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**Knowledge Rich Curriculum Plan**

Geography Y12 22/23



| **Topic 1: Tectonic Processes and Hazards**  **Enquiry question 1: Why are some locations more at risk from**  **tectonic hazards?** | |
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| **Key Idea** | **Intended Knowledge:**  **Key vocabulary identified and underlined in intended knowledge.**  *Students will know that…* | | **Prior Knowledge:**  *In order to know this students, need to already know that…* |
| The global distribution of tectonic hazards can be explained by plate boundary and other tectonic processes. | * The global distribution and causes of earthquakes, volcanic eruptions and tsunamis are mainly along plate margins. * The distribution of **plate boundaries** resulting from divergent, convergent and conservative plate movements (oceanic, continental and combined situations follow these patterns, and can be found at specific locations worldwide. * Not all tectonic events follow these patterns, there are clear **anomalies.** * **Intraplate earthquakes** are caused by stresses within a plate. Since plates move over a spherical surface, zones of weakness are created. Quakes can happen along these zones of weakness E.g. India 2001 * Hawaii is created by a **hot spot**: There is a plume rising under the surface which creates a hotspot on the surface. Over millions of years magma has cooled and created land. | | Students will have an understanding of plate tectonics from GCSE. |
| There are theoretical frameworks that attempt to explain plate movements. | * The modern Theory of Plate Tectonics has been informed and created by the body of geological and geophysical work that proceeded it. The most famous part in the timeline of tectonic movements is Wegener’s theory of **continental drift** and the theory of Pangea. * The current theory of seafloor spreading is evidenced by **palaeomagnetism**: The concept that Earth’s magnetic field can reverse at different times. * These stripes corresponded to times when the Earth’s magnetic field had reversed from North to South and so on, and iron particles in the erupting magma either side of the ridge cooled and aligned themselves with the Earth’s polarity at that time. * Wilson Cycles: The theory behind the cycle is that if continents move (rift) apart to form ocean basins then other oceans must close. * Evidence of these processes can be seen at each of the main plate margins, e.g. seafloor spreading can be observed at the **mid-Atlantic ridge.** * The **Benioff Zone** is an area of seismicity corresponding with the slab being thrust downwards in a subduction zone. The Benioff Zone is the site of intermediate/deep-focused earthquakes. This theoretical framework is an important factor in determining earthquake **magnitude** as it determines the depth and position of the hypocentre * **Volcanic eruption (VEI scale)** is determined by magma composition, which is in turn decided by plate margin. For example, at a **subduction zone** the magma will have a higher silica content and produce a more explosive eruption. | | * The global distribution and causes of earthquakes, volcanic eruptions and tsunamis are mainly along plate margins. * The distribution of plate boundaries resulting from divergent, convergent and conservative plate movements (oceanic, continental and combined situations follow these patterns, and can be found at specific locations worldwide. |
| **Physical processes explain the causes of tectonic hazards.** | * **P-Waves: Primary waves**. The fastest, (rate of about 8 km/sec) so they arrive first. Cause the least damage * **S-Waves: Secondary waves**. Arrive next (about 4 km / sec). Shake the ground violently, causing damage. * **L-Waves:** Arrive last, as they travel only on the surface - 'vibration occurring in the horizontal plane'. They have a large amplitude and cause significant damage, including fracturing the ground surface. * Volcanoes cause lava flows, pyroclastic flows, ash falls, gas eruptions, and secondary hazards (lahars, jökulhlaups). * The magnitude and the scale of the hazards varies depending on eruption type. For example, a Hawaiian eruption may only cause lava flows. * Tsunamis can be caused by sub-marine earthquakes at subduction zones as a result of sea-bed and water column displacement. * CASE STUDIES: Two Volcanoes and one tsunami event. Pupils to choose in independent study. | | * Evidence of these processes can be seen at each of the main plate margins, e.g. seafloor spreading can be observed at the mid-Atlantic ridge. * The Benioff Zone is an area of seismicity corresponding with the slab being thrust downwards in a subduction zone. The Benioff Zone is the site of intermediate/deep-focused earthquakes. This theoretical framework is an important factor in determining earthquake magnitude as it determines the depth and position of the hypocentre * Volcanic eruption (VEI scale) is determined by magma composition, which is in turn decided by plate margin. For example, at a subduction zone the magma will have a higher silica content and produce a more explosive eruption. |

| **Topic 1: Tectonic Processes and Hazards**  **Enquiry question 2: Why do some tectonic hazards develop into disasters?** | | | |
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| **Key Idea** | **Intended Knowledge:**  *Students will know that…* | **Prior Knowledge:**  *In order to know this students, need to already know that…* |
| **Disaster occurrence can be explained by the relationship between hazards, vulnerability, resilience and disaster** | * **Hazard**: a perceived natural event that has the potential to threaten both life and property. * **Disaster**: the reality of a hazard happening; when it causes a significant impact on a vulnerable population. * Deggs model suggests that disaster occurs when a geophysical event overlaps with a vulnerable human population. * The hazard-risk equation attempts to capture the various components that influence the amount of risk that a hazard may produce for a community or population. * 𝑅𝑖𝑠𝑘=𝐻𝑎𝑧𝑎𝑟𝑑 ×𝐸𝑥𝑝𝑜𝑠𝑢𝑟𝑒 × 𝑉𝑢𝑙𝑛𝑒𝑟𝑎𝑏𝑖𝑙𝑖𝑡𝑦/𝑀𝑎𝑛𝑎𝑔𝑒𝑎𝑏𝑖𝑙𝑖𝑡𝑦 * Risk can be impacted by **unpredictability** of hazards, lack of alternatives and the Russian roulette situation. * Age is significant in **resilience**; dependent groups of children and elderly people are likely to suffer much more during times of disaster. * The basis for the PAR model (also known as the Disaster Crunch Model) is that a disaster is the intersection of two processes: Processes generating vulnerability on one side, and the natural hazard event on the other. * The model highlights the three stages of vulnerability: * Root Causes: These include poor political and economic governance, which results in limited access to power, structures and resources. * Dynamic Pressures: Rapid urbanisation has happened faster than local institutions can keep up. This has exacerbated the root problems. * Unsafe conditions: A location can be at more risk due to its proximity to hazard events, but also due to low disaster preparedness and socio-economic constraints. * Economic impacts are roughly