Under Pressure

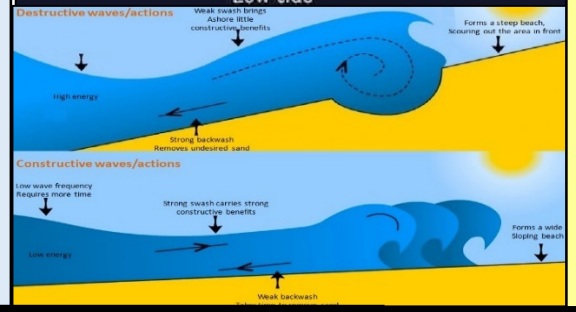
UP1 –Waves & Tides

Tides:

- These are the rise and fall of the sea level, due mainly to the pull of the moon
- As the moon travels around the Earth, it attracts the sea and pulls it upwards. The sun helps too – but its much further away. So its pull is not as strong.
- High tide occurs about every 12 and ½ hours, with low tides in between. The difference between the high and low tide is called the tidal range

Waves:

- Are formed by wind that blows over the sea, **friction** with the surface of water causes ripples to form and these develop into waves.
- The size of the wave depends on how strong the wind is, how far it has travelled and how long the wind blows for (**fetch**), and the speed of the wind (**strong winds = stronger waves**)
- As the water becomes shallower the **circular motion becomes more elliptical**, this causes the crest of the wave to rise up and collapse on the beach, the water rushes up the beach (**swash**) and then flows back towards the sea (**backwash**)



Constructive Waves:

- **Strong swash** and weak backwash that push sand and pebbles up the beach
- Low waves with longer gaps between the crests (**6-8 per min** – low frequency)
- **Under 1m**
- Known as spilling waves as they 'spill' up the beach
- Gently sloping wave front
- Formed by storms often 100s KMs away
- Gentle beach

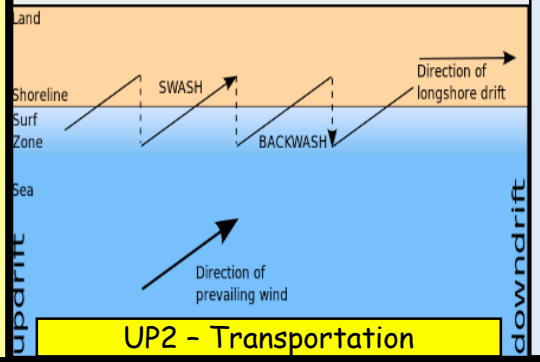
Destructive Waves:

- Weak swash and **strong backwash** pulling sand and pebbles back down
- Steep high waves where the crest is closer together (**up to 15 per min** – high frequency)
- Known as plunging waves as they break they plunge downwards
- Steep beach
- Formed by local storms close to the coast, they can destroy the beach
- **Over 1m**

UP2 – Transportation

Longshore Drift:

- Waves approach the beach **at an angle** due to the **prevailing wind** direction
- As the wave breaks, the **swash** carries material up the beach at the **same angle** (oblique angle) as the prevailing wind
- **The backwash** carries material back down the beach at a right angle (**90o**) due to **gravity**
- This means that material is moved along the beach in a **zig zag route**



Transportation:

- **Traction:**

Large boulders and sediments are rolled along the sea bed. They are too heavy to be picked up fully by the waves.

- **Saltation:**

where small pieces of shingle or large sand grains are bounced along the sea bed.

- **Suspension:**

small particles such as silts and clays are suspended in the flow of the water.

- **Solution:**

when minerals in rocks like chalk and limestone are dissolved in sea water and then carried in solution. The load is not visible.

UP2 –Erosion and Weathering

Erosion:

- **Abrasion** – loose rocks and sediment are thrown against the cliffs by waves. 'Sandpapering' effect of pebbles grinding over a rocky platform often causing it to become smooth
- **Hydraulic action** – water is forced into cracks in the rock. This compresses air inside. When the wave retreats the compressed air blasts out. It can force the rock apart, called cavitation
- **Attrition** – loose sediment knocked off the cliff by hydraulic action and abrasion is swirled around. It constantly collides with other sediment.
- **Corrosion** –sea water dissolves calcium carbonate from the rock, such as limestone and chalk

Weathering:

- **Mechanical weathering (freeze-thaw weathering):**

When it gets cold, water gets into cracks in the rock, and it freezes. The water expands when it turns to ice, so it puts pressure on the rock, causing it to break up.

