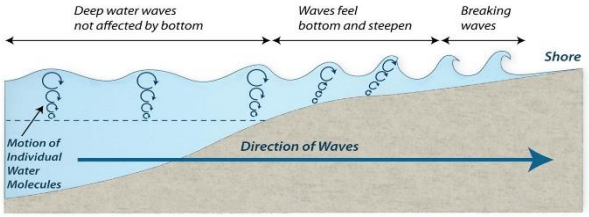
Physical Landscapes in the UK

How do waves form?

Waves are created by wind blowing over the surface of the sea. As the wind blows over the sea, friction is created - producing a swell in the water.

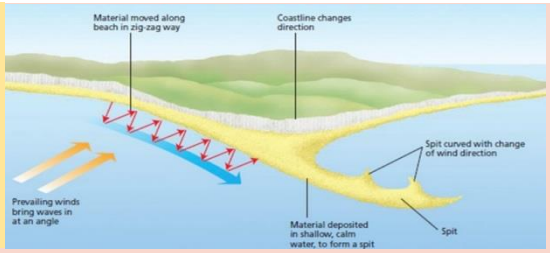
Why do waves break?

1	**Waves start out at sea.**
2	**As waves approaches the shore, friction slows the base.**
3	**This causes the orbit to become elliptical.**
4	**Until the top of the wave breaks over.**



Formation of Coastal Spits - Deposition

Example: Spurn Head, Holderness Coast.



1) Swash moves up the beach at the angle of the prevailing wind.
2) Backwash moves down the beach at 90° to coastline, due to gravity.
3) Zigzag movement (Longshore Drift) transports material along beach.
4) Deposition causes beach to extend, until reaching a river estuary.
5) Change in prevailing wind direction forms a hook.
6) Sheltered area behind spit encourages deposition, salt marsh forms.

Types of Erosion

The break down and transport of rocks – smooth, round and sorted.

Attrition	Rocks that bash together to become smooth/smaller.
Solution	A chemical reaction that dissolves rocks.
Abrasion	Rocks hurled at the base of a cliff to break pieces apart or scraped against the banks and bed of a river.
Hydraulic Action	Water enters cracks in the cliff, or river bank, air compresses, causing the crack to expand.

Types of Weathering

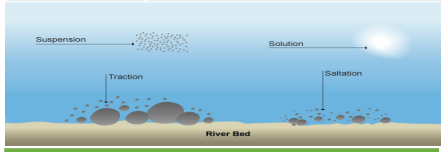
Weathering is the breakdown of rocks where they are.

Biological	Breakdown of rock by plants and animals e.g. roots pushing rocks apart.
Mechanical	Breakdown of rock without changing its chemical composition e.g. freeze thaw

Types of Transportation

A natural process by which eroded material is carried/transported.

Solution	Minerals dissolve in water and are carried along.
Suspension	Sediment is carried along in the flow of the water.
Saltation	Pebbles that bounce along the sea/river bed.
Traction	Boulders that roll along a river/sea bed by the force of the flowing water.



What is Deposition?

When the sea or river loses energy, it drops the sand, rock particles and pebbles it has been carrying. This is called deposition. Heaviest material is deposited first.

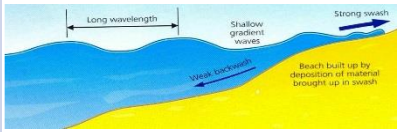
Mechanical Weathering Example: Freeze-thaw weathering

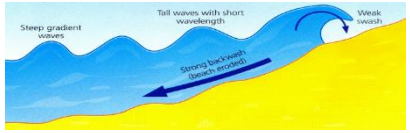
Stage Two
When the water freezes, it expands about 9%. This wedges apart the rock.

Stage Three
With repeated freeze-thaw cycles, the rock breaks off.

Types of Waves

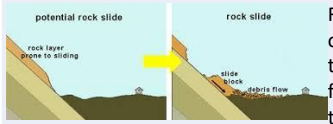
Constructive Waves	Destructive Waves
This wave has a swash that is stronger than the backwash. This therefore builds up the coast.	This wave has a backwash that is stronger than the swash. This therefore erodes the coast.



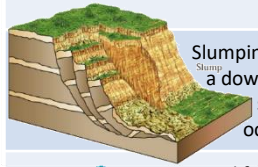


Mass Movement

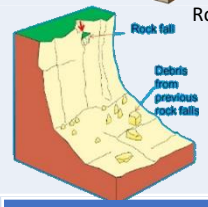
A large movement of soil and rock debris that moves down slopes in response to the pull of gravity in a vertical direction.



