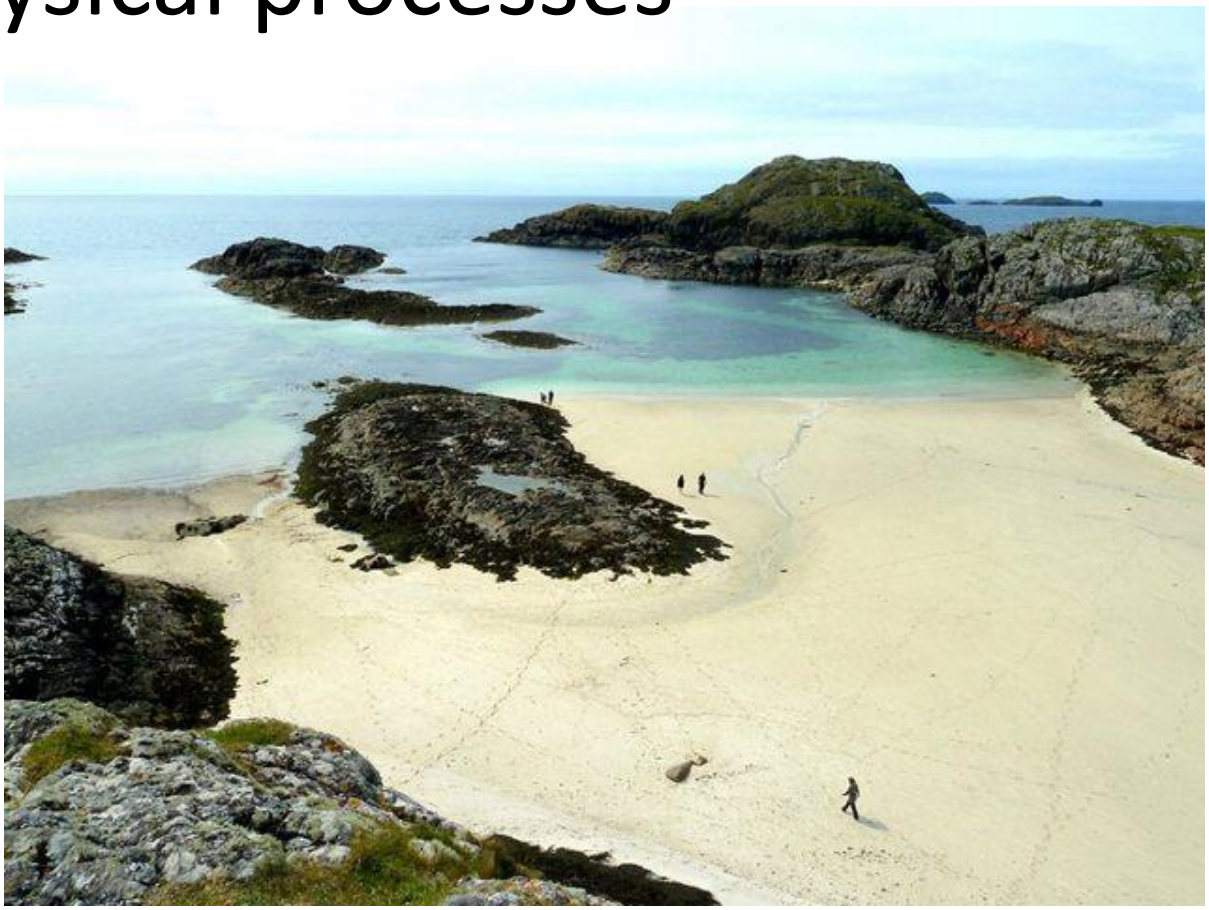
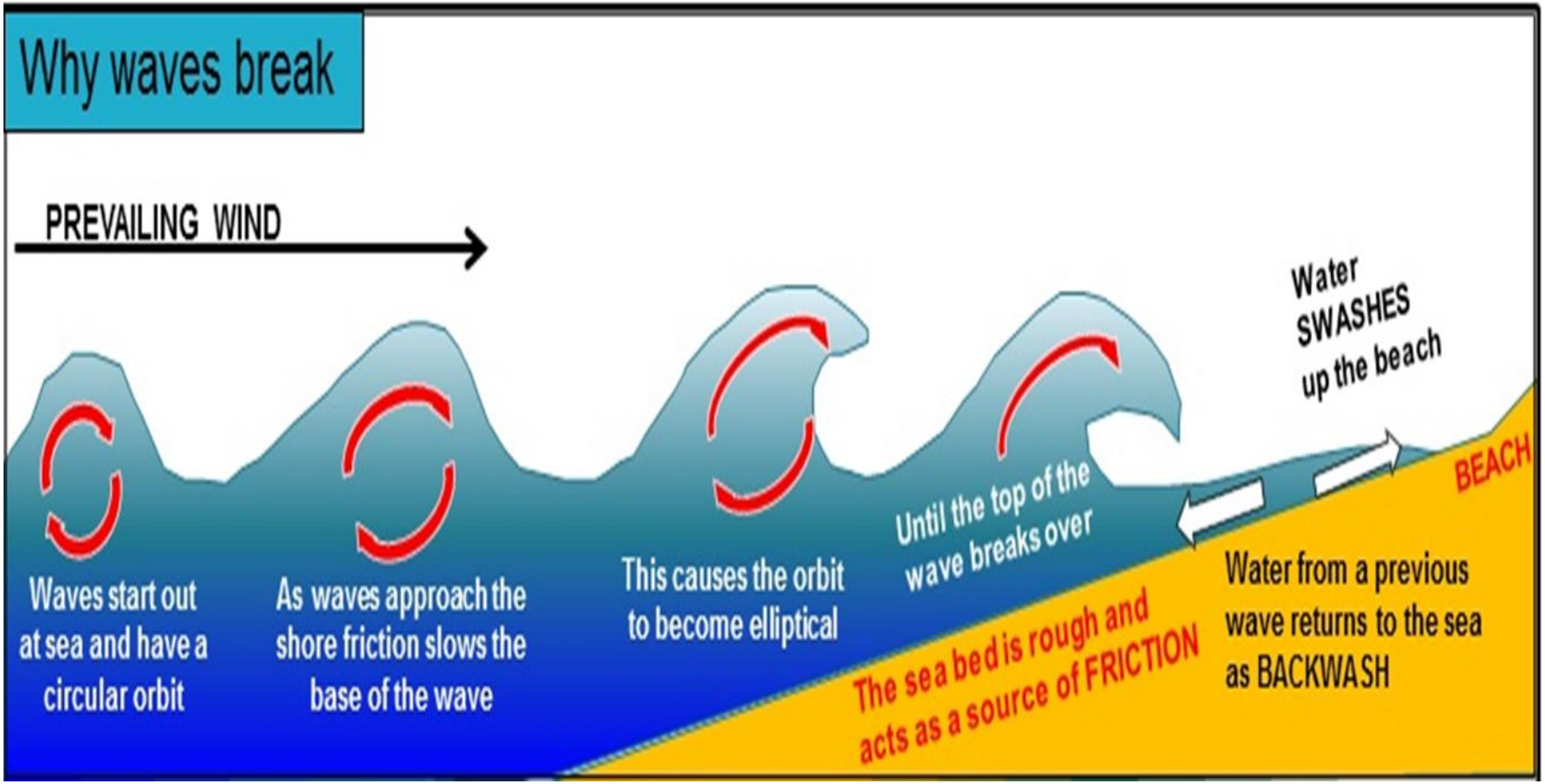
The coast is shaped by a number of physical processes

