Pearson Edexcel

GCSE (9-1) Geography A

GCSE (9-1) Geography A Knowledge Organiser

Paper 1: The Physical Environment

Key ideas and key content: a student guide

This guide is designed to support students on the key content of the GCSE Geography A specification for Paper 1 The Physical Environment. It covers:

- Topic 1: The changing landscapes of the UK
- Topic 2: Weather hazards and climate change
- Topic 3: Ecosystems, biodiversity and management

It can be used to identify gaps in learning, as a personalised checklist to aid revision or as a knowledge organiser.

Component 1: The Physical Environment

This is assessed by Paper 1 (90 minutes). It contains three sections. In Section A, you must answer Question 1 and choose two of three optional questions (Question 2 - Coastal landscapes and processes, Question 3 - River landscapes and processes, Question 4 - Glaciated upland landscapes and processes). You must answer all questions from Section B and C.

<table>
<tr><th colspan="2">Topic 1: The changing landscapes of the UK</th></tr>
<tr><th>Specification key ideas</th><th>Key content</th></tr>
<tr><td rowspan="2">1.1 There are geological variations within the UK.</td><td>The UK is made up of three main rock types.
Sedimentary rocks are formed in layers called beds. Examples include chalk (such as the South Downs) and limestone. They contain fossils.
Igneous rocks are hard and formed of crystals, so they are resistant to erosion. Examples include granite (such as Dartmoor) and basalt.
Metamorphic rocks are formed by heat and pressure. Examples are schist and slate (such as the Lake District).</td></tr>
<tr><td>Geology – The UK is split into two halves geologically. The north-west of the UK is mainly harder igneous and metamorphic rocks, forming upland landscapes. The south-east of the UK is mainly softer sedimentary rocks, forming lowland landscapes.

Plate tectonics – Millions of years ago, the UK was close to plate margins. Plate movements caused mountains (folds) and faults in the rocks.</td></tr>
<tr><td>1.2 A number of physical and human processes work together to create distinct UK landscapes.</td><td>Distinctive upland and lowland UK landscapes result from physical processes.
Glacial erosion and deposition – Glaciers carve out corries and U-shaped valleys.
Weathering – Freeze-thaw action breaks off rock, which forms scree slopes.
Climate – High levels of rain form streams over the impermeable rock surfaces.
River erosion – Meandering rivers erode wide valleys.</td></tr>
</table>

	• **River deposition** – Floods spread out over valley floors, depositing silt and forming floodplains. • **Slope processes** – Mass movement (landslides) and soil creep (gradual movement downhill) cause cliffs to collapse.
	Humans have changed almost all the landscapes of the UK through **farming**, such as hill sheep farming in upland areas and arable farming in fertile lowlands. **Forestry** is managing woodland for timber. The UK would naturally be covered by deciduous woodland. Many UK upland landscapes have been planted with trees for forestry. **Settlements** have influenced landscapes through deforestation to make way for buildings and roads. Wetland areas are sometimes drained, whilst valleys can be flooded to create reservoirs.
1.3 A variety of physical processes interact to shape coastal landscapes.	**Weathering** breaks down rocks but leaves the weathered material **in situ**. There are three types of weathering. • **Chemical** – Rocks reacting with slightly acidic water (acid rain), such as limestone. • **Biological** – Burrowing animals and tree roots widening cracks. • **Mechanical** – Freeze-thaw action – water freezes in cracks, expands and causes the rock to break apart. **Mass movement** is the downhill movement of material under the influence of gravity. An example of this is **slumping**. Waves erode the coast causing change. There are four types of erosion. • **Abrasion** – Waves throw sediment against the coast, wearing it down. • **Hydraulic action** – Waves compress air and water into cracks, widening them. • **Attrition** – Pebbles carried by waves rub together and break into smaller pieces, becoming smoother in the process. • **Solution** – The chemical action of sea water dissolves some rocks. **Longshore drift** is the process by which sediment is **transported** up the beach at the same angle as the wave approach (swash) but is transported back to the sea at right angles to the coastline due to gravity (backwash). Wave transport is influenced by wave energy and sediment size. Waves transport material in the ways listed below. • **Traction** – Large boulders are rolled along the seabed by waves. • **Saltation** – Smaller stones appear to ‘bounce’ along the seabed.