proportional to the land area exposed to the hazard. * Economic hazards need to be contextually considered taking into account: level of development, insurance rates, number of people affected and land value. * CASE STUDIES: 2 LIC’s vs 2 HIC’s. Independent study. | * The magnitude and the scale of the hazards varies depending on eruption type. For example, a Hawaiian eruption may only cause lava flows. * The Benioff Zone is an area of seismicity corresponding with the slab being thrust downwards in a subduction zone. The Benioff Zone is the site of intermediate/deep-focused earthquakes. This theoretical framework is an important factor in determining earthquake magnitude as it determines the depth and position of the hypocentre * P-Waves: Primary waves. The fastest, (rate of about 8 km/sec) so they arrive first. Cause the least damage * S-Waves: Secondary waves. Arrive next (about 4 km / sec). Shake the ground violently, causing damage. * L-Waves: Arrive last, as they travel only on the surface - 'vibration occurring in the horizontal plane'. They have a large amplitude and cause significant damage, including fracturing the ground surface. |
| Tectonic hazard  profiles are  important to an  understanding of  contrasting  hazard impacts,  vulnerability and  resilience. | * The magnitude and intensity of tectonic hazards is measured using different scales (Mercalli, Moment Magnitude Scale (MMS) and Volcanic Explosivity Index (VEI). * A **hazard profile** compares the physical processes that all hazards share and helps decision makers to identify and rank the hazards that should be given the most attention and resources. * Hazard profiles define the characteristics of earthquakes, volcanoes and tsunamis using the measures identified -**magnitude, speed of onset and areal extent, duration, frequency, spatial predictability.** * Hazard profiles are useful for comparing the same hazard in different locations (for example, the Sichuan Earthquake to the Haiti Earthquake) * However it is difficult to compare different hazards (volcanoes, tsunamis, earthquakes) without a certain degree of inaccuracy. * A government could use a hazard profile to: Implement land-use zoning to keep danger areas clear. Use hazard-resistant designs – this has had a very positive impact in places which experience lots of earthquakes, such as Chile. Educating local people about what to do in a disaster. * Different hazard profiles of earthquake, volcano and tsunami events show the severity of social and economic impact in developed, emerging and developing countries. | * The basis for the PAR model (also known as the Disaster Crunch Model) is that a disaster is the intersection of two processes: Processes generating vulnerability on one side, and the natural hazard event on the other. * The model highlights the three stages of vulnerability: * Root Causes: These include poor political and economic governance, which results in limited access to power, structures and resources. * Dynamic Pressures: Rapid urbanisation has happened faster than local institutions can keep up. This has exacerbated the root problems. * Unsafe conditions: A location can be at more risk due to its proximity to hazard events, but also due to low disaster preparedness and socio-economic constraints. * Volcanoes cause lava flows, pyroclastic flows, ash falls, gas eruptions, and secondary hazards (lahars, jökulhlaups). |
| Development and  governance are  important in  understanding  disaster impact  and vulnerability  and resilience. | * People’s basic health and access to food strong correlates with their ability to survive disasters. * There is a clear relationship between nutrition and disease; when people are forced to come into contact with each other in a disaster scenario, sick or **undernourished** people are at a greater risk of disease due to a weaker immune system. * Low income households suffer a disproportionate share of disaster losses and impacts. The social processes and power dynamic that drive the disaster risk-poverty nexus are strongly linked with inequality. * In the context of disasters, inequality has a number of dimensions: Asset **inequality**, inequality of entitlement, political inequality and social status inequality. * **Economic** governance is how decisions affect economic activities and relationships with other economies. Affects equity, poverty and quality of life. * **Administrative** governance is how policy is implemented. It requires good building codes, land use planning, environmental **risk** and vulnerability monitoring. * **Political** governance is the process of making policy including disaster risk planning. This brings together state, non-state and private-sector players and stakeholders. * **These forms of governance interact to increase or reduce hazard risk and vulnerability.** * An LIC, such as Haiti, would have poor administrative governance, hence increasing their disaster risk. | * The basis for the PAR model (also known as the Disaster Crunch Model) is that a disaster is the intersection of two processes: Processes generating vulnerability on one side, and the natural hazard event on the other. * Hazard profiles are useful for comparing the same hazard in different locations (for example, the Sichuan Earthquake to the Haiti Earthquake) * Different hazard profiles of earthquake, volcano and tsunami events show the severity of social and economic impact in developed, emerging and developing countries. |

| **Topic 1: Tectonic Processes and Hazards**  **Enquiry question 3: How successful is the management of tectonic hazards and disasters?** | | | |
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| **Key Idea** | **Intended Knowledge:**  *Students will know that…* | **Prior Knowledge:**  *In order to know this students, need to already know that…* |
| **Understanding the complex trends and patterns for tectonic disasters helps explain differential impacts.** | * The overall hazard trends, since about 1960 show a number of key points: * The total number of recorded hazards has increased. * Number of deaths in disasters is falling, but there are spikes with **mega-events** (Indian Ocean Tsunami, Haiti) * Economic costs have increased significantly * Total number of people affected is rising. * The number of reported disasters has risen, however the number of tectonic hazards has remained at a fairly stable level. Hydrometeorological hazards (those to do with the air/water) have increased dramatically. * Improvements in monitoring and recording events may be contributing to the current trends. *Seismometers and other equipment has improved over time.