Rock slides occur when there is a failure along the bedding plane.

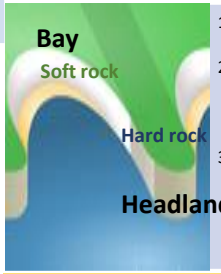


Slumping occurs when there is a downward rotation of sections of cliff. Often occur after heavy rain.



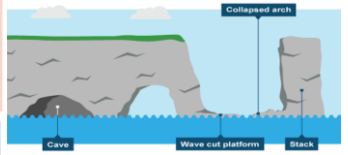
Rockfall is the rapid free fall of rock from a steep cliff face because of gravity.

Formation of Bays and Headlands



1) Waves attack the coastline.
2) Softer rock is eroded by the sea quicker forming a bay, calm area cases deposition.
3) More resistant rock is left jutting out into the sea. This is a headland and is now more vulnerable to erosion.

Formation of Coastal Stack



Example: Old Harry Rocks, Dorset

1) **Hydraulic action widens cracks in the cliff face over time.**
2) **Abrasion forms a wave cut notch between high tide and low tide.**
3) **Further abrasion widens the wave cut notch to from a cave.**
4) **Caves from both sides of the headland break through to form an arch.**
5) **Weather above/erosion below –arch collapses leaving stack.**
6) **Further weathering and erosion eaves a stump.**

f waves

l by:
h how
far the wave has travelled
- Strength of the wind.
- How long the wind has been blowing for.

Coastal Defences

Hard Engineering Defences

Groynes	**Wood barriers prevent longshore drift, so the beach can build up.**	✓ **Beach still accessible.** ✗ **No deposition further down coast = erodes faster.**
Sea Walls	**Concrete walls break up the energy of the wave . Has a lip to stop waves going over.**	✓ **Long life span** ✓ **Protects from flooding** ✗ **Curved shape encourages erosion of beach deposits.**
Gabions or Rip Rap	**Cages of rocks absorb the waves, protecting the cliff.**	✓ **Cheap** ✓ **Local material can be used to look less strange.** ✗ **Will need replacing.**

Soft Engineering Defences

Beach Nourishment	**Beaches built up with sand, so waves have to travel further before eroding cliffs.**	✓ **Cheap** ✓ **Beach for tourists.** ✗ **Storms = need replacing.** ✗ **Offshore dredging damages seabed.**
Managed Retreat	**Low value areas of the coast are left to flood & erode.**	✓ **Reduce flood risk** ✓ **Creates wildlife habitats.** ✗ **Compensation for land.**

Case Study: Holderness Coast

About 1.8m of land is lost each year. Farms and businesses are threatened.
Over 11km of coast is managed suing hard engineering to protect the towns of Hornsea, Withernsea and Mappleton as well as roads and the gas terminal at Easington that supplies 25% of the UIK's gas and is right on the cliff.

Processes: Erosion is causing cliffs to collapse. Cliffs are made of soft, easily eroded boulder clay. Prevailing winds mean material is moved South through LSD.

Management: Rock armour used. 450 m of coast line protected by 61 000 tonnes of rocks at a coast of £2million. Rocks absorb the power of the waves.
2 rock groynes trap sand and create a beach to protect the cliffs Hornsea has a sea wall and some groynes and at Withernsea there is a sea wall, groynes and rock armour.

Problems: Spurn Head spit is still being washed away. Protecting the gas terminal at Easington cost £6.6 million. Mappleton is protected by groynes but this leads to increased erosion south of Mappleton.

Middle Course of a River

Here the gradient is gentler, so the water has less energy. The river will begin to erode laterally making the river wider.

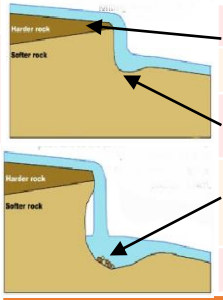
Physical and Human Causes of Flooding.

Physical: Prolong & heavy rainfall Long periods of rain causes soil to become saturated leading runoff.	Physical: Geology Impermeable rocks causes surface runoff to increase river discharge.
Physical: Relief Steep-sided valleys channels water to flow quickly into rivers causing greater discharge.	Human: Land Use Tarmac and concrete are impermeable. This prevents infiltration & causes surface runoff.