	• **Suspension** – Sand and small particles are carried along in the flow. • **Solution** – Some minerals are dissolved in seawater and carried in the flow. **Deposition** occurs when sediment is deposited as wave energy falls. This happens more when constructive waves are present.
	Concordant coasts are made up of the same rock type. On **discordant** coasts, the rock type alternates, forming headlands and bays. **Joints** and **faults** make rock more prone to erosion. Joints are smaller cracks whereas faults are much larger weaknesses. Coasts with more joints and faults are more likely to erode more quickly. **Constructive waves** have a lower energy and occur in calmer conditions. In a constructive wave, material is deposited, building up the coast. **Destructive waves** have a higher energy. They occur where there is a longer fetch and stronger wind has been blowing for a greater duration. In a destructive wave, the swash is weaker than the backwash. Sediment is pulled into the sea, eroding the coast.
	The UK's four seasons (**seasonality**) have different impacts on coastal erosion. Colder temperatures in the winter lead to freeze-thaw weathering and stronger waves accelerate coastal erosion. **Storm frequency** is high in many parts of the UK, subjecting coasts to stronger winds and destructive waves. Heavy rainfall can saturate cliffs and cause slumping. Spits, sand dunes and beaches can all easily change during strong storms. The **prevailing winds** in the UK are from the south-west. This brings warm, moist air from the Atlantic Ocean and frequent precipitation, adding to weathering and mass movement.
1.4 Coastal erosion and deposition create distinctive landforms within the coastal landscape.	**Headlands** and **bays** develop on discordant coastlines that have a mixture of hard and softer rock. More resistant rocks like chalk are left protruding out in the sea, forming headlands. Softer rocks such as sand and clay are eroded more quickly, forming bays. Headland features include caves, arches, and stacks. • **Caves** are formed when hydraulic action and abrasion erode a weakness in the headland such as a joint or fault. • An **arch** forms when two caves erode from either side of a headland. • A **stack** forms when an arch collapses due to continued erosion at the foot of the arch and weathering at the top. **Cliffs** are common coastal features. Cliffs are shaped through weathering and erosion. Softer rock erodes more easily to form gently sloping cliffs, whereas harder rock erodes more slowly forming

<table>
<tr><td></td><td>steeper cliffs. Abrasion and hydraulic action can form a wave-cut notch making a cliff unstable.

The erosion of cliffs can create wave-cut platforms – areas of flat rock at the base of the cliff.</td></tr>
<tr><td></td><td>Beaches are deposits of sand and shingle and are shaped by erosion, transportation and deposition. Deposition occurs where an area of coastline is sheltered, and wave energy is lower.

Spits are narrow beaches of sand or shingle that are attached to the land at one end. They often extend across a bay or estuary or where there is a change in the coastline direction. They are formed by longshore drift. Longshore drift is the zigzag movement of sediment along a beach. It is driven by prevailing winds, swash and backwash.

A bar forms in same way as a spit. Unlike a spit, however, a bar grows all the way across a bay connecting two headlands. It leaves an area of water called a lagoon between the bar and the mainland.</td></tr>
<tr><td rowspan="3">1.5 Human activities can lead to changes in coastal landscapes, which affect people and the environment.</td><td>Human activities can change coastal landscapes.

Urbanisation
• Building weight makes cliffs more vulnerable.
• Additional drainage decreases soil saturation.
• Urbanisation, promotes the need for sea defences, reducing coastal recession.

Agriculture
• Creates wildlife habitats
• Increases sedimentation
• Increases soil erosion.

Industry
• Increases air, noise and visual pollution
• Can destroy habitats for sea life and birds
• Creates employment opportunities.</td></tr>
<tr><td>The effects of coastal recession and flooding are:

• the loss of people’s homes and businesses (cafes)
• decreasing property values (makes insurance difficult)
• disruption to roads and railways lines (commuters)
• cliffs become dangerous for people
• wildlife habitats can be destroyed.</td></tr>
<tr><td>Hard engineering protects coastlines but spoils the landscape. Soft engineering works with nature to maintain the coastline but is less effective.

Hard engineering Soft engineering</td></tr>
</table>

	• **Sea walls** protect cliffs and buildings but are the most expensive option. • **Groynes** trap sand and build up beaches but lead to increased erosion downdrift as the process of longshore drift is slowed down. • **Rip rap** absorbs wave energy. It is less expensive than a sea wall but restricts beach access. • **Beach nourishment** reduces wave energy and is good for tourism. • **Managed retreat**
1.6 Distinctive coastal landscapes are the outcome of the interaction between physical and human processes.	The Holderness coast, East Riding of Yorkshire is changing. **Significance of location** • Softer boulder clay is easily eroded and prone to slumping following heavy rainfall. Chalk is more resistant at Flamborough Head. • It is exposed to strong waves from the North Sea. **Physical processes** • Coastal erosion – Clay is easily eroded. • Mass movement – Clay slumps after periods of rainfall. • Transport – Destructive waves move sediment away from the coastline. **Human processes** • Hard engineering at Mappleton have protected it from erosion. • Hard engineering has prevented transportation, making erosion worse in other places. **Changes** • Some parts of the coastline are retreating by nearly 2 metres per year. • Farmland, property and houses have been lost to the sea.
1.7 A variety of physical processes interact to shape river landscapes.	**Weathering** is the wearing away **in situ** of the river valley sides. The three types of weathering are listed below. • Chemical – Rocks reacting with slightly acidic water (acid rain) such as limestone. • Biological – burrowing animals and tree roots widening cracks. • Mechanical – Freeze-thaw action – water freezes in cracks, expands and causes the rock to break apart. **Mass movement** is the downhill movement of material under the influence of gravity. The two types of mass movement are listed below. • **Sliding** – Rock and weathered material moves down a slope owing to gravity.