* * Improvements in technology allow for more reporting, giving the impression that hazards are more frequent. * The global population has increased by 4.3 billion since 1960; more people living on marginal land means more people exposed to disasters. * Rapid urbanisation means that previously permeable land is now covered and therefore flood risk has increased dramatically. * Data collection is not always accurate. This is due to the immediate focus being on response, not data collection, political bias, no organisation being solely responsible and media bias (e.g. Boxing Day tsunami exaggeration). * Tectonic mega-disasters can have regional or even global significance in terms of economic and human impacts. (2004 Asian tsunami, 2010 Eyafjallajokull eruption in Iceland (global interdependence) and 2011 Japanese tsunami (energy policy) * **Multiple Hazard Zones**: These are places where a number of physical hazards combine to create an increased level of risk for the country and its population. * The Philippines is a key example of a MHZ. * The Philippines lies on a destructive plate boundary; one that is part of the Pacific Ring of Fire. * The Philippines proximity to the tropics means it lies in the path of tropical cyclone (hurricane) activity. * Land and mud slides are common due to the mix of tectonic and hydrological disasters. | * Low income households suffer a disproportionate share of disaster losses and impacts. The social processes and power dynamic that drive the disaster risk-poverty nexus are strongly linked with inequality. * In the context of disasters, inequality has a number of dimensions: Asset inequality, inequality of entitlement, political inequality and social status inequality. * The distribution of plate boundaries resulting from divergent, convergent and conservative plate movements (oceanic, continental and combined situations follow these patterns, and can be found at specific locations worldwide. |
| Theoretical frameworks can be used to understand the predication, impact and management of tectonic hazards | * **Prediction and forecasting** (P: role of scientists) accuracy depend on the type and location of the tectonic hazard. * Volcanoes are easier to **predict** than earthquakes, as they give off clear warning signals. * In order to predict earthquakes, scientists would need to identify a ‘diagnostic precursor’. These have never been scientifically identified. * **Gas Monitoring**: sulphur levels can be monitored – high levels mean magma is near the surface. * Thermal Imaging: can detect heat around a volcano – heat near the surface indicates magma is near the surface. * **Hazard management**: is where governments and other organisations work together to protect people from natural hazards. * Hazard management aims to: Avoid or reduce loss of life or property. Provide help to those affected. Ensure a rapid and effective recovery. * The theoretical hazard management model shows hazard management as a continuous four stage cycle. * **Mitigation**: Preventing hazard events or minimising their effects. * The main aim is to reduce loss of life and property (largely by helping communities to become less vulnerable). Examples include protective structures and land use zoning. * **Preparedness**: Preparing to deal with a hazard event. * Minimising loss of life and property and facilitating response and recovery. Examples include evacuation routes and early prediction methods. * **Response**: Responding effectively to a hazard event. * The main aims are to save lives, protect property, make affected areas safe and reduce economic loss e.g. search and rescue * **Recovery**: Getting back to normal * The Park model shows how countries or regions might  respond after a hazard event. * The model uses time to show the change from normality ranging from before, during to after the event. It is useful for comparing disasters. | * Low income households suffer a disproportionate share of disaster losses and impacts. The social processes and power dynamic that drive the disaster risk-poverty nexus are strongly linked with inequality. * In the context of disasters, inequality has a number of dimensions: Asset inequality, inequality of entitlement, political inequality and social status inequality. * The global population has increased by 4.3 billion since 1960; more people living on marginal land means more people exposed to disasters. * The basis for the PAR model (also known as the Disaster Crunch Model) is that a disaster is the intersection of two processes: Processes generating vulnerability on one side, and the natural hazard event on the other. * The model highlights the three stages of vulnerability: * Root Causes: These include poor political and economic governance, which results in limited access to power, structures and resources. * Dynamic Pressures: Rapid urbanisation has happened faster than local institutions can keep up. This has exacerbated the root problems. * Unsafe conditions: A location can be at more risk due to its proximity to hazard events, but also due to low disaster preparedness and socio-economic constraints. |
| **Tectonic hazard impacts can be managed by a variety of mitigation and adaptation strategies, which vary in their effectiveness.** | * Managing the impact of hazards can be done via mitigation (modifying the event) and adaptation (modifying resilience). * Strategies to modify the event include **land-use zoning, hazard – resistant design and engineering defences as well as diversion of lava flows.** * Strategies to modify vulnerability and resilience include hi-tech monitoring, prediction, education, community preparedness and **adaptation.** * Strategies to modify loss include emergency, short and longer term aid and insurance and the actions of affected communities themselves. * The Sendai Framework aims to guide the multi-hazard management of disaster risk in development at all levels as well as within and across all sectors. | * **Mitigation**: Preventing hazard events or minimising their effects. * The main aim is to reduce loss of life and property (largely by helping communities to become less vulnerable). Examples include protective structures and land use zoning. * **Preparedness**: Preparing to deal with a hazard event. * Minimising loss of life and property and facilitating response and recovery. Examples include evacuation routes and early prediction methods. * **Response**: Responding effectively to a hazard event. * The main aims are to save lives, protect property, make affected areas safe and reduce economic loss e.g. search and rescue * **Recovery**: Getting back to normal * The Park model shows how countries or regions might  respond after a hazard event.   The model uses time to show the change from normality ranging from before, during to after the event. It is useful for comparing disasters. |

| **Topic 2: Landscape Systems, Processes and Change**  Option 2B: Coastal Landscapes and Change  **Enquiry question 1: Why are coastal landscapes different and what processes cause these differences?** | | |
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| **Key Idea** | **Intended Knowledge:**  *Students will know that…* | **Prior Knowledge:**  *In order to know this students, need to already know that…* | |