- **Biological weathering:**

Plants grow in cracks in the rock and their roots push the rocks apart. Animals burrow and break up rocks.

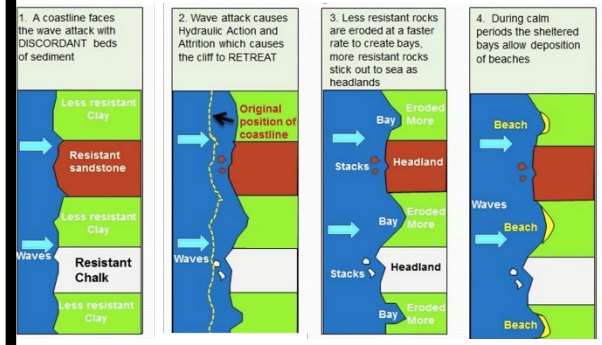
- **Chemical weathering:**

Rain is slightly acidic, so when it comes into contact with rocks, it wears away the top layer of rock

Mechanical

Biological

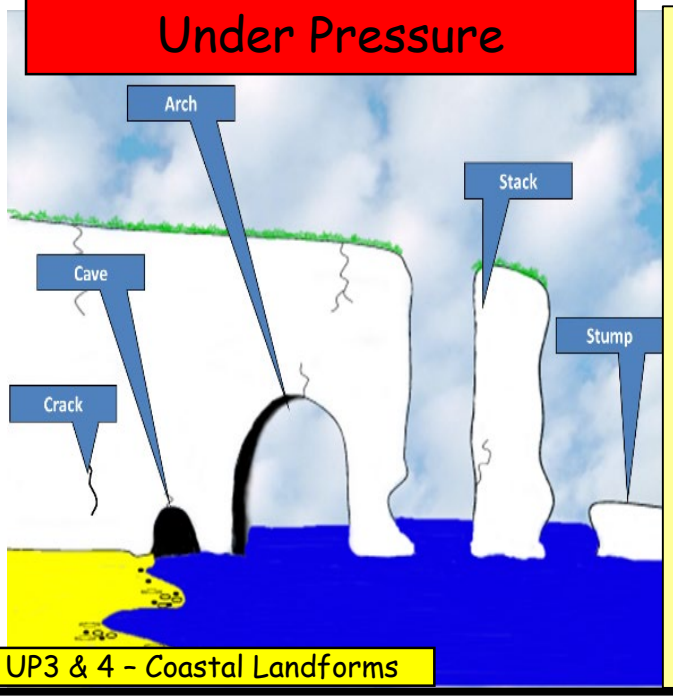
Chemical



The formation of headlands and bays:

Headlands and Bays form on **Coastlines** where there are differing bands of hard (resistant) rock and soft (weak) rock. The **weak rocks** like **clay** erodes faster than the **resistant rocks** like **limestone**. This leaves the resistant rocks jutting out as **headlands**. The Weaker softer rocks develop as **bays** and often accumulate **beaches** as **sediments** are deposited in their **sheltered** areas as constructive waves deposit material.

UP3 & 4 – Coastal Landforms



The formation of a coastal stack & stump:

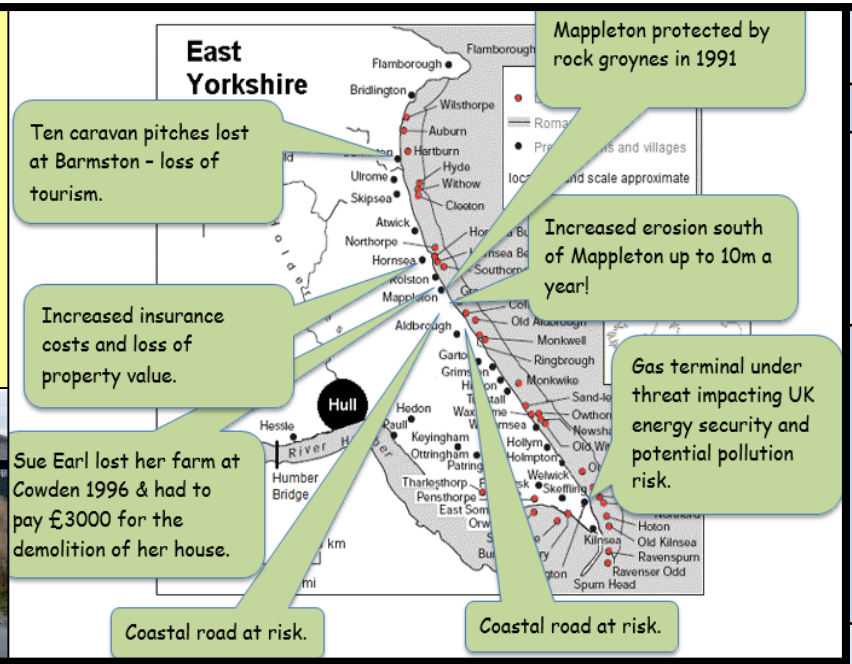
- **Cracks** in the side of a **headland** are enlarged by **erosion** (**Hydraulic action**, **abrasion** etc.) creating a **Cave**.
- The cave eventually is eroded through the headland to form an **Arch**.
- Over time the arch is eroded from the base and weathered from the top until its roof collapses leaving behind a **Stack** detached from the headland.
- The stack will eventually collapse leaving a **Stump**.

