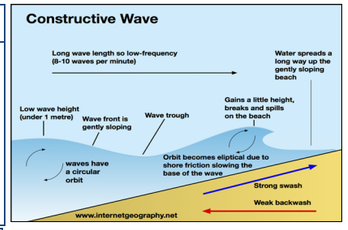
Unit 2: Topic 4a Coastal Change and conflict

How do waves and geology influence the coastline?

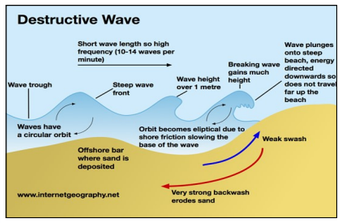
Waves are generated by wind blowing over the sea. Friction with the surface of the water causes ripples to form . The amount of energy in the waves depends on their height which in turn depends on wind strength, duration and the distance over which the wind has blown (fetch). As they approach the beach they lose energy as the water surges up the beach (swash) then runs back into the sea due to gravity (backwash).

What are the two wave types?

Constructive
Gentle winds, short fetch, less energy, deposition, low height, 8-10 per min, strong swash, weak backwash, wide and shallow beaches offering protection to cliffs absorbing wave energy



Destructive
Strong winds, long fetch, powerful, cause erosion, steep, 11 -15 per min, strong backwash, weak swash, narrow and steep beaches form offering little protection to the cliffs

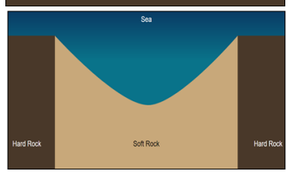


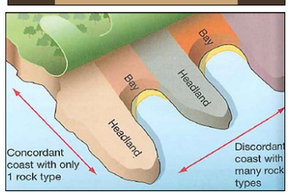
What is the geological structure of concordant and discordant coasts?

The UK's coastline includes an number of distinctive landforms resulting from wave action and physical processes interacting with the geological structure and rock type. Concordant coasts display band of resistant and less resistant rock that run at right angles to the coastline. Discordant coasts have bands of resistant or less resistant rocks that run parallel to the coastline.

How are headlands and bays formed?

Formed on discordant coasts where rock resistance affects rates of erosion. E.g. Harder chalk rocks at Studland and limestone south of Swanage can resist wave attacks and erosion for longer and therefore stand out as headlands unlike the soft clay of Swanage bay eroding much quicker to form a bay. Fewer headlands and bays exist on concordant coasts where the rock if the same type along it's length. The hard rocks act as a barrier but can be breached on lines of weaknesses such as faults and joints creating a cove, a circular area of water with a narrow entrance from the sea.





What other forms of erosion are created due to coastal erosion?

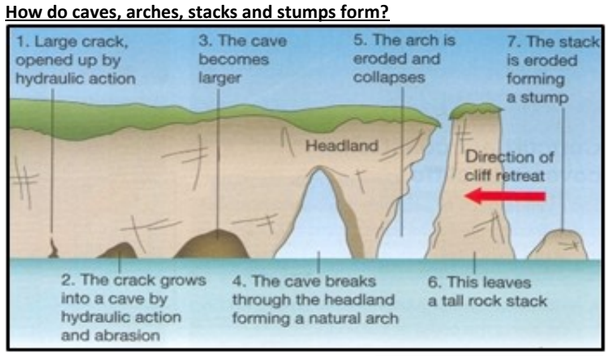
There are four main types of erosion which can be affected by:

Seasons—low pressure in winter and strong winds leads to more erosion from high energy destructive waves.

Storm frequency– areas susceptible to strong storms are likely to suffer with more erosion. **Prevailing winds**—mainly from the south-west bringing warm moist air and frequent rainfall, this leads to more weathering and erosion.

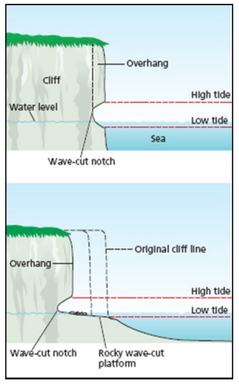
Abrasion	Load is dragged by water wearing away the cliffs and sea bed and causes most erosion.
Attrition	Load collides with load and wears down/breaks up
Solution	Weak acid dissolves rocks such as Limestone
Hydraulic Action	The shear force of the water trapping air in cracks fracturing the rock in cliffs and the sea bed

How do caves, arches, stacks and stumps form?



How are wave cut notches/platforms created?