1. Waves
2. Wave types
3. Weathering
4. Mass movement
5. Erosion
6. Transportation
7. Deposition



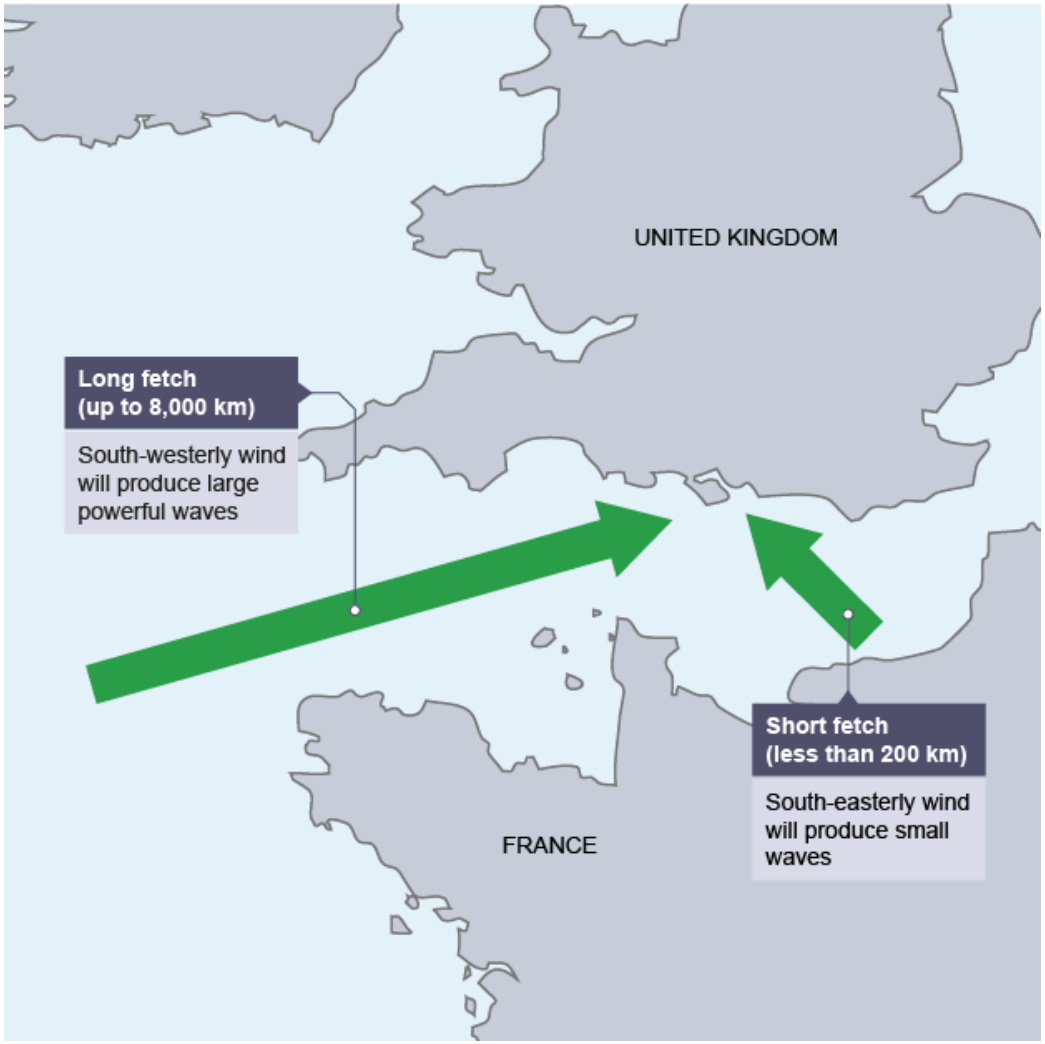
The coast is shaped by a number of physical processes

The wave diagram shows that when waves reach shallow water the speed at the base of the wave will slow due to the friction on the beach whereas the top of the wave continues to travel at speed causing it to break on the shore.



Waves

- Waves are formed by the friction of the wind blowing over the sea (not tsunamis!)
- *The largest waves are formed when the winds are **very strong**, blow for lengthy periods & cross a large expanse of water (fetch)*
- In the case of SW England the fetch is the whole of the Atlantic ocean so waves can often be big along the SW peninsula



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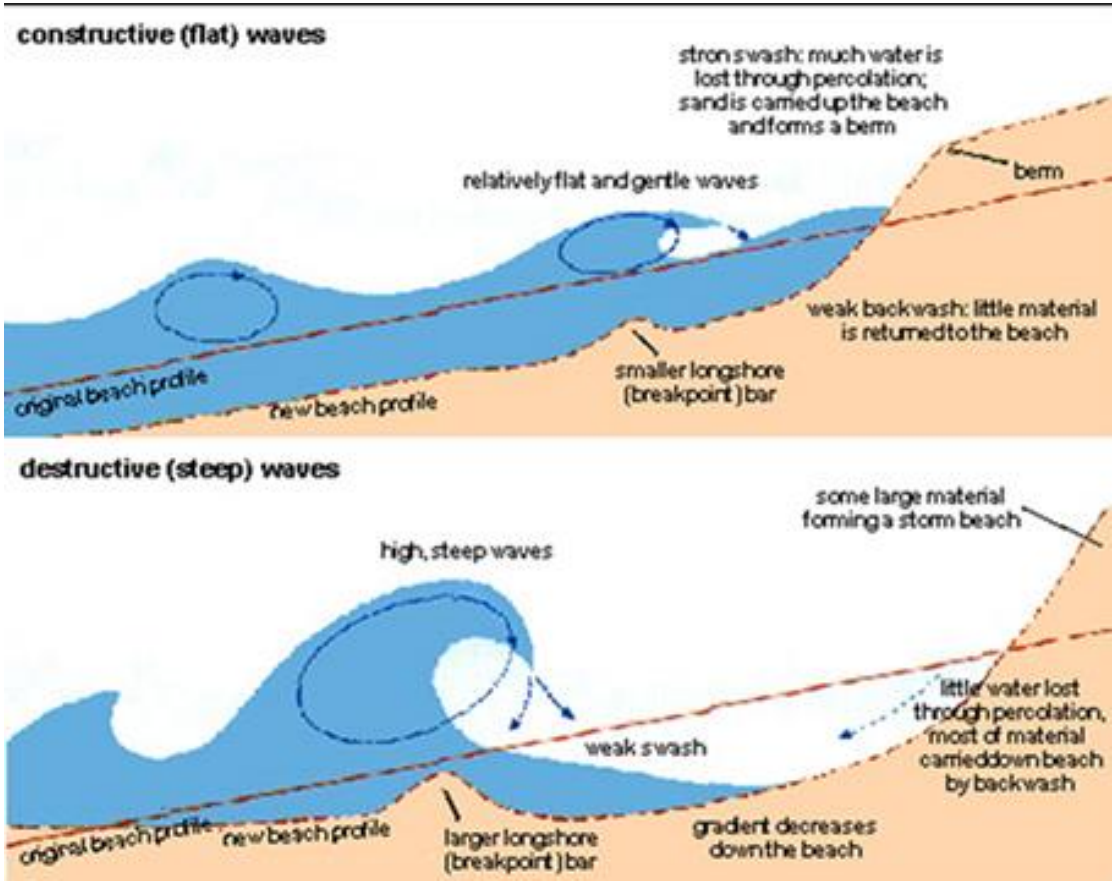
Wave types

Constructive waves have limited energy. Most of this is used by the ***swash*** to transport material up the beach.