- **Slumping** – A river erodes the bottom of a valley slope, making it steeper. The material above then slides downwards, particularly if saturated.

Rivers **erode** and shape landscapes. The four types of erosion are listed below.

- **Abrasion** – Material carried by the river rubs against the bed and banks wearing them away.
- **Hydraulic action** – The force of the water on the bed and banks removes material.
- **Attrition** – The load carried by the river rubs together and break into smaller pieces, becoming smoother in the process.
- **Solution** – Some rock minerals dissolve in river water.

Transportation is the way in which the river carries eroded material. The four main types of transportation are listed below.

- **Traction** – Large boulders are rolled along the riverbed.
- **Saltation** – Smaller pebbles are bounced along the riverbed.
- **Suspension** – Finer sediment is carried along in the flow.
- **Solution** – Some minerals (such as chalk) are dissolved in the water and carried along. This material can be deposited onto a floodplain during a flood.

A river's long profile shows the height and distance downstream from the river's source to its mouth.

	Upper course	**Middle course**	**Lower course**
Gradient	Steep	Less steep	Shallow
Discharge	Small	Large	Very large
Depth	Shallow	Deeper	Deep
Channel width	Narrow	Widening	Wide
Velocity	Slowest	Fast	Very fast
Valley profile	Steep sides	Gentler sides	Flat, gentle sides
Features	Waterfalls	Meanders	Floodplain
Sediment	Large and angular	Getting smaller and rounder	Small, rounded pebbles

The UK has experienced some extreme weather in recent years. The factors listed below can increase the risk of flooding.

- **Frequency of storms** – Greater periods of heavy, intense rainfall causing rivers to overflow.

	• **Periods of hot, dry weather** – Hardens the soil surface, meaning rain cannot soak in. This increases the surface runoff and river discharge. The list below outlines the impact of climate on rivers. • Discharges will be greater in wetter climates. Hotter temperatures mean greater evaporation, so less discharge. • The erosion rate will be higher with greater discharge. • The transport rate will be greater when the energy of the water is greater. • The weathering of rocks will be greater where temperatures range from just above to just below freezing (freeze-thaw weathering).
1.8 Erosion and deposition interacting with geology create distinctive landforms in river landscapes.	In the upper course, rivers erode vertically. This forms three distinct landforms. • **Interlocking spurs** – At its source, a river has limited energy and naturally flows around ridges of more resistant rock. • **Waterfalls** – Form where there is a layer of more resistant rock overlying a less resistant rock. The less resistant rock is eroded by hydraulic action and is undercut. The overhang eventually collapses to leave a waterfall. • **Gorges** – Over time, the continued undercutting and collapsing means that the waterfall retreats, forming a gorge.
	In the middle course, a river erodes laterally as the velocity increases. This causes the channel to become wider and deeper. The river starts to bend, which is called a meander. On the outer bend of a meander, where the velocity is greater, erosion forms a **river cliff**. On the inside of a meander, the velocity is slower due to increased friction, and sediment is deposited. This forms a **point bar** (made up of sand, silt and pebbles). **Ox-bow lakes** form as the neck of a meander narrows and eventually erodes through. The water now takes the quickest route, and deposition cuts off the old meander leaving behind an ox-bow lake.
	Depositional processes in the lower course produces two distinctive landforms, listed below. • A **floodplain** is shaped by meanders and lateral erosion. During floods the river deposits sediment, forming the floodplain. • The deposition during flooding continues until eventually embankments are created at the side of the river, forming **levees**.
1.9 Human activities can lead to changes	Human activities lead to changes in river landscapes **Urbanisation** Increases **impermeable** **Agriculture** • Deforestation and field drainage **Industry** • A big user of water that can reduce

in river landscapes which affect people and the environment.	surfaces, increasing surface run-off, increasing discharge. transports water more quickly into streams and rivers. • Water is extracted from rivers for irrigation. the amount erosion. • Chemical waste can pollute rivers. Physical causes of flooding can include the factors listed below. • **Rainfall intensity** – Large amounts of rainfall reduces soil **infiltration**. • **Geology** – **Impermeable** rocks means water cannot **percolate** from above. • **Snowmelt** – During spring, snow melts adding more water to a river. • **Drainage basin** – Steep-sided valleys carry water into a river system quicker. Human causes of flooding include: • **urbanisation** – more impermeable surfaces • **deforestation** – less interception and greater surface run off. The **physical effects** of flooding include soil erosion and loss of wildlife habitats. The **human effects** include loss of life, economic damage/financial loss, damage to property, loss of jobs and disruption to farming and transport.
	Hard engineering involves building structures as a defence against flooding. • **Dams** and **reservoirs** are barriers constructed to hold back water. They store large volumes of water until it is needed and can be used to generate hydro-electric power. However, they are expensive, and sediment can build up in reservoirs. • **Channelisation** straightens and/or widens the river channel allowing water to flow more quickly from the area at flood risk. However, water moves more quickly downstream, increasing the flood risk to other settlements. Soft engineering uses natural processes to protect against river flooding. • **Floodplain zoning** prevents development in areas most at risk to flooding. This reduces the number of homes at risks and allows infiltration to take place. • **Washlands** are areas adjacent to rivers that are deliberately flooded in order to avoid flooding of residential areas and important farmland.
1.10 Distinctive river landscapes	The River Dee flows south-east from its source in Snowdonia, Wales. **Human factors causing change**