| The coast, and wider littoral zone, has distinctive features and landscapes. | * The **littoral zone** is defined as the wider coastal zone including adjacent land areas and shallow parts of the sea just offshore. * The littoral zone consists of backshore, nearshore and offshore zones. * The coastal system has a variety of **inputs**: Marine (waves, tides, storm surges) Atmospheric (weather/climate, climate change, solar energy) Land (rock type and structure, tectonic activity) People (human activity, coastal management) * The coastal system has a variety of processes: **Weathering** (wearing away of material) **Mass movement** (movement of surface material) Erosion (wearing away of material) Transport (movement of sediment) Deposition (dropping off of sediment) * The coastal system has a variety of **outputs:** Erosional landforms (arch, stack, stump, headland, bay) Depositional landforms (splits, tombolos, beaches) Different types of coasts (rocky shores, sandy beaches, coastal wetlands, coral reefs) * Coasts can be classified based on: * **Geology:** Which can create rocky, sandy and estuarine coasts, as well as concordant and discordant coasts. * Energy: Levels of energy create high or low energy coastlines. * Balance: Between erosion and deposition, creating either erosional or depositional coasts. * Sea level: Changes in sea level create either emergent or submergent coastlines. * **Rocky coasts** (high and low relief) result from resistant geology (withstands erosive forces of sea, rain and wind), often in a high-energy environment. * Coastal plain landscapes (sandy and estuarine coasts) are found near areas of low relief and result from supply of sediment from different terrestrial and offshore sources, often in a low-energy environment. | Students will have some understanding of coastal process from GCSE study. | |
| **Geological structure influences the development of coastal landscapes at a variety of scales.** | * A crucial element of coastal management is understanding **rates or erosion or recession.** * This is influenced by many factors but they key one is lithology or rock type. * **Lithology:** The physical characteristics of particular rocks * The three major rock types (igneous, sedimentary and metamorphic) erode at different rates. * Igneous rocks (e.g. granite) are **crystalline,** resistant & impermeable. * Sedimentary rocks (e.g. limestone) are formed in strata. Jointed sedimentary rocks are permeable. Other sedimentary rocks (e.g. chalk) have air spaces between the particles – marking them porous and **clastic.** * Metamorphic rocks (e.g. marble and schist) are very hard, impermeable and resistant. * Submergent coastlines are those that have been flooded due to a rise in sea levels at that location. This is also known as eustatic sea level change. * An example of this is the Dalmatian Coasts or Pacific Coasts (e.g. in Croatia or Southern Chile) They are a type of concordant coastline which have formed due to a rise in sea level. * Haff coasts also have concordant features – they have long spits of sand and lagoons which are aligned parallel to the coastline. * These are names after the Haffs, or lagoons, found on the southern shore of the Baltic Sea. They are enclosed by sand spits or dunes. * In the south-west, Cornwall bears the brunt of the worst of the weather rolling in from the Atlantic Ocean. * It is made from older and more resistant rocks such as: Igneous rocks (such as basalt and granite) Older compacted sedimentary rocks (such as old red sandstone) Metamorphic rocks (such as slates and schists). * Eastern and southern Britain has a weaker and younger geology include in chalks, clay, sand and sandstone. * Geological structure influences coastal morphology: Dalmatian and Haff type concordant coasts and headlands and bays on discordant coasts. * **Joints**: These are fractures, caused either by contraction as sediments dry out, or by earth movements during uplift. * **Strata**: Layers of rock * **Dip:** This refers to the angle at which rock strata lie (horizontally, vertically, dipping towards the sea or dipping inland) * **Bedding planes:** These are natural breaks in the strata, caused by gaps in time during periods of rock formation * **Folds**: Formed by pressure during tectonic activity, which makes rocks buckle and crumple (e.g. the Lulworth Crumple) * **Faults:** Formed when the stress or pressure to which a rock is subjected, exceeds its internal strength (causing it to fracture). The faults then slip or move along fault planes. * **Geological structure** (jointing, dip, faulting, folding) is an important influence on coastal morphology and erosion rates, and also on the formation of cliff profiles and the occurrence of micro-features, e.g. caves | * The coastal system has a variety of inputs: Marine (waves, tides, storm surges) Atmospheric (weather/climate, climate change, solar energy) Land (rock type and structure, tectonic activity) People (human activity, coastal management) * The coastal system has a variety of processes: Weathering (wearing away of material) Mass movement (movement of surface material) Erosion (wearing away of material) Transport (movement of sediment) Deposition (dropping off of sediment) * Geology: Which can create rocky, sandy and estuarine coasts, as well as concordant and discordant coasts. * Energy: Levels of energy create high or low energy coastlines. * Balance: Between erosion and deposition, creating either erosional or depositional coasts. | |
| **Rates of coastal recession and stability depend on lithology and other factors** | * Bedrock lithology (igneous, sedimentary, metamorphic) and unconsolidated material (boulder clay) geology are important in understanding rates of coastal recession. * **Differential erosion** of alternating strata in cliffs (permeable/impermeable, resistant/less resistant) produces complex cliff profiles and influences recession rates. * Vegetation plays an important role in the shaping of coastal landscapes. Many coastlines are protected from erosion by plants; these plants **stabilise** loose material and hold it together. * The roots bind sediment so it is harder to erode. When submerged, plants growing in sediment provide a protective layer so that it is not exposed to water moving over it * Plants protect sediment from wind erosion by reducing the wind speed (it is reduced by friction with the plants) * Succession refers to how a group of plants changes over time. One community of plants is replaced by another as succession develops. The process is especially important on coasts as it stabilises the coastal features. * When following a satellite image, sand dunes follow the pattern: Embryo dunes, Yellow Dunes, Fixed Dunes, Dune Slack and Heath/Woodland. | * Geological structure (jointing, dip, faulting, folding) is an important influence on coastal morphology and erosion rates, and also on the formation of cliff profiles and the occurrence of micro-features, e.g. caves * Haff coasts also have concordant features – they have long spits of sand and lagoons which are aligned parallel to the coastline. * These are names after the Haffs, or lagoons, found on the southern shore of the Baltic Sea. They are enclosed by sand spits or dunes. * In the south-west, Cornwall bears the brunt of the worst of the weather rolling in from the Atlantic Ocean. * It is made from older and more resistant rocks such as: Igneous rocks (such as basalt and granite) Older compacted sedimentary rocks (such as old red sandstone) Metamorphic rocks (such as slates and schists). * Eastern and southern Britain has a weaker and younger geology include in chalks, clay, sand and sandstone. * Geological structure influences coastal morphology: Dalmatian and Haff type concordant coasts and headlands and bays on discordant coasts. | |