Destructive waves have much more energy. Most of this is used by the ***backwash*** to transport material back down the beach.



Constructive waves	Destructive waves
These are low waves that surge up the beach with a powerful swash	Formed by local storms close to the coast, waves are often high and steep
They 'construct' the beach by depositing large amounts of sand and pebbles	They can destroy a beach and with a powerful backwash they remove sand and pebbles
Surfers prefer constructive waves as they give a longer ride!	They are often chaotic masses of swirling water – not great for surfing!

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Weathering

Exposed rocks along the coastline can be broken down by the processes of weathering.

Biological weathering

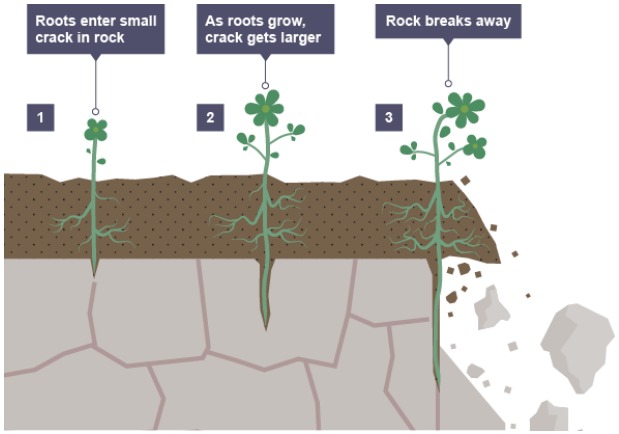
- ✓ Plants and animals can also have an effect on rocks. Roots burrow down, weakening the structure of the rock until it breaks away.
- ✓ Plant roots can get into small cracks in the rock.
- ✓ As the roots grow, the cracks become larger.
- ✓ This causes small pieces of rock to break away.

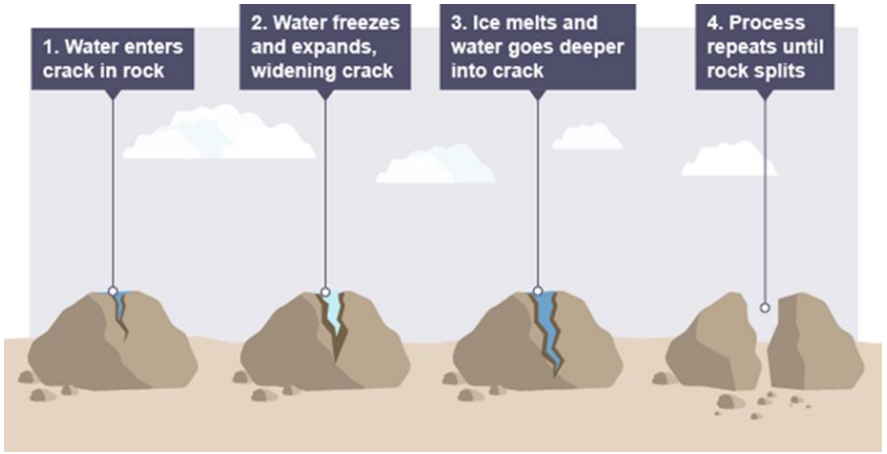
Chemical weathering

Rainwater and seawater can be a weak acid. If a coastline is made up of rocks such as limestone or chalk, over time they can become dissolved by the acid in the water.

Freeze-thaw weathering

- Freeze-thaw weathering occurs when water enters cracks in the rock.
- When temperatures drop, the water freezes and expands causing the crack to widen.
- The ice melts and water makes its way deeper into the cracks.
- The process repeats itself until the rock splits entirely.





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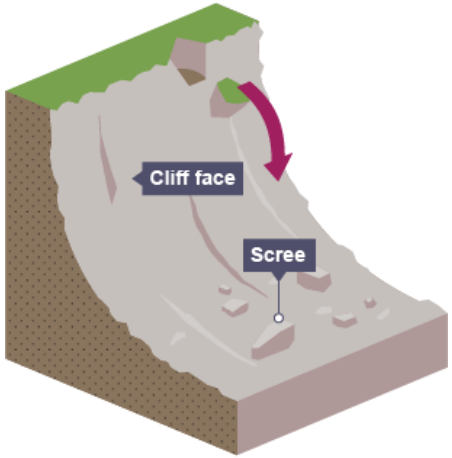
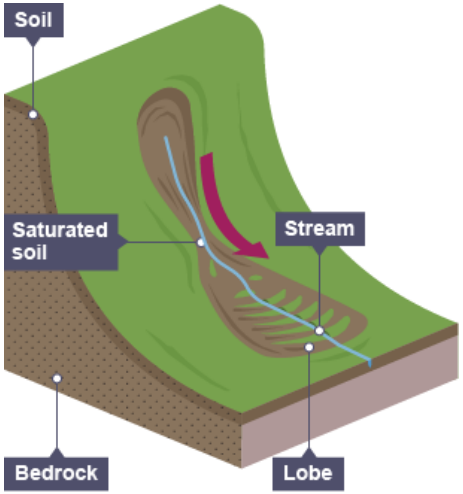
Mass movement



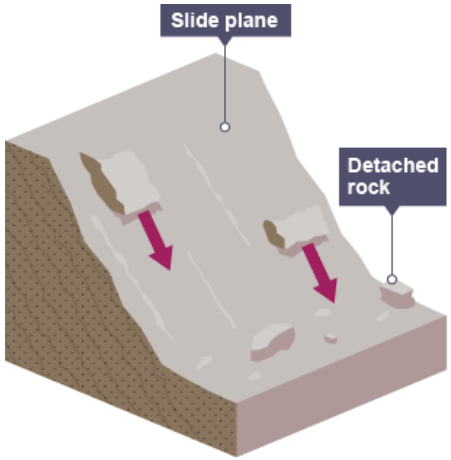
Rockfall

Bits of rock fall off the cliff face, usually due to freeze-thaw weathering.



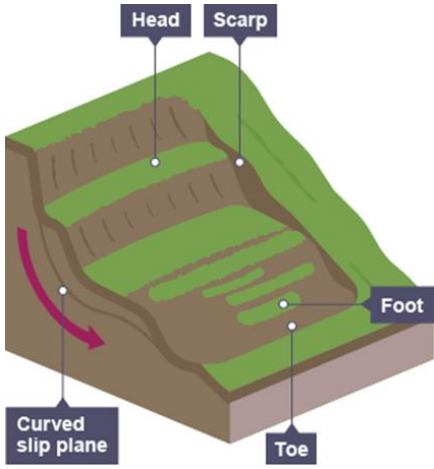
Mudflow

Saturated soil (soil filled with water) flows down a slope.



Landslide

Large blocks of rock slide downhill.



Rotational Slip

Saturated soil slumps down a curved surface.

Mass movement is the downhill movement of material. Often rock and cliff material ends up on the beach ready to be eroded, transported and deposited further along the coast.

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Erosion

The wearing away of rock along the coastline.

Destructive waves are responsible for erosion on the coastline.

Hydraulic action - this is the sheer power of the waves as they smash against the cliff. Air becomes trapped in the cracks in the rock and causes the rock to break apart.

Abrasion - this is when pebbles grind along a rock platform, much like sandpaper. Over time the rock becomes smooth.