Upper Course of a River

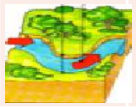
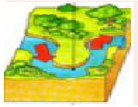
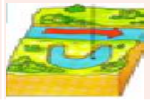
Near the source, the river flows over steep gradient from the hill/mountains. This gives the river a lot of energy, so it will erode the riverbed vertically to form narrow valleys.

Formation of a Waterfall



1) River flows over alternative types of rocks.
2) River erodes soft rock faster creating a step.
3) Further hydraulic action and abrasion form a plunge pool beneath.
4) Hard rock above is undercut leaving cap rock which collapses providing more material for erosion.
5) Waterfall retreats leaving steep sided gorge.

Formation of Ox-bow Lakes

Step 1	Step 2
 Erosion of outer bank forms river cliff. Deposition inner bank forms slip off slope.	 Further hydraulic action and abrasion of outer banks, neck gets smaller.
Step 3	**Step 4**
 Erosion breaks through neck, so river takes the fastest route, redirecting flow	 Evaporation and deposition cuts off main channel leaving an oxbow lake.

Case Study - Boscastle flood August 16th 2004

Boscastle is a small village in Cornwall. It has a permanent population of under 1000. 90% of jobs in the village are linked to tourism.

Causes of flood - 5 hours of heavy rain (3 inches in 1 hour), Impermeable rock, steep valley sides, thin soils limit vegetation. Buildings narrowing river channel. Narrow bridges trapped debris.
Effects of flood - 100 homes and 25 businesses damaged. 75 cars and 8 boats washed away. 150 people had to be rescued. Damage cost £15 million.
Responses to flood - Scheme cost £4.6 million. Beds of rivers lowered and channels widened. Bridges widened. Car park raised. Trees removed from near river.

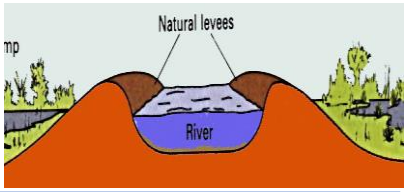
Lower Course of a River

Near the river's mouth, the river widens further and becomes flatter. Material transported is deposited.

Formation of Floodplains and levees

When a river floods, fine silt/alluvium is deposited on the valley floor. Closer to the river's banks, the heavier materials build up to form natural levees.

✓ Nutrient rich soil makes it ideal for farming.
✓ Flat land for building houses.



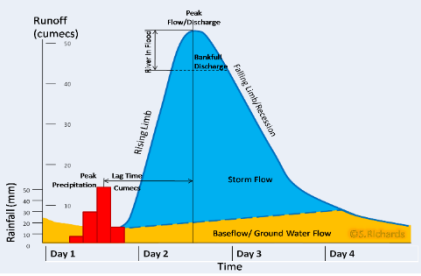
River Management Schemes

Soft Engineering	Hard Engineering
Afforestation – plant trees to soak up rainwater, reduces flood risk. Demountable Flood Barriers put in place when warning raised. Managed Flooding – naturally let areas flood, protect settlements.	Straightening Channel – increases velocity to remove flood water. Artificial Levees – heightens river so flood water is contained. Deepening or widening river to increase capacity for a flood.

Hydrographs and River Discharge

River discharge is the volume of water that flows in a river. Hydrographs who discharge at a certain point in a river changes over time in relation to rainfall

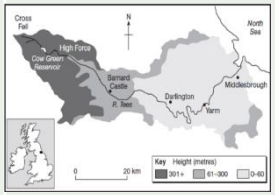
1. Peak discharge is the discharge in a period of time.
2. Lag time is the delay between peak rainfall and peak discharge.
3. Rising limb is the increase in river discharge.
4. Falling limb is the decrease in river discharge to normal level.



Case Study: The River Tees

Location and Background
Located in the North of England and flows 137km from the Pennines to the North Sea at Red Car.

Geomorphic Processes
Upper – Features include V-Shaped valley, rapids and waterfalls. High Force Waterfall drops 21m and is made from harder Whinstone and softer limestone rocks. Gradually a gorge has been formed.
Middle – Features include meanders and ox-bow lakes. The meander near Yarm encloses the town.
Lower – Greater lateral erosion creates features such as floodplains & levees. Mudflats at the river's estuary.