| **Topic 2: Landscape Systems, Processes and Change**  Option 2B: Coastal Landscapes and Change  **Enquiry question 2: How do characteristic coastal landforms contribute to coastal landscapes?** | | | |
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| **Key Idea** | **Intended Knowledge:**  *Students will know that…* | **Prior Knowledge:**  *In order to know this students, need to already know that…* | | |
| Marine erosion creates distinctive coastal landforms and contributes to coastal landscapes | * **Beach morphology:** the shape of a beach, including the width and slope and features such as berms, ridges and runnels. It also includes the type of sediment. * Summer beach = Beaches are steeper, berms are built up and backwash is weaker so more sediment is deposited. * Winter beach = High frequency waves, berms are eroded quickly, strong backwash transports sediment offshore. * Waves cause erosion but erosion is not a constant process. Most erosion occurs during a small number of large storms. * Erosion processes (hydraulic action, corrosion, abrasion, attrition) are influenced by wave type and size. * Erosion is higher when waves are at their largest, which is influenced by wind speed and fetch, meaning they have lots of energy, Waves approach the coast at a 90° angle to the cliff face and the tide is high, propelling waves higher up the cliff face. * Erosion creates distinctive coastal landforms (wave cut notches, wave cut platforms, cliffs, the cave-arch-stacks stump sequence) | | * The three major rock types (igneous, sedimentary and metamorphic) erode at different rates. * Igneous rocks (e.g. granite) are crystalline, resistant & impermeable. * Sedimentary rocks (e.g. limestone) are formed in strata. Jointed sedimentary rocks are permeable. Other sedimentary rocks (e.g. chalk) have air spaces between the particles – marking them porous. * Metamorphic rocks (e.g. marble and schist) are very hard, impermeable and resistant. | |
| **Sediment transport and deposition create distinctive landforms and contribute to coastal landscapes** | * Sediment transportation is influenced by the angle of wave attack, the process of longshore drift, tides and currents. * **Transportation and deposition** processes produce distinctive coastal landforms (beaches, recurved and double spits, offshore bars, barrier beaches and bars, tombolos and cuspate forelands) * Vegetation can help to trap and stabilise the sediment to make it stronger against wind and waves. * Depositional landforms become **vulnerable** when their vegetation is damaged, which is why tourism at some beaches can be limited. * Deposition occurs as the coastal inputs exceed the coastal outputs. * Sediment moves along the coastlines in sediment cells. * Within each cell, the sediment moves between the beach, cliffs and sea through the processes of erosion, transport and deposition. * The coastline of England and Wales is divided up into 11 major  sediment cells. * The amount of sediment available within a cell is called the sediment budget. * In each cell, features build up which are in equilibrium with the amount of  sediment that is available. * If the budget falls, waves continue to transport sediment (and erosion may  therefore increase in some areas). One change has led to another change; this is known as positive feedback. * If the budget increases, then more deposition is likely. This is known as negative feedback. | | * **Beach morphology**: the shape of a beach, including the width and slope and features such as berms, ridges and runnels. It also includes the type of sediment. * Summer beach = Beaches are steeper, berms are built up and backwash is weaker so more sediment is deposited. * Winter beach = High frequency waves, berms are eroded quickly, strong backwash transports sediment offshore. * Waves cause erosion but erosion is not a constant process. Most erosion occurs during a small number of large storms. * Erosion processes (hydraulic action, corrosion, abrasion, attrition) are influenced by wave type and size. * Erosion is higher when waves are at their largest, which is influenced by wind speed and fetch, meaning they have lots of energy, Waves approach the coast at a 90° angle to the cliff face and the tide is high, propelling waves higher up the cliff face. * Erosion creates distinctive coastal landforms (wave cut notches, wave cut platforms, cliffs, the cave-arch-stacks stump sequence) | |
| **Subaerial processes of mass movement and weathering influence coastal landforms and contribute to coastal landscapes.** | * The two processes of weathering and mass movement combine to create more rapid erosion. * **Weathering** is the gradual breakdown of rock, *in situ*, at or close to the ground surface. It can be divided into three different types: mechanical, chemical and biological. * **Mass Movement** is the movement of weathered material downslope as a result of gravity. * Freeze Thaw weathering This occurs when water enters cracks or joints when it  rains. This water then freezes in the cold weather. * Salt Weathering: When salt water evaporates, it leaves salt crystals behind. These can grow over time and exert stresses in the rock (just like ice does) which causes it to break up. * Frequency cycles of wetting and drying are common on the coast. Rocks which are rich in clay (such as shale) expand when they get wet and contract as they dry. This can cause them to crack and break up. * **Carbonation:** The slow dissolution of limestone due to rainfall (weak  carbonic acid, pH 5.6) producing calcium bicarbonate in  solution. This affects limestone and other carbonate rocks. * Hydrolysis: The breakdown of minerals to form new clay minerals, plus materials in solution, due to the effect of water and dissolved CO2. igneous and metamorphic rocks containing feldspar and other silicate minerals. * Oxidation: The addition of oxygen to minerals, especially iron compounds. This produces iron oxides and increases volume contributing to mechanical breakdown. Sandstones, siltstones and shales often contain iron compounds that can be oxidised. * Tree and plant roots grow into small cracks and fissures in the rock faces which causes the rocks to break apart. This happens more as the roots grow. * Rock Boring: Many species of clams and molluscs bore into the rock face and may also secrete chemicals that dissolve rock. * Animals: Different birds (such as puffins) and animals (such as rabbits) dig burrows into cliffs and cause them to break. * Repeated freeze-thawing and rock falls can lead to the creation of **talus scree slopes**. This is where the eroded material (scree) builds up at the foot of the slope or cliff. * Rotational slumping will leave marks on the landscape which are known as **rotational scars**. * Repeated slumping creates a **terraced cliff profile**. The one shown below is at Naish Farm in Christchurch Bay, an area vulnerable to erosion. | | * The coastal system has a variety of inputs: Marine (waves, tides, storm surges) Atmospheric (weather/climate, climate change, solar energy) Land (rock type and structure, tectonic activity) People (human activity, coastal management) * The coastal system has a variety of processes: Weathering (wearing away of material) Mass movement (movement of surface material) Erosion (wearing away of material) Transport (movement of sediment) Deposition (dropping off of sediment). * Waves cause erosion but erosion is not a constant process. Most erosion occurs during a small number of large storms. | |