Attrition - this is when rocks that the sea is carrying knock against each other. They break apart to become smaller and more rounded.

Solution - this is when sea water dissolves certain types of rocks. In the UK, chalk and limestone cliffs are prone to this type of erosion.

Transportation

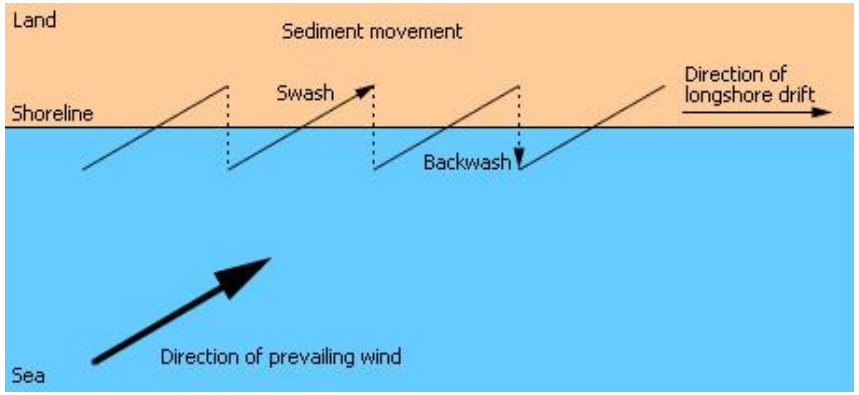
Beach material can be moved in four different ways. These are:

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

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

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

Traction – where pebbles and larger material are rolled along the sea bed.



Sediment is carried by the waves along the coastline. The movement of the material is known as **longshore drift**.

- Waves approach the coast at an angle because of the direction of **prevailing wind**.
- The swash will carry the material towards the beach.
- The backwash then flows back to the sea, down the slope of the beach.
- The process repeats itself along the coast in the zigzag movement.

Deposition

When the sea loses energy, it drops the material it has been carrying. *This is known as deposition.* Deposition can occur on coastlines that have **constructive waves.**

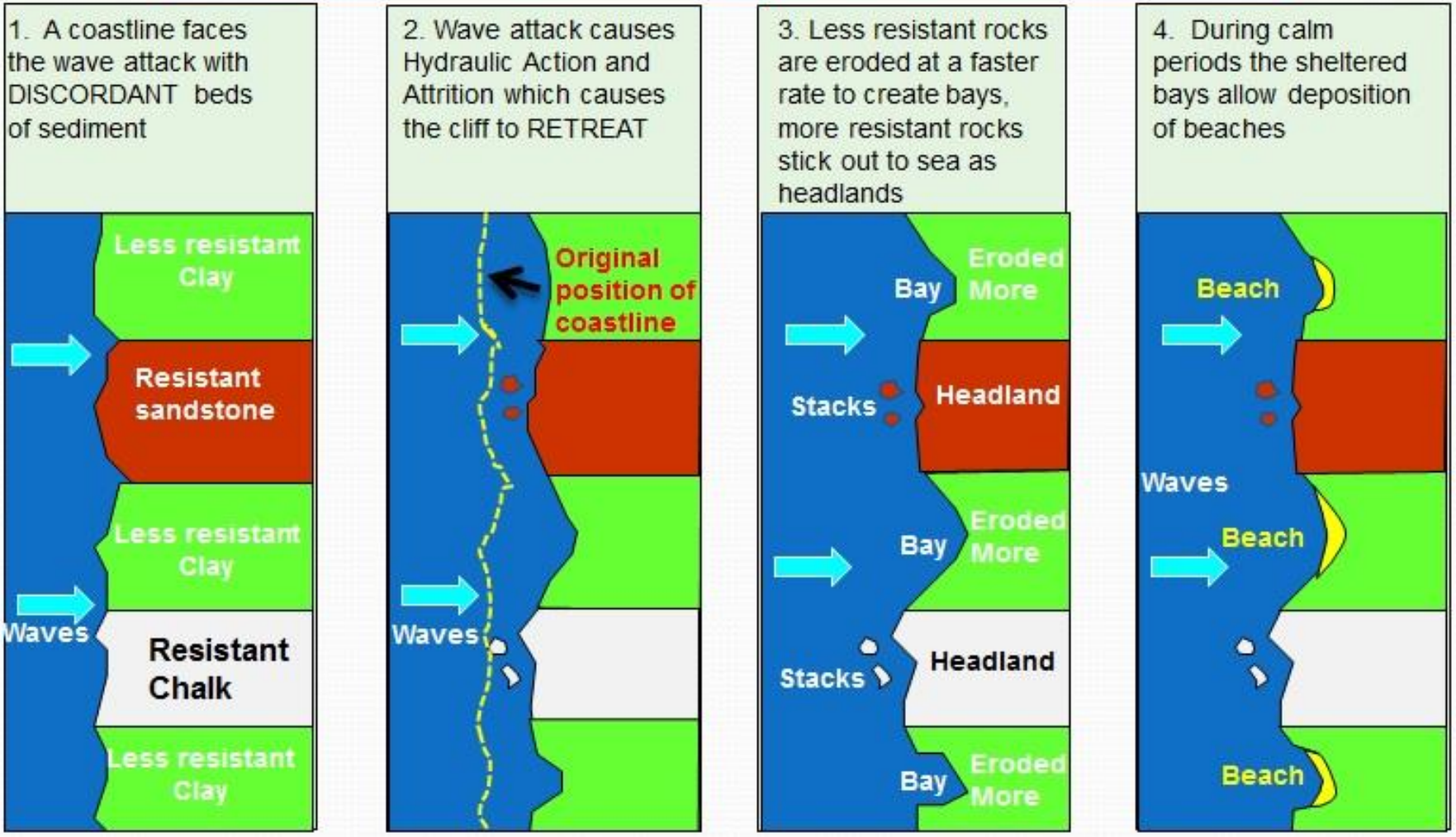
Factors leading to deposition include:

- waves starting to slow down and lose energy
- shallow water
- sheltered areas, e.g. bays
- little or no wind