A wave-cut notch is created when erosion occurs at the base of a cliff. As undercutting occurs the notch gets bigger. The rock will overhang the notch. The overhang will collapse and the cliff will retreat. This will create a wave-cut platform which is visible during low tide and submerged during high tide.



How fast is the coast changing?

Rates of erosion vary around the UK with around 28% of the coastline is eroding more than 10cm per year whilst other are eroding much higher. It is not always a gradual process, landslips after storms are sudden losses.

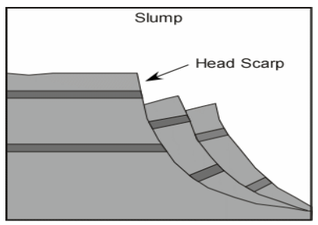
What sub-aerial processes act on coastlines?

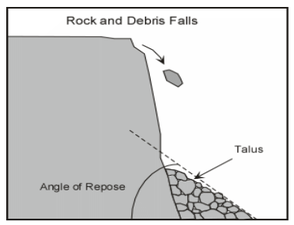
Weathering and mass movement weaken the cliffs above the high-water mark. Weathering is the breakdown of rock:

Physical/ mechanical (Freeze-thaw)	During the day when temperatures are higher, the snow melts and water enters the cracks in the rock. When the temperature drops below 0°C the water in the crack freezes and expands by about 9%. This makes the crack larger. As this process is repeated through continual thawing and freezing the crack gets larger over time. Eventually pieces of rock break off.
Chemical (acid rain)	slightly acidic rainfall, polluted by factories and vehicles, reacts with weak minerals causing them to dissolve and decay.
Biological weathering	the roots of plants grow in cracks and split the rock apart as do burrowing animals.

Mass movement is the downslope movement of rocks and soil under gravity:

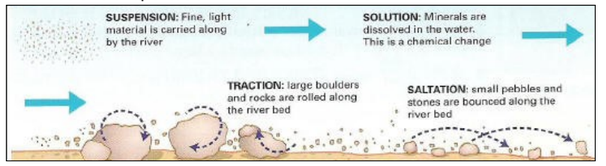
Rock falls	Sudden movement of rock from the cliff that has either weathered or undercut causing the collapse
Sliding	loosened rocks and soil suddenly tumble down the slope usually a bedding plane.
Slumping	When permeable rock or soil becomes saturated. Where permeable rock (sandstone) meets impermeable rock (clay) the saturated rock slumps and slips.



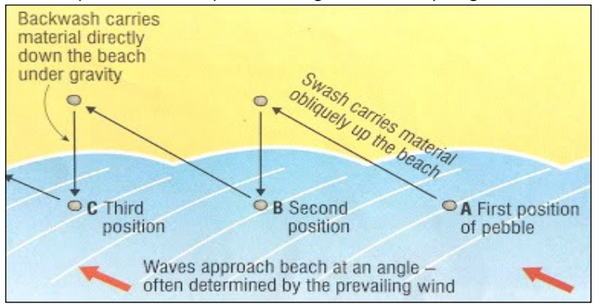


What are the influences of transportation and deposition on the coast?

Methods of transportation are similar to those in rivers:



The transport of sand and pebbles along the coast is by longshore drift.



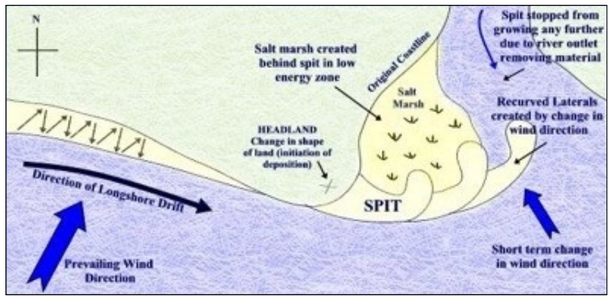
What are the landforms created by transportation and deposition?

When the sea loses energy, it drops the sand, rock particles and pebbles it has been carrying. Deposition happens when the swash is stronger than the backwash and is associated with constructive waves generally in sheltered areas such as bays, in calm conditions and with a gentle gradient.