| **Topic 2: Landscape Systems, Processes and Change**  Option 2B: Coastal Landscapes and Change  **Enquiry question 3: How do coastal erosion and sea level change alter the physical characteristics of coastlines and increase risks?** | | |
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| **Key Idea** | **Intended Knowledge:**  *Students will know that…* | **Prior Knowledge:**  *In order to know this students, need to already know that…* | |
| **Sea level change influences coasts on different timescales** | * The two types of sea level change are called: **Eustatic change** – when the sea level itself rises or falls. **Isostatic change** – when the land rises or falls, relative to the sea. * Past tectonic activity has had a direct impact on some coasts across the world, as well as on sea levels, due to the uplift of mountain ranges and coastal land at destructive and collision plate margins * Eustatic Sea level fall occurs during glacial times, when ice sheets form on land in high latitudes (far north and south), water evaporated from the sea is locked up on land as ice. * Eustatic sea level rise occurs at the end of a glacial period, melting ice returns water to the sea causing sea levels to rise globally. * Isostatic sea level fall occurs during the build up of ice sheets, the weight of the ice causes the Earth’s crust to sink (isostatic subsidence) * As it melts it causes the Earth to slowly rebound (called post-glacial adjustment or isostatic recovery). The land slowly lifts out of the sea * Isostatic sea level rise occurs because land can ‘sink’ at the coast due to the deposition of sediment (accretion). * This can happen especially in large river deltas where the weight of sediment deposition causes delta subsistence. * Eustatic changes occur relatively quickly but isostatic changes take much longer. Despite melting of ice over 8,000 years ago, the UK is still uplifting. * Land in the north and west (which was covered by ice) is rising as a result of *isostatic recovery.* * Land in the south and east (which was not covered by ice) is sinking. Sediment deposition is causing the crust to sink and relative sea levels to rise. * Sea level change has produced **emergent coastlines** (raised beaches with fossil cliffs) and **submergent coastlines** (rias, fjords and Dalmatian). * Contemporary sea level change from global warming or tectonic activity is a risk to some coastlines. * The Maldives is at particular risk from contemporary sea level rise. | * Submergent coastlines are those that have been flooded due to a rise in sea levels at that location. This is also known as eustatic sea level change. * An example of this is the Dalmatian Coasts or Pacific Coasts (e.g. in Croatia or Southern Chile) They are a type of concordant coastline which have formed due to a rise in sea level. * Tectonic activity can result in the movements of tectonic crust. This can occur at a variety of plate margins globally. | |
| **Rapid coastal retreat causes threats to people at the coast.** | * Rapid coastal recession is caused by physical factors (geological and marine) but can be influenced by human actions (dredging or coastal management) * Subaerial processes (weather and mass movement) work together to influence rates of coastal recession – TAUGHT IN PREVIOUS KEY IDEA * Rates of recession are not constant and are **influenced** by different factors both short- and longer term (wind direction/fetch, tides, seasons, weather systems and occurrence of storms – TAUGHT IN PREVIOUS KEY IDEA |  | |
| Coastal flooding is a significant and increasing risk for some coastlines. | * Local factors increase flood risk on some low-lying and estuarine coasts (height, degree of subsidence, vegetation removal); global sea level rise further increases **risk**. * Bangladesh is at greater risk of **coastal flooding** due to a variety of factors. * Population Density: Bangladesh is the world’s most densely populated country * Land Height: 46% of the country’s population live less than 10 metres above sea level. * Location: Bangladesh lies on the flood plains of three major rivers (Brahmaputra, Meghna and Ganges). The tree converge in Bangladesh and flow through to the Bay of Bengal. * Himalayas: Bangladesh lies below Nepal. As increased snow melt (due to global warming) flows into rivers, more water is flowing through Bangladesh. * **Mangrove forests** are found in coastal regions of tropical and sub-tropical places around the world. * Satellite studies show that 71% of the mangroves are retreating by up to 200m per year; caused by erosion, sea levels and human actions. * 25% of global mangrove loss has occurred as land has been converted into lucrative shrimp farms (happening in Asia and Latin America) * Storm surges are changes in sea level caused by intense low-pressure systems and high wind speeds. * During high tide and in low-lying areas (such as Bangladesh), the results can be deadly. * Climate change and the increase in global temperatures is causing sea levels to rise. This rise is causing changes at the coast, such as increased incidence of storms and flooding. * Climate change is one factor that interacts with others (such as land use and management) to produce an overall result**.** * The IPCC are the major scientific body responsible for predicting and researching changes in climate. They have predicted that: * ‘It is *very likely* that sea level will rise in more than about 95% of the ocean area’ * ‘It is *virtually certain* that global mean sea level rise will continue for centuries beyond 2100’ | * Vegetation plays an important role in the shaping of coastal landscapes. Many coastlines are protected from erosion by plants; these plants stabilise loose material and hold it together. * The roots bind sediment so it is harder to erode. When submerged, plants growing in sediment provide a protective layer so that it is not exposed to water moving over it * Plants protect sediment from wind erosion by reducing the wind speed (it is reduced by friction with the plants) * Succession refers to how a group of plants changes over time. One community of plants is replaced by another as succession develops. The process is especially important on coasts as it stabilises the coastal features. * When following a satellite image, sand dunes follow the pattern: Embryo dunes, Yellow Dunes, Fixed Dunes, Dune Slack and Heath/Woodland. | |

| **Topic 2: Landscape Systems, Processes and Change**  Option 2B: Coastal Landscapes and Change  **Enquiry question 4: How can coastlines be managed to meet the needs of all players?** | | | |