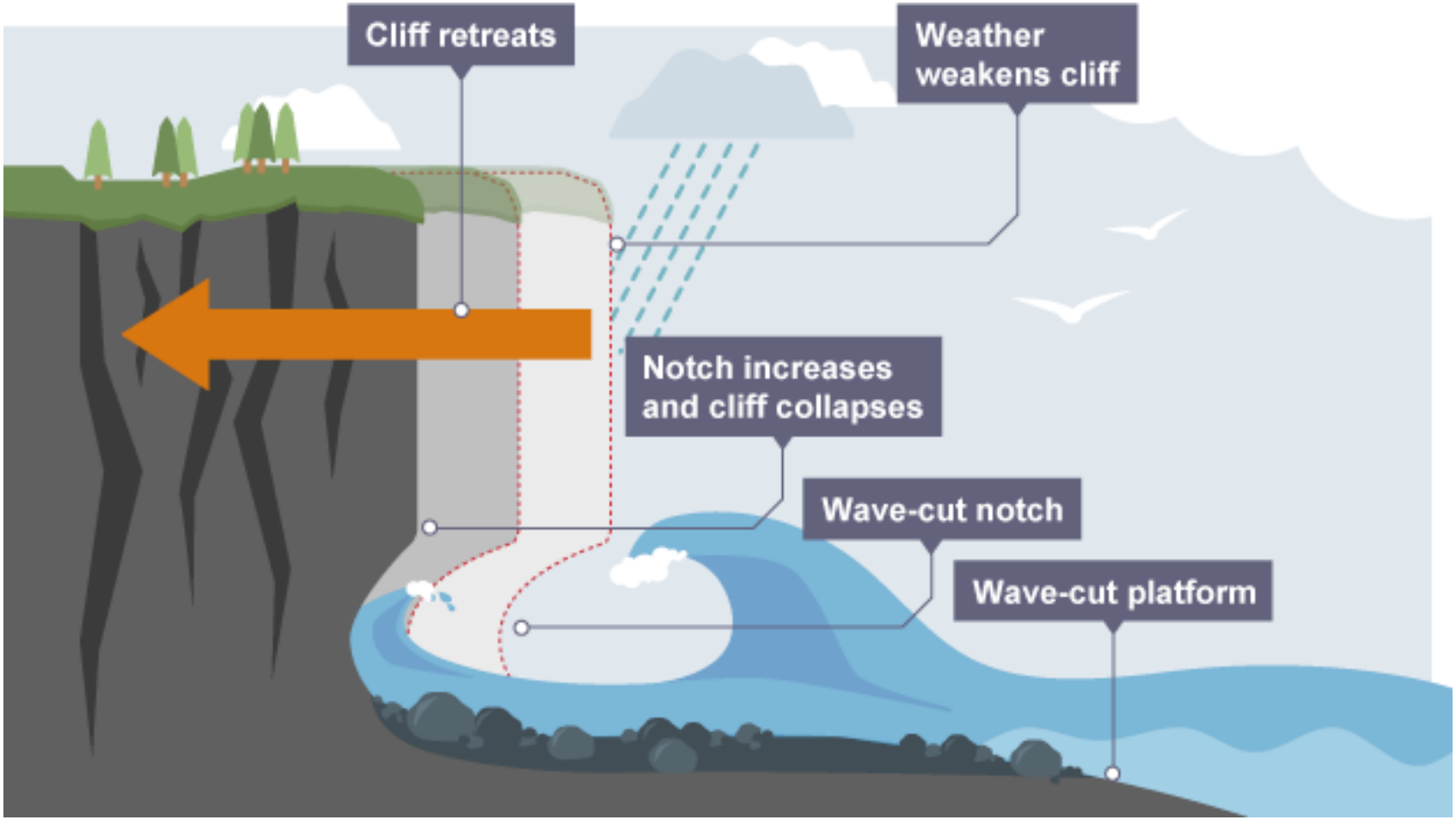
Coastal landforms created by coastal erosion

1. Bays and headlands
2. Cliffs, wave cut notch and wave cut platform
3. Cave, arch, stack

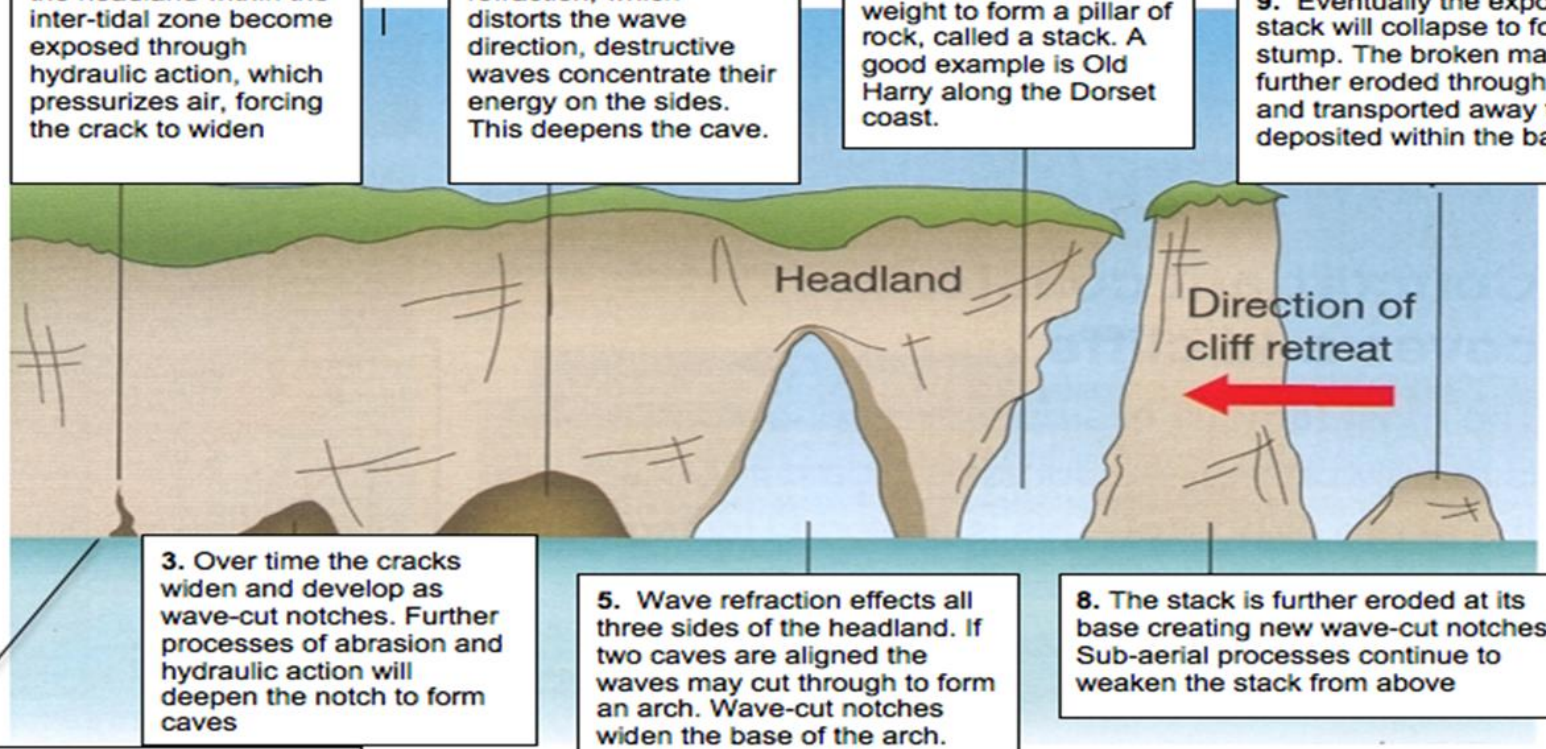
The formation of Bays and Headlands



Cliffs and wave cut platforms



Caves, arches & stacks



1. Cracks at the base of the headland within the inter-tidal zone become exposed through hydraulic action, which pressurizes air, forcing the crack to widen

2. Cracks are further widened by weathering processes such as salt crystallization and wet and dry weathering that affects chalk.

3. Over time the cracks widen and develop as wave-cut notches. Further processes of abrasion and hydraulic action will deepen the notch to form caves

4. As a result of wave refraction, which distorts the wave direction, destructive waves concentrate their energy on the sides. This deepens the cave.

5. Wave refraction effects all three sides of the headland. If two caves are aligned the waves may cut through to form an arch. Wave-cut notches widen the base of the arch.