are the outcome of the interaction between physical and human processes.	• Channelisation has improved navigation but has increased velocity and discharge. • A series of reservoirs has been constructed. • Embankments have been built up along the middle course to protect agricultural land and property. **Physical factors causing change** • As the river meanders, floods and deposits sediment, it has changed course over time. • Rising sea levels could replace freshwater marsh landscapes. • In the Dee Estuary, rising sea levels could destroy the landscape and habitats.
1.11 A variety of physical processes interact to shape glaciated upland landscapes.	Post-glacial processes are still shaping upland landscapes today. • **Soil movement** – Saturated soil particles move downwards due to gravity. Frost action weakens the soil, acting as a slipping plane. • Rock falls/slides – More rapid movement of loosened rocks cause by freeze-thaw weathering. Glaciers erode upland landscapes in two ways. • **Abrasion** – Small, jagged rocks embedded in the glacier wear away at the sides and bedrock. Larger fragments causes scrapes called **striations**. • **Plucking** – Blocks of loosened rock freeze to the glacier and get pulled out as the glacier moves down the valley. Glaciers move in two ways. • **Basal sliding** – Meltwater at the base of the glacier acts as a lubricant, helping the glacier move downhill. • **Internal flow** – Ice crystals within the glacier slide over each other, changing the shape and size. Glacial deposition occurs mainly when the ice melts. • **Fluvioglacial material** is the sediment that is deposited by streams flowing from the melting glacier. • **Till deposits** occur when material is deposited directly by the ice.
	Freeze-thaw weathering also shapes glaciated upland landscapes. Water fills a crack or joint in the rock. As the water freezes, it expands and widens the crack. This causes blocks of rock to break off, which forms scree slopes.
	The UK weather and climate affect processes that impact on glaciated upland landscapes. **Past climates** The last significant ice age in the UK ended around 10-12 thousand years ago, whereby glaciers created U-shaped valleys in upland landscapes such as the Lake District.

	Current climate • Seasonality – In the winter, freeze-thaw weathering will form scree slopes. • Diurnal temperature variations will increase freeze-thaw weathering in a 24-hour period.
1.12 Glacial erosion and deposition create distinctive landforms within glaciated upland landscapes.	Distinct landforms in glaciated upland landscapes are a result of glacial erosion. • **Corries** and **tarns** form when snow accumulates in a hollow and is compressed into ice. As the weight of the ice increases and begins to move, it deepens the hollow forming a corrie. After a glacial period, glacial meltwater is trapped in the corrie (by the lip) forming a tarn. • **Aretes** are steep-edged ridges formed when the back of two corries meets. Freeze-thaw and glacial erosion make the ridge steeper. • **Roche moutonnee** form where abrasion has smoothed the upstream side of a band of rock and plucking has roughened the downstream side. • A **glacial trough** is a large U-shaped valley. A glacier changes the shape from a V-shaped valley to U-shaped valley through abrasion and plucking. As the glacier erodes the valley sides, it can cut off interlocking spurs, leaving **truncated spurs** and **hanging valleys**. A hanging valley hangs above a larger one; if it has a river, the water will pour down into the larger valley as a waterfall.
	When a glacier melts, it deposits eroded material called **moraine**. **Terminal moraine** occurs at the snout (end) and marks the furthest point of a glacier. **Ground moraine** is deposited (**boulder clay** or **till**) on the valley floor as a glacier loses energy.
	A **drumlin** is an elongated hill of glacial deposits that is shaped like an egg. They form beneath the ice in lowland area. The steeper side of the drumlin, called the **stoss**, faces the direction of ice flow whereas the elongated end, called the **lee**, is caused by erosion. A **crag** and **tail** is a landform consisting of a rock hill and an elongated ridge. It forms when a glacier is forced over a band of resistant rock. Erosion forms the 'crag' and deposition creates the 'tail'.
1.13 Human activities can lead to changes in glaciated upland landscapes.	Over time, glaciated upland landscapes have been shaped by human activity. • **Settlements** – It is difficult to build owing to the steep terrain and access, so settlements are often small farming communities and holiday homes. Usually found on the wide, flat valley floor. Deforestation takes place to make way increasing soil erosion and changing the landscape. • **Farming** – The hills are used for sheep and cattle farms. Overgrazing can increase soil erosion.