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| **Key Idea** | **Intended Knowledge:**  *Students will know that…* | **Prior Knowledge:**  *In order to know this students, need to already know that…* |
| **Increasing risks of coastal recession and coastal flooding have serious consequences for affected communities.** | * Economic losses (housing, businesses, agricultural land, infrastructure) and social losses (relocation, loss of livelihood, amenity value) from coastal recession can be significant, especially in areas of dense coastal developments. * Certain places in the UK have very high land value. Those which are at risk of coastal flooding tend to lose their value, however some high-value areas are still at risk. * In Holderness, a house which is 20m from the cliff edge  will be lost to the sea in a few years time. For the residents this means: * Falling property values as erosion brings the coastline closer * An inability to sell their property because of the risk of erosion * The loss of their major asset and the cost of getting a new home * **Storm surge** can increase the risks that coastal erosion and flooding poses. * As a result of a huge storm surge in 1953, the Dutch  embarked on one of the largest coastal engineering  projects on the planet – The Deltawerken. * The Deltawerken is an example of a megaproject – a project costing over US$1billion which is technically difficult and usually a long-term project. Many megaprojects have multiple aims and often have large environmental impacts. * Tuvalu’s highest point is only 4.5m above sea level and  most land is 1-2m above sea level. As global sea levels  rise, the island will sink further underneath the water. * The future for Tuvalu is that many people will become **environmental refugees**; people may have to abandon the islands if the rising sea  levels make them **uninhabitable.** | * Storm surges are changes in sea level caused by intense low-pressure systems and high wind speeds. * Local factors increase flood risk on some low-lying and estuarine coasts (height, degree of subsidence, vegetation removal); global sea level rise further increases risk. * Climate change and the increase in global temperatures is causing sea levels to rise. This rise is causing changes at the coast, such as increased incidence of storms and flooding. * Climate change is one factor that interacts with others (such as land use and management) to produce an overall result**.** * The IPCC are the major scientific body responsible for predicting and researching changes in climate. They have predicted that: * ‘It is *very likely* that sea level will rise in more than about 95% of the ocean area’ * ‘It is *virtually certain* that global mean sea level rise will continue for centuries beyond 2100’ |
| There are different approaches to managing the risks associated with coastal recession and flooding. | * **Hard Engineering:** This involves building structures along the coast (usually at the base of a cliff or on a beach) e.g. sea walls, groynes and revetments. Tends to be very expensive and unaesthetically pleasing. * Hard engineering approaches (groynes, sea walls, rip rap, revetments, offshore breakwaters) are economically costly and directly alter physical processes and systems. * Groynes can prevent longshore drift occurring, this can result in the impacts being worse further downstream. * **Soft Engineering**: This approach is designed to work with the natural processes in the coastal system in order to manage erosion. Soft engineering tends to look nicer and be more popular in public opinion. * Soft engineering approaches (beach nourishment, cliff regrading and drainage, dune stabilisation) attempt to work with physical systems and processes to protect coasts and manage risks caused by changes in sea-level. * An analysis of the **costs** (negatives – not just financial) and **benefits** (positives) is carried out before a coastal management project is  allowed to happen. * **Tangible**: Where costs and benefits are known and can be assigned monetary value (e.g. building costs). * **Intangible**: Where costs may be difficult to assess but are important (e.g. the visual impact of a revetment). * **Sustainable management** is designed to cope with future threats (increased storm events, rising sea levels) but its implementation can lead to local conflicts in many countries. * Different players at different places and scales have opposing views: Residents, Business owners, Local taxpayers, Local council and Environmentalists/conservationists. | • Beach morphology: the shape of a beach, including the width and slope and features such as berms, ridges and runnels. It also includes the type of sediment.  • Summer beach = Beaches are steeper, berms are built up and backwash is weaker so more sediment is deposited.  • Winter beach = High frequency waves, berms are eroded quickly, strong backwash transports sediment offshore.  • Waves cause erosion but erosion is not a constant process. Most erosion occurs during a small number of large storms.  • Erosion processes (hydraulic action, corrosion, abrasion, attrition) are influenced by wave type and size.  • Erosion is higher when waves are at their largest, which is influenced by wind speed and fetch, meaning they have lots of energy, Waves approach the coast at a 90° angle to the cliff face and the tide is high, propelling waves higher up the cliff face.  • Erosion creates distinctive coastal landforms (wave cut notches, wave cut platforms, cliffs, the cave-arch-stacks stump sequence) |
| Coastlines are now increasingly managed by holistic integrated coastal zone management (ICZM). | * Coastal management increasingly uses the concept of littoral cells to manage extended areas of coastline. Throughout the world, countries are developing schemes that are sustainable and use holistic ICZM strategies. * **Shoreline Management** Policy decisions (**No Active Intervention, Strategic Realignment, Hold The Line, Advance The Line**) are based on complex judgements (engineering feasibility, environmental sensitivity, land value, political and social reasons); Cost Benefit Analysis (CBA) and Environmental Impact Assessment (EIA) are used as part of the decision-making process. * Policy decisions can lead to conflicts between different players (homeowners, local authorities, environmental pressure groups) with perceived winners and losers in countries at different levels of development (developed and developing or emerging countries) | * Sediment transportation is influenced by the angle of wave attack, the process of longshore drift, tides and currents. * Transportation and deposition processes produce distinctive coastal landforms (beaches, recurved and double spits, offshore bars, barrier beaches and bars, tombolos and cuspate forelands) * Vegetation can help to trap and stabilise the sediment to make it stronger against wind and waves. * Depositional landforms become vulnerable when their vegetation is damaged, which is why tourism at some beaches can be limited. * Deposition occurs as the coastal inputs exceed the coastal outputs. * Sediment moves along the coastlines in sediment cells. * Within each cell, the sediment moves between the beach, cliffs and sea through the processes of erosion, transport and deposition. * The coastline of England and Wales is divided up into 11 major  sediment cells. * The amount of sediment available within a cell is called the sediment budget. * In each cell, features build up which are in equilibrium with the amount of  sediment that is available. * If the budget falls, waves continue to transport sediment (and erosion may  therefore increase in some areas). One change has led to another change; this is known as positive feedback. |