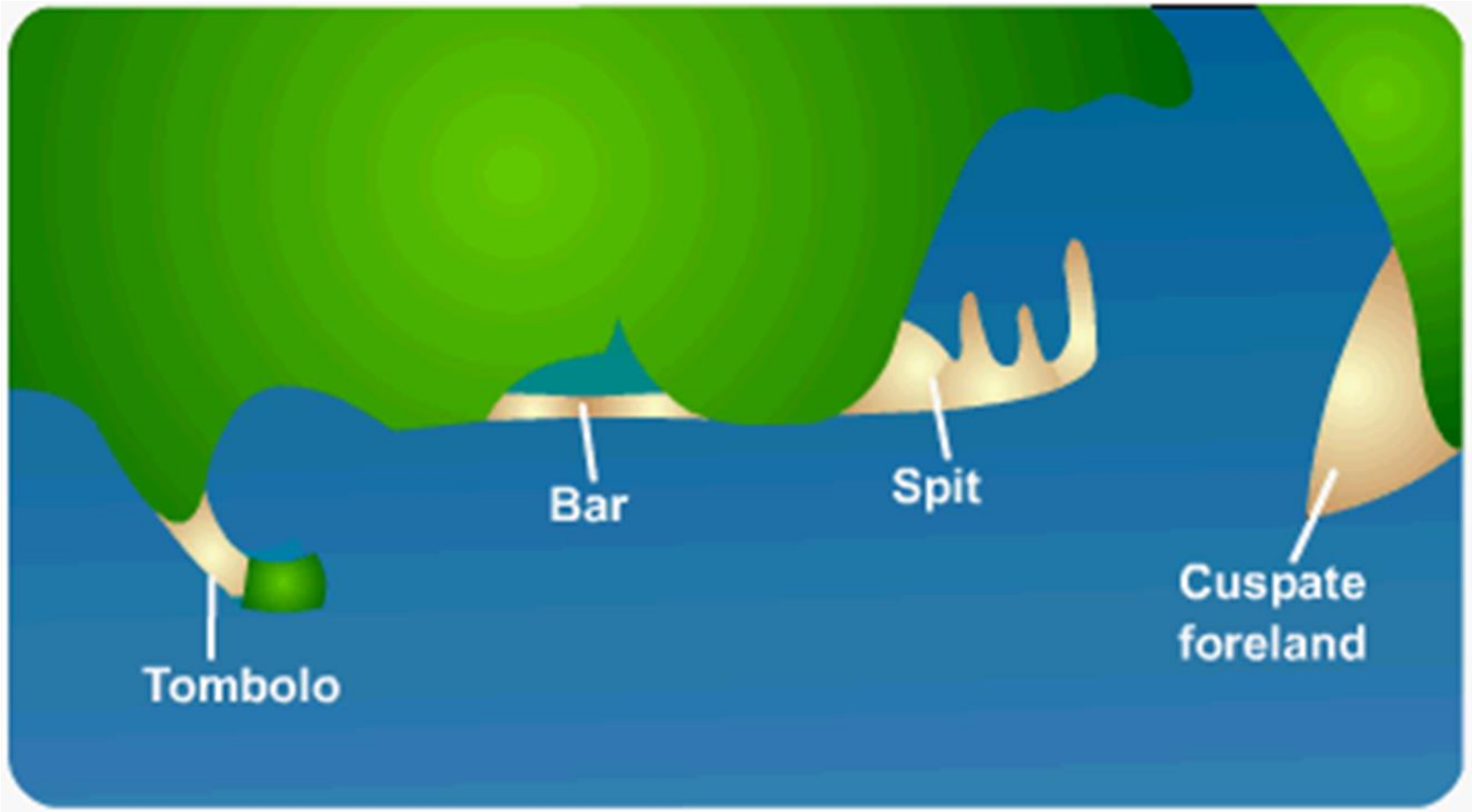
6. Vertical joints are exposed by tall breakers associated with destructive waves. Joints can also be weathered from above such as through carbonation in limestone. Here blowholes may form.

7. Over time the arch becomes unstable and collapses under its own weight to form a pillar of rock, called a stack. A good example is Old Harry along the Dorset coast.

8. The stack is further eroded at its base creating new wave-cut notches. Sub-aerial processes continue to weaken the stack from above

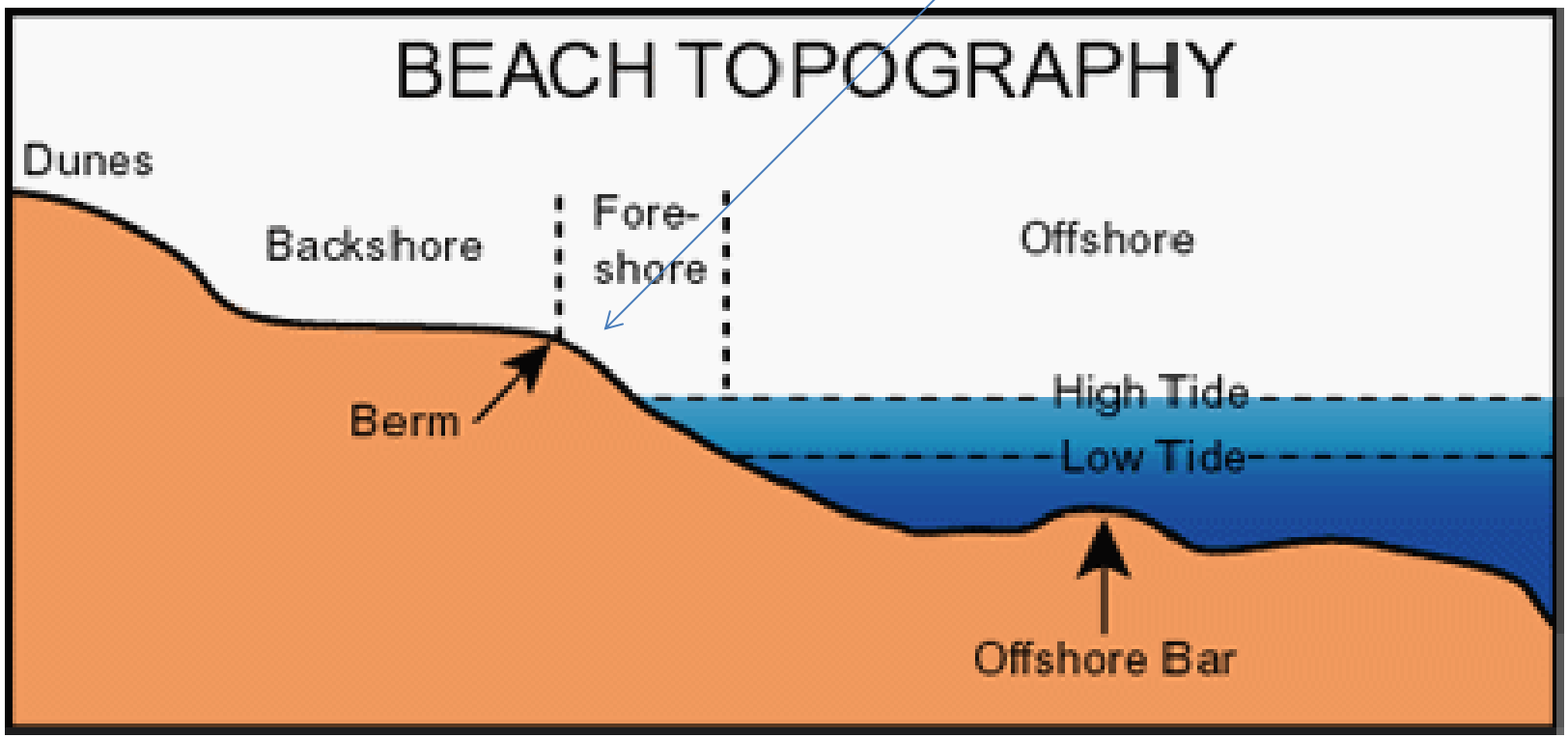
9. Eventually the exposed stack will collapse to form a stump. The broken material is further eroded through attrition and transported away to be deposited within the bay