	• **Forestry** – In some areas, conifers are planted to reduce soil erosion. However, they can unbalance ecosystems, forcing species to migrate.
	Development of glaciated upland landscapes • Glaciated valleys have been used to create reservoirs for **water storage** and supply in order to provide water for towns and cities. However, they can destroy habitats and look unappealing. • Glaciated landscapes are popular for **recreation** and **tourism**. This increases jobs for local people, but walkers can increase soil erosion. • Dams and reservoirs can provide **renewable energy** (HEP) generating energy which does not produce any carbon emissions into the atmosphere. However, they can spoil the landscape. • **Conservation** helps to protect ecosystems that contain plants and wildlife. However, they can be expensive to maintain.
1.14 Distinctive glaciated upland landscapes are the outcome of the interaction between physical and human processes.	Snowdonia **National Park**, located in North Wales, consists of sedimentary, metamorphic, and igneous rocks. Weathering and glacial erosion has formed a distinct glaciated landscape, including corries and glacial troughs. Slate **mining** was once an important industry in Snowdonia, changing the landscape by leaving large scars of waste tips and terraces. The large volume of **tourists** also changes the landscape, eroding footpaths and increasing surface run-off. Popular villages often become congested with visitors, increasing noise and air pollution.

Topic 2: Weather hazards and climate change	
Specification key ideas	**Key content**
2.1 The atmosphere operates as a global system transferring heat and energy.	As you move further away from the Equator, Earth receives less solar radiation. There is more heat at the Equator and less at the Poles. A Hadley cell, Ferrel cell and Polar cell in each hemisphere redistributes this heat energy. 1. At the Equator, warm air rises forming low pressure (causing rainfall). The air cools, diverges and moves 30° north and south of the Equator where the now cooler and dry air sinks to form high pressure (deserts). 2. Some of the cool air moves back towards the Equator (trade winds), the rest travels across the lower part of the Ferrel cell to 60° north and south of the Equator. 3. At 60°, the warmer air meets the cold polar air. The warmer air rises (forming low pressure and causing rainfall) and

	travels towards the Poles. The now cold dry air sinks at the Poles forming high pressure. Ocean currents also transfer heat from the Equator. Surface currents move warmer water towards the Poles where the dense, salty water sinks. Deeper ocean current moves the colder water back towards the Equator. Oceans currents such as the North Atlantic Drift prevent the Poles from becoming too cold and the Equator too hot.
2.2 The global climate was different in the past and continues to change due to natural causes.	Earth's climate has naturally changed over time, creating both warmer and colder periods. Over the last 2.6 million years (the **Quaternary Period**), there have been more than 60 cold periods, lasting about 100,000 years each. Warmer interglacial periods (in between) typically last about 15,000 years. We are currently in an interglacial period. Over the last 200 years the Earth's temperature has risen quicker than it has before.
	There are several natural causes for past climates. • **Milankovitch cycles** change how much solar radiation the Earth receives. The Earth's orbit changes from a circular orbit to a more elliptical (oval) cycle leading to greater seasonality. This is known as **eccentricity**. **Axial tilt** also changes: the greater the tilt, the greater the angle causing colder winters. Lastly, **precession cycles**, change the direction the axis is facing affecting seasonal temperatures. • **Solar variation** levels vary. Higher levels of solar radiation cause interglacial periods whereas lower levels cause glacial periods. • **Volcanic eruptions** emit ash and dust into the atmosphere blocking out the sun causing temperatures to fall. The evidence for natural climate change includes: • fossilised animals • U-shaped valleys • samples from ice that contain trapped carbon dioxide • historical records such as old paintings or diaries.
2.3 Global climate is now changing as a result of human activity.	Human activity increases carbon dioxide and methane levels in the atmosphere, trapping heat energy from the sun and enhancing the **greenhouse effect**. The list below includes examples of human activity. • **Industry** – Burning fossil fuels (coal, oil and gas) to produce consumer goods. • **Energy** – Electricity produced from fossil fuels for a growing population. • **Farming** – A growing demand for more meat increases methane levels. • **Transport** – Increased car ownership and air travel increase emissions.

	The list below includes negative impacts of climate change on the environment. • **Rising sea levels** from melting ice sheets and glaciers. Melting ice could also cause the Gulf Stream (an ocean current) to move further south, cooling temperatures in Western Europe. • **Coastal flooding** could contaminate ecosystems with salt water. • **Retreating glaciers** contribute to rising sea levels. The list below includes negative impacts of climate change on people. • Unreliable rainfall in regions such as the Sahel (Africa) could cause drought and lower **crop yields**, leading to food shortages. • **Flood risk** from rising sea levels in low-lying places such as the Maldives could force people to leave, losing their homes and livelihoods.
2.4 The UK has a distinct climate which has changed over time.	The UK's climate has changed in the past. One thousand years ago, during the **Medieval Warm Period** (owing to increased solar radiation), higher temperatures meant greater crop yields. More recently, the **Little Ice Age** during the 1600s (owing to volcanic activity), temperatures were low enough to freeze the River Thames.
	There are significant spatial variations within the UK. • North-west Britain has mild winters and mild summers. • North-east Britain has cold winters and mild summers. • South-west Britain has mild winters and warm summers. • South-east Britain has cold winters and warm summers.
	The UK lies between 50°N and 60°N of the equator. This and other factors affect its climate. 1. **Maritime influence** – As an island, the air around the UK contains lots of moisture, leading to rainfall all year. 2. **Prevailing wind** – South-westerly winds from the Atlantic Ocean bring moisture and rainfall. 3. **North Atlantic Drift** – This ocean current brings warm water and a milder climate to the UK for its latitude. 4. **Atmospheric circulation** – The UK sits between the Ferrel and Polar cells where air rises and forms low pressure bring rainfall. 5. **Altitude** – Higher regions in the UK (north and west) receive more rainfall.
2.5 Tropical cyclones are extreme weather events that develop	Tropical cyclones (Indian Ocean), hurricanes (Atlantic Ocean) and typhoons (Pacific Ocean) need a source of warm water that is over 26.5°C. 1. This causes warm, moist air to rise forming thunderstorms.