The Impacts of Coastal Erosion:

The Holderness coast is the fastest eroding coastline in Europe

1. Strong prevailing winds creating **longshore drift** that moves material south along the coastline.
2. The cliffs are made of a **soft boulder clay**. It will therefore erode quickly, especially when saturated as water weakens the clay increasing slipping and slumping speeding up erosion.
3. Land is being lost on an average of 2-3m per year along this coastline.

UP5 & 6 – Impacts of Erosion



Sea level rise is a threat to many coastal communities. Sea levels are rising and are predicted to rise further due to global climate change:

- The **melting of ice pack** particularly in the **Arctic** and **Antarctic**.
- **Thermal expansion** of the oceans (heating of the Ocean causing expansion)

The Maldives:

This is a group of around a thousand low-lying islands to the south west of India in the Indian Ocean. Their low-lying landscape is particularly vulnerable to sea level rise caused by **global warming**.

The islanders are concerned that rising sea levels will inundate (flood) their islands as well as increase the severity of erosion. This will cause problems such

- Loss of **Tourist** industry
- Loss of **Fishing** industry
- **Houses** and **land** lost
- **Fresh water** supplies **contaminated**
- **Climate refugees** (forced migration as a result of climate change).

UP5, 8 & 9 – Sea Level Rise

Managing sea level rise in the Maldives:

- Building dykes to hold back sea water. Protecting the islands from flooding and allowing tourism to continue for now.
- Build the islands upwards,
- Educate world leaders on the impacts of climate change and populations at risk.
- Build sea walls in densely populated areas
- Begin to abandon the islands slowly, becoming environmental refugees.
- Ask for foreign aid to build defences and offer advice.

Method	How does it work?	Advantages	Disadvantages
Hard engineering – man made structures to control the erosion			
Recurved Sea wall	Made of stone or concrete it reflects waves and withstands waves breaking on it	Total protection from erosion and can help prevent flooding too.	Very expensive. Just like a cliff face it will erode and need replacement and repair
Groynes	A low wall built out into the sea that traps sand that is moved by longshore drift. Usually made out of wooden fences but can also be made out of large boulders such as at Mappleton.	Traps beach material and creates a protective beach, which acts as a natural barrier to erosion and which is also attractive to tourists.	Costly to build and maintain (still cheaper than a seawall) and may be viewed as unattractive. Can create problems 'down-drift' as in the case of Mappleton and Sue Earl's farm
Rock armour (rip rap)	Large boulders which protect the coast by breaking up the waves, dissipating the energy of the waves.	Absorbs wave energy and cheaper than a seawall.	Still relatively expensive and again will erode and need maintenance.
Soft engineering – more sustainable methods that work with natural processes			
Beach nourishment	Adding sand to the beach to make it wider. This can be brought from elsewhere or dredged from the sea bed.	Creates a natural defence, relatively inexpensive and beach is attractive to tourists	Requires constant maintenance and replacement each year,
Dune Regeneration	Obstacles are put on the beach for sand dunes to form around. Marram grass is planted to bind the sand together.	Creates a natural barrier against erosion and a new habitat for wildlife.	Have to be maintained and can be destroyed in stormy weather. Blocks access to the beach for tourists.
Managed retreat	Abandoning the existing sea defences and building new ones further inland, creating a salt marsh which also floods in storm conditions.	Low cost & encourages the creation of beaches and salt marshes which are good for the environment	People will still lose their property and may need compensation

UP7, 8 & 9 – Coastal Management