Coastal landforms created by deposition

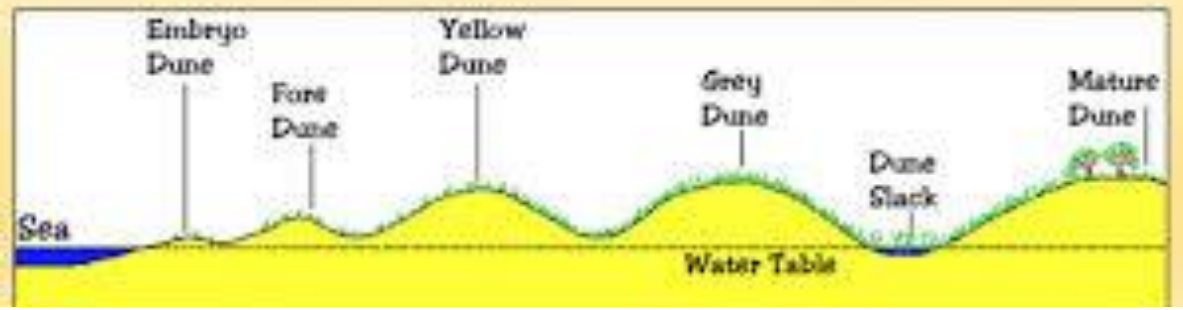


Beach profile

This berm marks the high tide line where seaweed and rubbish get washed up on the beach



How are Sand Dunes formed on a coast?



Sand accumulates against a feature and builds upper beach height	Wind speed drops behind accumulation resulting in more sand deposition	Marram grass colonises embryo dunes stabilizing further dune migration	Marram leaves further reduce wind speed and capture more blown sand. Decaying plants add humus	Microclimate and soil conditions change allowing colonisation by additional species

Time

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Spits

How does a spit like Dawlish Warren form?

A spit is a long narrow ridge of sand and shingle which is projected into the sea from the coastline

Longshore drift transports material along the coastline

Spits form in shallow and sheltered water when there is a change in the direction of the coastline

Deposition occurs which results in the accumulation of and shingle

The material initially deposited is the largest material, dropped due to the reduction in energy

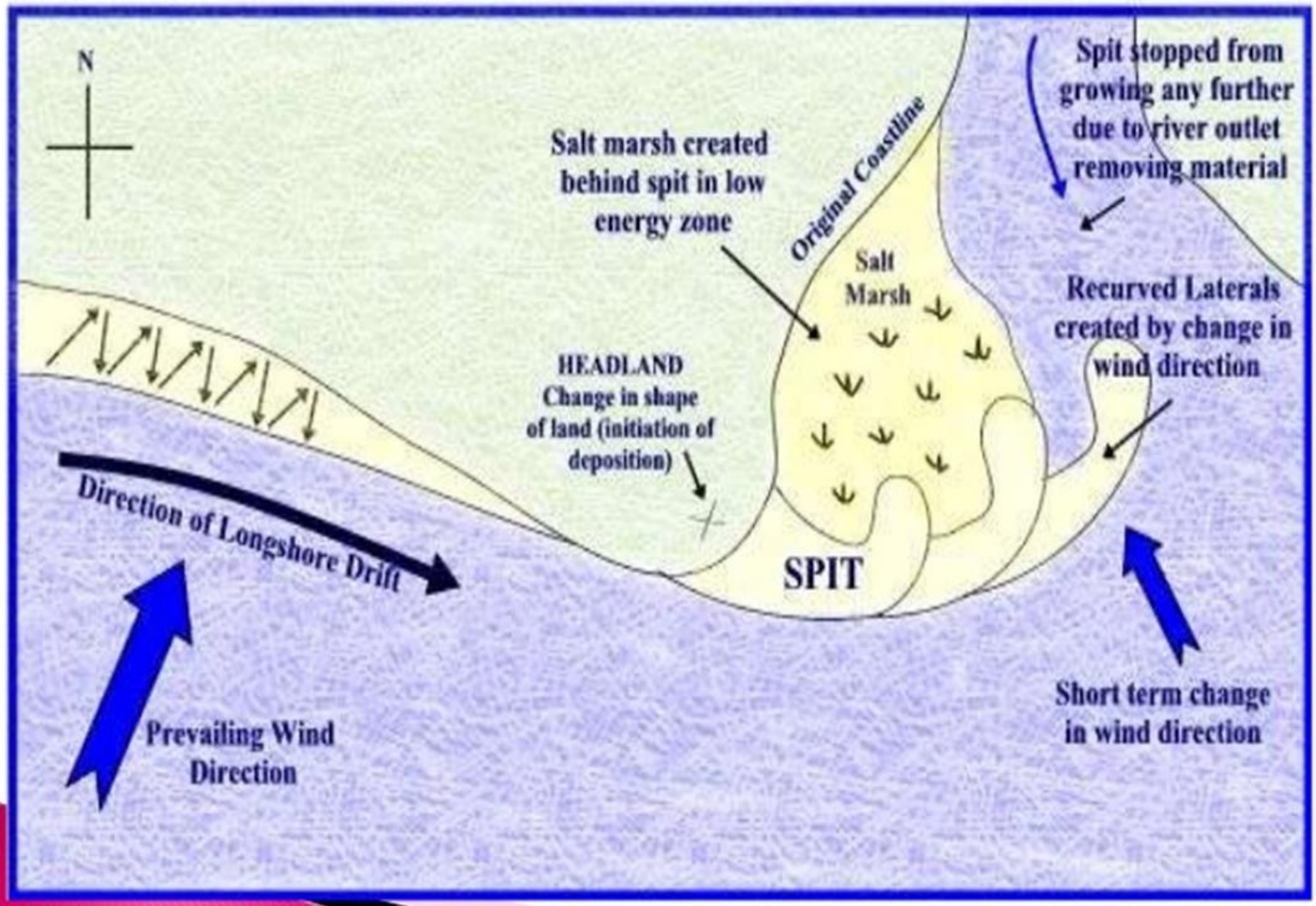
Finer material is then deposited helping to build up the rest of the spit

As a spit grows outwards a change in wind direction may result in a change in the direction of the spit causing it to curve or hook at the end

If growing across a river estuary the length of the spit will be restricted due to the strength of the river current.