| Area of study 3: Physical Systems and Sustainability  Topic 5: The Water Cycle and Water Insecurity  Enquiry question 1: What are the processes operating within the hydrological cycle from global to local scale? | | | |
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| Key Idea | Intended Knowledge:  *Students will know that…* | Prior Knowledge:  *In order to know this students, need to already know that…* |
| The global hydrological cycle is of enormous importance to life on earth | * The GHC is the circulation of water around the Earth. It is a closed system of linked processes so there are no external inputs or outputs. The only thing that changes is the state in which the water exists. * The power that drives the cycle comes from two sources: Solar Energy (in the form of heat). Gravitational Energy; causes rivers to flow downhill and precipitation to fall to the ground. * The cycle involves stores, flows and fluxes. Stores are reservoirs where water is held. * Stores: these are stocks of water, places where the water is held. For example, the oceans. * Fluxes: this is the measurement of the rate of flow between the stores. * Processes: the physical factors which drive the fluxes of water between stores. * Stores include the atmosphere, cryosphere and oceans. * The global water budget limits water available for human use and water stores have different residence times; some stores are non-renewable (fossil water or cryosphere losses). * Residency Time: These are the average times a water molecule with spend in the reservoir or store. Residence times impact on turnover within the water cycle system. * There is a strong link between residence times and levels of water pollution: stores with a slower turnover tend to be more easily polluted as the water is *in situ* for a longer length of time. | Students will have a base understanding of rivers and river processes from GCSE. This is to be explored in verbal discussion and feedback. |
| The drainage basin is an open system within the global hydrological cycle. | * The drainage basin is a subsystem within the global hydrological cycle. It is an open system with eternal inputs and outputs that cause the amount of water in the basin to vary over time. * A drainage basin is often referred to as the catchment (the area of land drained by a river and its tributaries). * The hydrological cycle is a system of linked processes: inputs (precipitation patterns and types: orographic, frontal, convectional) flows (interception, infiltration, direct runoff, saturated overland flow, throughflow, percolation, groundwater flow) and outputs (evaporation, transpiration and channel flow). * Physical factors within drainage basins determine the relative importance of inputs, flows and outputs (climate, soils, vegetation, geology, relief). * Humans disrupt the drainage basin cycle by accelerating processes (deforestation, changing land use) and creating new water storage reservoirs or by abstracting water. * In China groundwater irrigates 40% of farmland and  provides 70% of drinking water in the north-west and  north. Groundwater dropped by a metre per year between 1974-2000. * Cloud Seeding: The is the attempt to change the amount or type of precipitation by dispersing substances into the air that serve as cloud condensation nuclei (hygroscopic nuclei). * China used cloud seeding in Beijing just before the 2008 Olympic Games to create rain to clear the air of pollution | * The GHC is the circulation of water around the Earth. It is a closed system of linked processes so there are no external inputs or outputs. The only thing that changes is the state in which the water exists. * The cycle involves stores, flows and fluxes. Stores are reservoirs where water is held. * Stores: these are stocks of water, places where the water is held. For example, the oceans. * Fluxes: this is the measurement of the rate of flow between the stores. * Processes: the physical factors which drive the fluxes of water between stores. * Stores include the atmosphere, cryosphere and oceans. |
| The hydrological cycle influences water budgets and river systems at a local scale. | * Water budget: This is the annual balance between inputs (precipitation) and outputs (the channel flow and evaporation). * We can use the following equation to calculate a water budget: Precipitation (P) = channel discharge (Q) + evapotranspiration (E) ± change in storage (S) * When there is more than enough water (this is called a positive water balance) * When there is not enough water (this is called a negative water balance) * Water budgets are viewed by constructing line graphs. Using the line graphs, you can see: * There is more input than output and so more water is available. Water runs off into streams, and groundwater levels are topped up. * Evapotranspiration increases until it is higher than precipitation so water is drawn up from the soil and starts to get used up * The point where evapotranspiration is highest and precipitation is lowest due to hot weather conditions. River levels fall, plants use up soil moisture and crops need irrigation. * Soil water is used up and only specially adapted plants survive. * Precipitation is higher than evapotranspiration so the amount of soil moisture starts to increase again * Soil is saturated and cannot hold any more moisture. This is also known as field capacity. * The shape of storm hydrographs depends on physical features of drainage basins (size, shape, drainage density, rock type, soil, relief and vegetation) as well as human factors (land use and urbanisation). * These factors influence the lag time, peak discharge and potential to cause flooding. | * The drainage basin is a subsystem within the global hydrological cycle. It is an open system with eternal inputs and outputs that cause the amount of water in the basin to vary over time. * A drainage basin is often referred to as the catchment (the area of land drained by a river and its tributaries). * The hydrological cycle is a system of linked processes: inputs (precipitation patterns and types: orographic, frontal, convectional) flows (interception, infiltration, direct runoff, saturated overland flow, throughflow, percolation, groundwater flow) and outputs (evaporation, transpiration and channel flow). * Physical factors within drainage basins determine the relative importance of inputs, flows and outputs (climate, soils, vegetation, geology, relief). |