under specific conditions and in certain locations.	2. Low pressure forms in the middle as the storms converge together. 3. The storms rotate owing to Earth's rotation (**Coriolis effect**). As they rise inwards and upwards, tropical cyclones form.
	The characteristics off tropical cyclones are: • Low pressure • Rising rotating air surrounding a calm **eye** in which air descends • A width up to 400km and height up to 10km. Tropical cyclones are more likely to happen from June to November in the northern tropics and November to April in the southern tropics. Tropical cyclone movement is determined by prevailing winds and ocean currents. A cyclone's **track** is influenced by how far it travels – they can travel up to 600 km a day. They are monitored using satellite images.
2.6 There are various impacts of and responses to natural hazards caused by tropical cyclones depending on a country's level of development.	The hazards listed below are associated with tropical cyclones. • **Storm surges** – Low pressure causes a large mass of water to surge inland. • **Landslides** – Saturated soil becomes heavy and slides downhill. • **Coastal flooding** – Damage to property and potential loss of life. • **Intense rainfall** – Heavy rainfall can lead to flooding, stranding people. • **High winds** – Strong winds can uproot trees and damage buildings.
	Hurricane Sandy hit New Jersey and New York City (NYC) in north-east USA on 29 October 2012. The USA is an example of a developed country. Storm surges flooded large parts of the East Coast states. Social media helped with the assessment as images were loaded onto platforms such as Twitter. The hurricane's impact was: • economic – property damages of US$65 billion and a petrol shortage • social – 150 people died, homes were damaged and schools closed for days • environmental – nature reserves were damaged and there were sewage leaks in NYC. Responses included the American Red Cross providing aid and the government supporting victims, as well as a charity concert that included many famous performers.
	Typhoon Haiyan formed on 2 November 2013 close to Micronesia. Micronesia is an example of an emerging country. Most damage

	was on the islands of Samar and Leyte, with flooding and landslides in the Philippines. The hurricane's impact was: • economic – damage costing US$2 billion. Damaged infrastructure made aid difficult • social – over 6000 people were killed and 600,000 were made homeless • environmental – mangroves and forests were damaged. Responses included relief aid from the UK and Canada. The World Health Organisation assisted the Philippines and governments provide loans and grants for water and shelter.
2.7 The causes of droughts are complex with some locations more vulnerable than others.	In **arid** areas, the climate is dry owing to high pressure. Arid environments have permanent low precipitation such as the Sahara Desert. **Drought** conditions occur when there are low precipitation conditions. In the UK, this is 15 consecutive days without rainfall.
	The list below includes natural causes of drought. • **Meteorological** – This is where an area receives less than average precipitation. • **Hydrological** – This is where the hydrological cycle receives less rainfall than normal leading to less groundwater. The list below includes human causes of drought. • **Deforestation** – Can reduce evaporation as there are less trees to transpire. • **Dams** – Restrict water flow downstream causing drought conditions. • **Agriculture** – Water extraction for irrigation.
	Global circulation makes some locations more vulnerable to drought. At 30° north and south of the equator between the Hadley and Ferrel cells, air descends forming high pressure and little rainfall.
2.8 The impacts of, and responses to drought vary depending on a country's level of development.	Droughts are hazardous to people. They can lead to **crop failure** and famine, water shortages and **contamination** of water and **wildfires**.
	California (western USA, a developed country) has been experiencing drought since 2012. Groundwater levels have fallen, land has been contaminated as salt is drawn in from the ocean and beneath, and wildfires have destroyed vegetation. The impact included: • low river levels for fish and breeding • wildlife habitats and people's property destroyed by wildfires

	• reduced crop production and incomes. The government have run water education programmes and imposed a law to cut water use by 25%. Farmers are encouraged to use drip irrigation and homeowners to repair leaks.
	Ethiopia, a developing country, often suffers from drought. In 2015, it suffered its worst drought since the 1980s. 85% of the population live in rural areas and rely on agriculture. The main hazards are a loss in crop yields, leading to malnutrition, and longer journeys to find water resulting in children not going to school. The impact included: • death of livestock and crop failure making the population weaker • girls missing out on education having to walk further to collect water • spread of diseases among humans and wildlife owing to a lack of clean water. The USA government gave over US$100 million in food aid. Aid agencies like Oxfam have assisted in helping people obtain water and raise awareness and money.