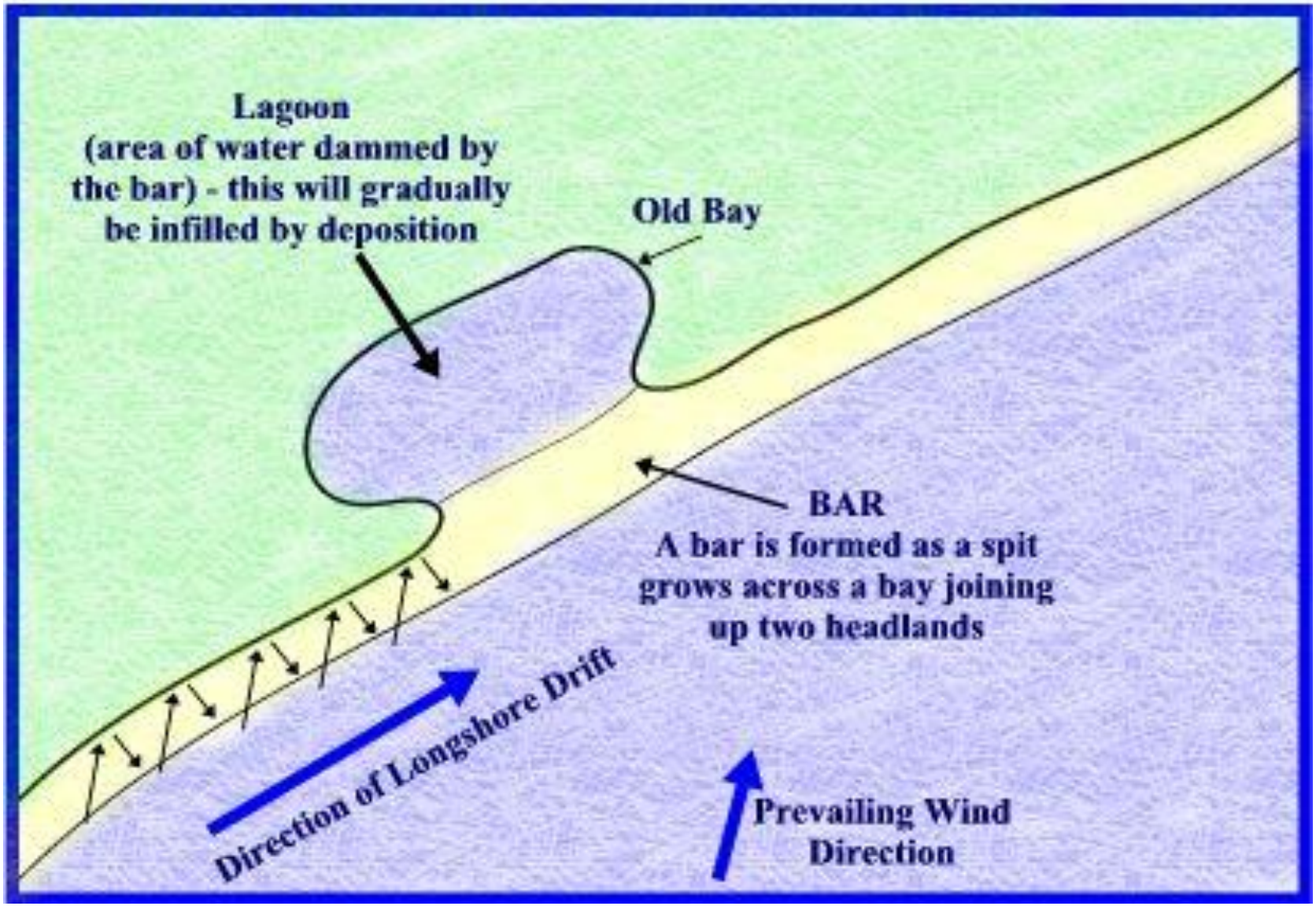
A saltmarsh may form in the sheltered low energy zone behind the spit

The Formation of a Spit



http://geobytesgcse.blogspot.com/2007/08/coastal-deposition-landforms-features.html

Formation of a Bar



CASE STUDY:
Landforms of erosion and deposition along the Dawlish coastline

Learn your case study that you completed in class to show the different landforms found along the Dawlish coast.

Be able to:

- ✓ Locate them
- ✓ Describe them
- ✓ Explain how they were formed

Different management strategies can be used to protect the coast

Hard engineering

- Sea walls
- Groynes
- Rock armour
- Gabions

Soft engineering

- Beach nourishment
- Dune regeneration
- Managed retreat

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Hard engineering

Sea wall

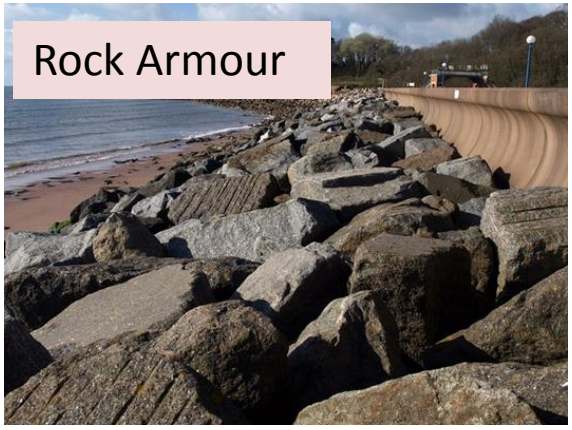
Seawalls absorb the impact of the wave or deflect the power of the wave (curved sea wall) this takes away the erosive power of the wave.

They are usually built to protect roads and towns along the coast or in the case of Dawlish to protect the mainline train line.

Groynes

Groynes are wooden or rock barriers built at right angles to the beach.

They trap sand from longshore drift and build up a wide beach. This slows the waves before they reach the cliffs or sea wall behind through friction of the wave on the sand or shingle/pebbles.



Rock Armour

Rock armour (Rip-Rap) are large boulders or man-made installations piled up on the beach. They work to reduce the erosion by absorbing the impact of the wave before the wave can hit the cliff or seawall behind.

Gabions

Wire cages filled with rocks that can be built up to support a cliff or provide a buffer against the sea.

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Soft engineering

Beach nourishment

This **replaces** beach material that has been removed by erosion or longshore drift. Beach replenishment or nourishment is one of the most popular soft engineering techniques. It involves importing sand/shingle from another location to build up the beach & stop it eroding completely. The imported beach material must be of a similar quality to the existing beach material so it can integrate with the natural processes occurring there.

Dune replenishment

Coastal sand dunes protect inland areas from erosion. They are able to absorb the impact from high energy storms and act as a barrier to destructive waves.

Coastal dunes are highly sensitive to any number of human activities and need careful management in order to survive. Marram grass and fencing are used to manage the dunes

Managed Retreat

Areas of the coast are allowed to **erode and flood** naturally. Usually this will be areas considered to be of **low value** - e.g. places not being used for housing or farmland.

The advantages are that it encourages the development of **beaches** (a natural defence) and **salt marshes** (important for the environment) and cost is low.

Managed retreat is a cheap option, but people will need to be **compensated** for loss of buildings and farmland.

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Costs and benefits of hard/soft engineering

Advantages of hard engineering	Disadvantages hard engineering
Effective at stopping the waves from eroding	They are very expensive and can involve lots of maintenance e.g. Sea walls and Gabions
Create a wide beach (Groynes) for tourists to enjoy so good for the economy	They interfere with natural coastal processes and can have destructive knock on effects further down the Coast e.g. Mappleton on the Holderness Coast
Can be relatively cheap e.g. Gabions	They look unnatural
Can blend in reasonably quickly as they become vegetated e.g. Gabions	
Advantages of soft engineering	**Disadvantages of soft engineering**
Tends to be cheaper than hard engineering	Needs constant maintenance unless hard structures are also used to maintain the beach e.g. every few years beaches will need replenishing and dunes need replanting with marram grass
Blends in with the existing landscape so they look natural	Time consuming to plant marram grass and fence dunes off
Soft engineering approaches such as beach nourishment try to work with the natural coastal processes so are more sustainable	Can be easily damaged by storms

CASE STUDY: Holderness coastline, NE England

An example of a coastal management scheme in the UK

Learn your case study that you completed in class to show how the Holderness coastline is being managed

Be able to show:

- ✓ The reasons for management
- ✓ The management strategy
- ✓ The resulting effects and conflicts