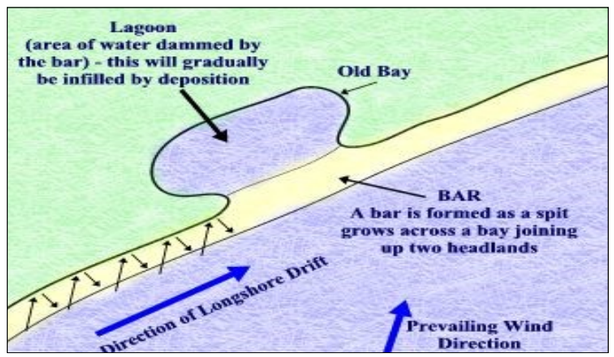
Depositional landforms:

Beaches—can be straight or curved. Curved beaches are formed by waves refracting or bending as they enter a bay. They can be sandy or pebbly (shingle). Shingle beaches are found where cliffs are being eroded. Ridges in a beach parallel to the sea are called berms and the one highest up the beach shows where the highest tide reaches.

Spits– narrow projections of sand or shingle that are attached to the land at one end. They extend across a bay or estuary or where the coastline changes direction. They are formed by longshore drift powered by a strong prevailing wind. The area behind the spit is sheltered where silt and mud is deposited creating a saltmarsh.



Bars—form in the same way as spits, with longshore drift depositing material away from the coast until a long ridge is built up. However, bars grow right across the bay, cutting off the water to form a lagoon.



How do geographers investigate coastal landscapes using OS maps?

On OS maps of coastal areas different landforms are identifiable by using symbols. Using 4 and 6 figure grid references as well as scale enables us to identify landforms. For example the 4 figure grid reference for Ballard Point is 0481. The 6 figure grid reference for the same feature is 048813.

How do human activities influence coastal landscapes?

Whilst the UK's coast are affected by natural processes large areas are affected by human activities often increasing the risk of coastal erosion:

Activity	Impacts
Settlements	20million people live in the coastal zone. 29 villages along the Holderness coast were lost from coastal erosion over 1000yrs
Tourism	Groynes used to build and protect beaches. By trapping sand they remove sediment from the system, reducing transportation and deposition further along the coast.
Infrastructure	Roads, railways, oil refineries etc are located along the coast. Esso in Fawley which handles 2000 ships per year transporting 22million tonnes of crude oil. Sea defences protect high value areas but the coastline doesn't change naturally.
Construction	Dredging removes sand and silt from the system. 1897—600,000 tonnes were dredged near Plymouth. 1917 the village of Hallsands disappeared with no beach for protection.
Agriculture	Farmland often has low value so isn't protected.

What challenges do coastal landforms experience and how are they managed?

Climate change— As temperatures rise, it is likely the intensity and frequency of storms will increase. This will increase the height of the waves and when combined with high tides and rainfall will increase the risk of flooding and erosion. As sea temperatures increase the water expands and sea levels rise. Added to this ice melting on land adds to the amount of water in the oceans and seas, therefore increasing the risk of flooding.

Rising sea levels-A warmer climate means that sea water will expand, ice will melt and sea levels will rise. Likely impacts are: increased erosion (especially in areas of soft rock e.g. clay), cliff retreat and the wave cut notch and platform changing position.

Storms and Storm surges— large scale increases in seal level (3m)due to storms. Gales drive water towards the coastline and along with low air pressure this allows the sea level to rise E.g. 1953 a storm surge lasting 2 days breached the flood defences killing 307 people, damaging 24,000 properties and 65,000 hectares of land around Lincolnshire, East Anglia and Kent. A similar event in December 2013 was dealt with by early warnings and improved defences.

Can we protect our coastline?

Planners have the challenge of identifying sustainable solutions that minimise conflicts between people and the environment through the **Integrated Coastal Zone Management.** The Environment Agency then publishes a **Shoreline Management Plan** with the following possibilities:

1. No intervention—no investment in defences against flooding or erosion
2. Hold the line—build defences to maintain the existing coastline
3. Managed realignment— allow the shoreline to change naturally
4. advance the line—build new defences on the seaward side.

Planners use a **cost-benefit analysis** to compare the social, economic and environmental costs of 'do nothing' strategy with the costs of defences.

Defence	Advantages	Disadvantages
Sea wall	Protects the base of cliffs, land and buildings Can prevent coastal flooding.	Expensive. may begin to erode. The cost of maintenance is high.
Groynes	Traps material along the coast carried by longshore drift allowing the build up of a beach a natural defence against erosion and an attraction for tourists.	Can be seen as unattractive. Costly to build and maintain.
Beach replenishment	Natural defence against erosion and coastal flooding. Beaches attract tourists. Inexpensive	Material is easily transported away, needs replacing
Slope stabilisation	Prevents mass movement	Difficult and costly to install