Topic 3: Ecosystems, biodiversity and management	
Specification key ideas	**Key content**
3.1 Large-scale ecosystems are found in different parts of the world and are important.	Large-scale ecosystems (biomes) are found in different parts of the world. • **Boreal biome** – Mostly pine forests at higher latitudes where the Sun's rays are weaker. For example, Canada. • **Temperate forests** – Deciduous forests with seasonal variations, losing their leaves in the winter. For example, the UK. • **Tundra biome** – Within the Arctic circle, the Sun gives off little energy and there is little precipitation. For example, northern Canada. • **Desert biome** – Close to the tropics, the Sun's energy is concentrated, making it hot during the day. For example, the Sahara in North Africa. • **Tropical rainforest** – Found within the tropics where it is hot and wet. For example, the Brazilian rainforest. • **Temperate grasslands** – Hot in summer and very cold in winter, with rainfall in late spring and summer. For example, mid-USA. • **Tropical grassland** – mostly in the tropics – hot all year but always with a dry season. For example, Kenya.

	Climate 1. **Temperature** – Growing seasons are much longer in warmer locations; the further you move away from the Equator the shorter they become. 2. **Precipitation** – The global circulation system influences precipitation. For example, low pressure found between the Hadley cells where warm air rises causing rain. 3. **Sunshine hours** – Lower amounts of sunshine towards the Poles at certain times of the year means less sunlight for photosynthesis. Local factors: 1. **Rock and soil type** – Different vegetation can grow in the same ecosystem owing to different types of rock and soil. 2. **Altitude** – The higher the altitude, the lower the temperature. This means that different plants can grow within the same ecosystem.
3.2 The biosphere is a vital system.	The biosphere provides vital resources for people. **Food** from the biosphere includes: • Fruits, nuts, and berries • Land for growing crops • Fish and meat. **Energy** resources from the biosphere includes: • Animal dung for burning • Trees (wood) • Fermenting crops (bioethanol). **Medicine** from the biosphere includes: • Poppies (morphine) • Vitamin C (oranges) • Aloe plant (skin creams). **Building** materials from the biosphere include: • Straw for roofing • Timber for construction • Animal dung mixed with clay. **Water** from the biosphere • Water moves through living organisms. **Minerals** from the biosphere include: • Iron ore • Silver • Copper.
3.3 The UK has its own variety of distinctive ecosystems that it relies on.	The UK has four main terrestrial ecosystems. 1. **Moorlands** – Heather woodland, peat bogs and rough grassland, found mostly in upland areas of Scotland and northern England. 2. **Heaths** – a mixture of marshes and dry, sandy heathland found in lowland areas of southern England. 3. **Woodlands** – Remaining ancient woodlands (for example, birch and oak) such as those in north-east Scotland. 4. **Wetlands** – Waterlogged soils mainly located in Scotland and East Anglia.

<table>
<tr><td></td><td>UK marine ecosystem importance
Tourism – provides jobs and an income for the local economy.
Energy – wind energy is reducing the UK's reliance on fossil fuels.
Fishing – marine ecosystems provide jobs in the fishing industry.</td><td>UK marine ecosystem degradation
Coastline developments destroy wildlife habitats. For example, salt marshes.
Climate change introduces new species, which changes food webs.
Overfishing (for example, cod) damages the food chain.
Fertilisers lead to eutrophication, damaging food chains.</td></tr>
<tr><td rowspan="5">3.4 Tropical rainforests show a range of distinguishing features.</td><td colspan="2">Biotic and abiotic components depend on each other.
Biotic components – Living parts of the ecosystem. For example, plants and animals.
Abiotic components – Non-living parts of the ecosystem. For example, soil and water.
Indigenous tribes hunt animals and gather food as well as taking part in small-scale farming. However, soil quality is poor because of leaching. Heavy rainfall washes the nutrients away with it as it flows through the soil.</td></tr>
<tr><td colspan="2">The Gersmehl model illustrates how nutrients are transferred between three key stores – biomass, litter and soil. Biomass is the largest store – nutrients are recycled quickly because of the hot and wet conditions, which leads to rapid plant growth and decomposition of dead matter. Soil and litter stores are much smaller in comparison.</td></tr>
<tr><td colspan="2">The tropical rainforest is the most diverse and productive ecosystem. It has a distinct layered structure providing habitats for a range of species. The hot and wet conditions, and year-round sunshine are excellent for photosynthesis.</td></tr>
<tr><td>The list below includes examples of animal adaptations.
Monkeys have evolved with strong grips and long tails for balancing to collect fruit and nuts from the tall main canopy.
Many species are camouflaged to blend in</td><td>The list below includes examples of plant adaptations.
Buttress roots which provide stability for trees that can grow up to 40 metres height.
Tree roots are shallow to gain any nutrients from the top layer of soil.
Plants have drip tip leaves so that water runs off, preventing rotting.</td></tr>
</table>

