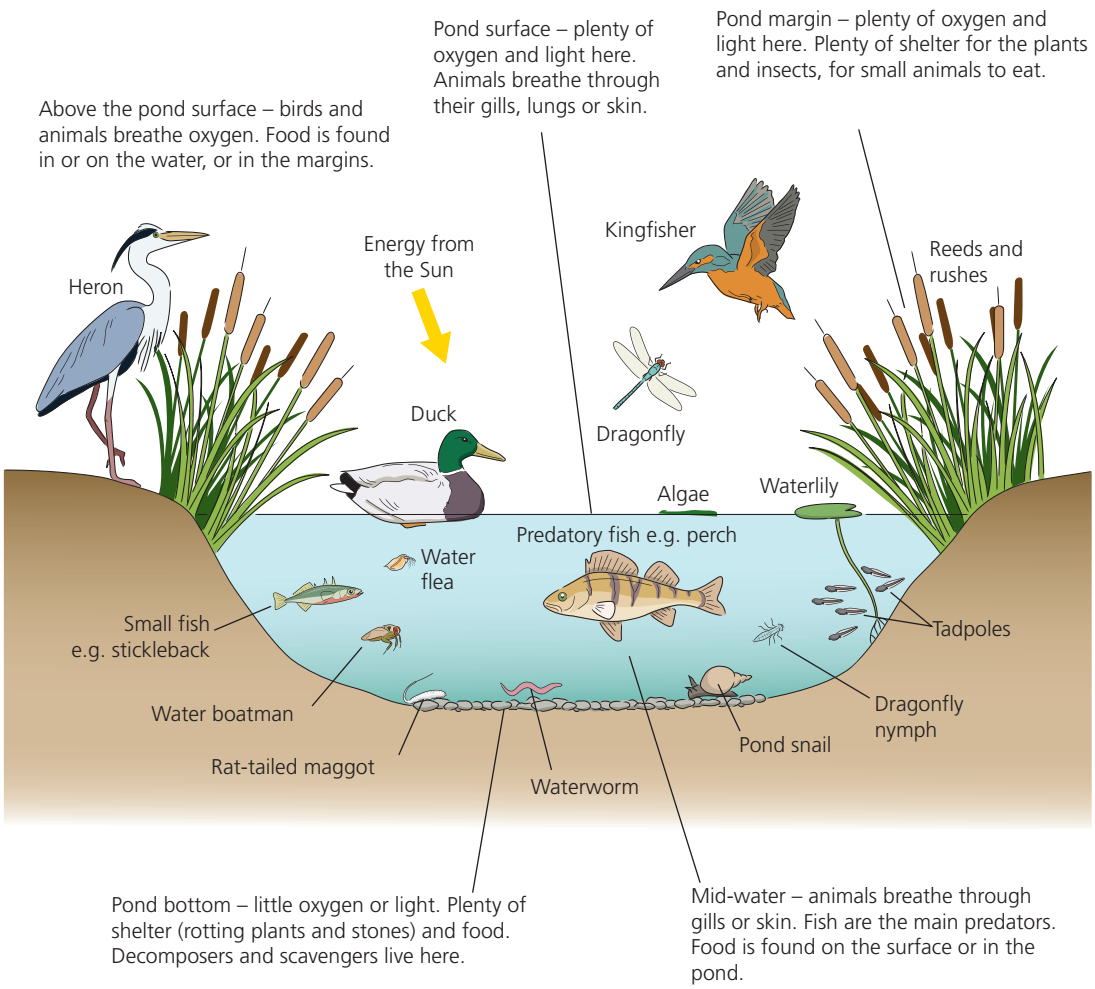


Figure 5.1 A freshwater pond ecosystem

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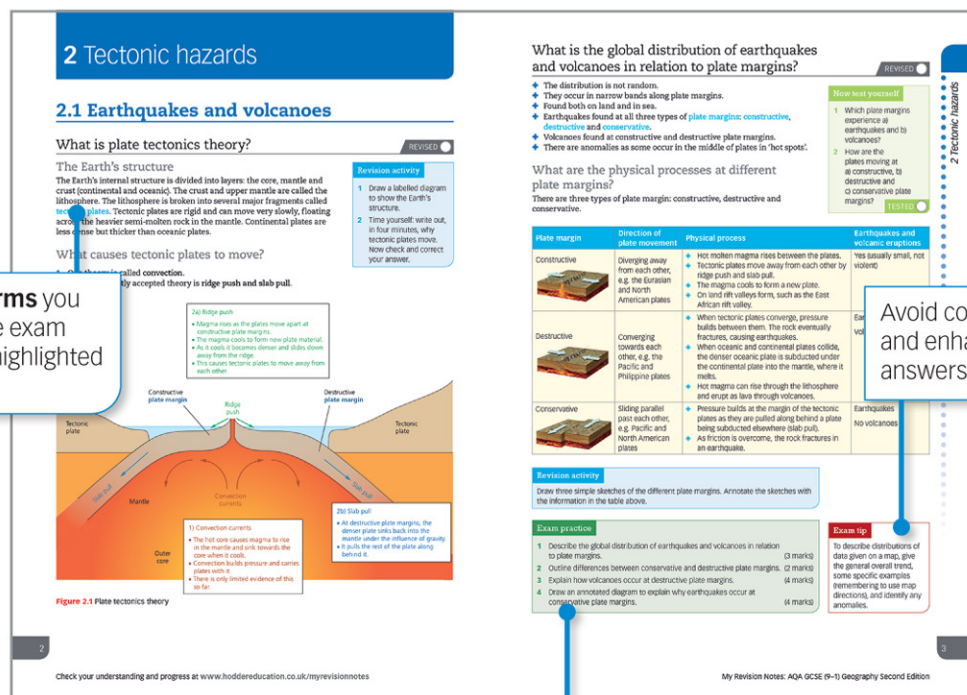

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HODDER EDUCATION

t: 01235 827827

e: education@hachette.co.uk

w: hoddereducation.co.uk

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