	with the surroundings, such as geckos. • Parrots and macaws have powerful beaks to break open nuts.	
3.5 Tropical rainforest ecosystems provide a range of goods and services, some of which are under threat.	Tropical rainforest **goods** include: • food such as fruit and nuts for indigenous tribes • a range of plant species for medicines • timber for furniture, construction, and fuels. Tropical rainforest **services** include: • a home for indigenous tribes • a source of income through tourism • a carbon store – removes CO_2 from the atmosphere.	
	Effects of climate change are listed below. • **Functioning** – Longer periods of drier conditions could stop 'cloud functioning'. • **Biodiversity** – Less rainfall, which could threaten the survival of plants and animals, leading to the invasion of other non-tropical rainforest species. • **Structure** – Drier conditions slow down the process of decomposition, reducing the biomass store.	
	Causes of tropical rainforest deforestation are listed below. • **Population growth** – Urbanisation and agricultural needs means that land is cleared to meet needs. • **Cattle ranching** is the biggest cause of deforestation in the Amazon. Large areas of land are needed for cattle to graze. • **Palm oil plantations** – Large areas are cleared for palm oil, as the demand for foods and cosmetics grows for an increasing population. • **Mining** – Valuable minerals are found in the tropical rainforest, such as iron ore.	
	Ecotourism is one way that helps manage tropical rainforest. It can help educate local inhabitants, workers and tourists about the importance of conservation. Income generated from tourists can be reinvested into conservation. It also creates jobs, such as guides. **National Forests** also help manage tropical rainforests by protecting biodiversity through government policy. 'Reduced-impact logging' (RIL) can be more profitable than large clearance and is more sustainable. This is also known as selective logging.	
3.6 Deciduous woodlands show a range of distinguishing	Deciduous woodlands also have distinct biotic and abiotic characteristics. • **Abiotic** – The non-living part of a biome, which includes the atmosphere, water, rock and soil.	

<table>
<tr><td rowspan="5">features.</td><td colspan="2">• Biotic – The living part of a biome, which is made up of plants (flora) and animals (fauna).</td></tr>
<tr><td colspan="2">The Gersmehl model illustrates that in deciduous woodlands, biomass and soil stores are larger than the litter store. The litter store is smaller owing to decomposition.</td></tr>
<tr><td colspan="2">Deciduous woodlands have less biodiversity compared to the tropical rainforest because of:
• less nutrient cycling in winter due to colder temperatures and less sunlight
• smaller size ecosystem than the tropical rainforest
• higher latitude, which means a lower temperature and less sunlight hours, so less photosynthesis.</td></tr>
<tr><td colspan="2">Deciduous woodlands have four distinct seasons, forcing plants and animals to adapt.</td></tr>
<tr><td>Animal adaptations include:
• birds which migrate away in the winter to warmer climates
• squirrels who store food by burying it in the summer to use in winter
• some animals that hibernate in the winter, such as hedgehogs.</td><td>Plant adaptations include:
• trees which spread their branches for greater sunlight
• broad thin leaves which absorb maximum sunlight
• large, deep roots which reach nutrients and groundwater
• leaves which drop in the winter to reduce transpiration and conserve water.</td></tr>
<tr><td rowspan="3">3.7 Deciduous woodlands ecosystems provide a range of goods and services, some of which are under threat.</td><td colspan="2">Deciduous woodland goods include:
• Wood used for fires and stoves in the winter
• Wood pellets used in power stations (biofuel)
• Timber used in the construction industry (roofing).

Deciduous woodland services include:
• Carbon storage – Removes CO_2 from the atmosphere
• Protection of plants and animal species
• Recreation – Used for cycling, walking and picnics.</td></tr>
<tr><td colspan="2">Some effects of climate change are listed below.
• Structure – Rising temperatures and drier conditions which increase the risk of forest fires destroying wildlife habitats.
• Functioning – Periods of drought which could threaten the survival of deciduous trees and make them vulnerable to disease.
• Biodiversity – milder winters which could also threaten species as pests survive, causing a rise in diseases.</td></tr>
</table>

	Some causes of deciduous woodland deforestation are listed below. • **Agricultural change** – Increased demand putting pressure on ancient woodlands. • **Urbanisation and population growth** – Pressure on the countryside where houses are sought after. • **Timber extraction** – Faster growing and more profitable trees reduce biodiversity.
	National Parks protect deciduous woodlands through **sustainable management**, such as the New Forest. Protection strategies are listed below. • **New trees planted** to replace those cut down. Private landowners are **funded to plant native species**. • **The Green Leaf Tourism Scheme** promotes the use of local products and businesses dedicate land for wildlife and recreation. • **Careful management** by the **National Park Authority (NPA)** provides dedicated walk and cycle routes in fragile areas.