Physical Landscapes in the UK - Coasts

AQA

You should also revise the UK map for this topic

Wave types and characteristics

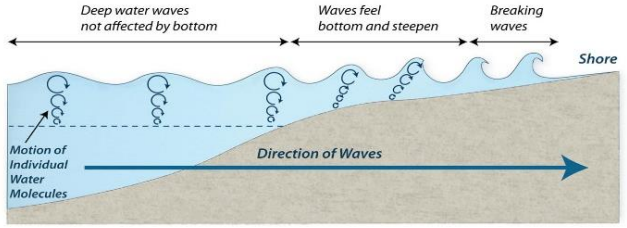
Waves are created by wind blowing over the surface of the sea. This creates friction, producing ripples, which grow to produce waves.

Why do waves break?

1. Waves start out at sea.
2. Approaching the shore, friction slows the base.
3. The crest of the wave rises up until…
4. Top of the wave breaks rushing up the beach

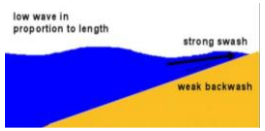
Size of waves

- Fetch (distance wind has blown over the water)
- Wind strength
- Time wind has been blowing



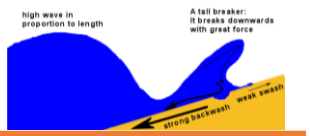
Constructive Waves

Swash is stronger than backwash This builds up the beach.



Destructive Waves

Backwash is stronger than the swash. This erodes the coast.



Coastal Processes

Weathering	**Mechanical** – breakdown of rock without physical change e.g. Freeze-thaw **Chemical** – breakdown of rock by chemical changes e.g. carbonation (dissolving in acidic rain water)
Mass movement	**Sliding** – Blocks of rock slide downhill **Slumping** – Saturated soil/weak rock slump along a curved surface **Rock fall** – Rock fragments break away and fall from cliff face (often linked to freeze-thaw
Erosion	**Hydraulic power** – Power of the waves against the cliff, forcing air into cracks and breaking the rock apart **Abrasion** – Scraping of sand and pebbles against rocks, making them smooth (sandpaper effect) **Attrition** – Rock fragments in the sea collide and break apart
Transportation	**Solution, suspension, saltation and traction (see rivers)** **Longshore drift** – Movement of sediment along a beach by a zig-zag pattern of swash and backwash
Deposition	Coastal deposition takes place where water flow is slowed down, e.g. sheltered bays where wave energy is reduced.

Coastal Landforms

Geology (rock type) affects coastal landforms. Soft rock (like clay) is more quickly eroded. Hard rock (e.g. granite) erodes very slowly.

Landforms from erosion

Headlands and bays	Bands of softer rock erode faster to form bays, bands of harder rock erode slowly, sticking out to sea, forming headlands.
Cliffs and wave cut platforms	Waves erode the base of the cliffs at high tide, forming a wave-cut notch. Over many years, this gets bigger, undercutting the cliff. Eventually, the overlying cliff collapses. This repeats, leaving a gently sloping rocky wave-cut platform.
Caves, arches, stacks and stumps	1. Rocks in headlands have lines of weakness (cracks) 2. Waves hitting the cliffs widens cracks through hydraulic action and abrasion, eventually forming a cave 3. 2 back to back caves from both sides of the headland break through to form an arch. 4. Continued weathering and erosion enlarges the arch 5. When the arch is too big, the roof collapses leaving an isolated pillar of rock (a stack) 6. Further erosion causes the stack to collapse, leaving a stump.

Landforms from deposition

Beaches	Beaches mainly form in sheltered bays and are built up by constructive waves. They can be made of sand, shingle or pebbles.
Sand dunes	Sand blown inland by winds can form dunes. Embryo dunes for around obstacles like rocks. Vegetation like marram grass grows on the new dunes, stabilising them. Rotting vegetation slowly adds organic matter to the dunes, making them more fertile, bigger plants can then grow there.
Spits and bars	1. Swash moves up the beach at the angle of the prevailing wind. 2. Backwash moves down the beach at 90° to coastline due to gravity. 3. Zigzag movement (Longshore Drift) transports material along beach. 4. Deposition causes beach to extend, until reaching a river estuary. 5. Change in prevailing wind direction forms a hook. 6. Deposition in sheltered area behind spit, salt marsh forms.

Example of UK coastline: The Swanage Coast

Swanage is a seaside town in Dorset on the south coast of England. The coastline is made up of alternating hard and soft rock bands, forming headlands and bays.

Erosional Landforms
Headlands: Ballard Point
Bays: Swanage Bay, Studland Bay
Caves, arches, stacks: The Foreland, Old Harry (stack)

Depositional Landforms
Spit : Studland Heath
Beach and dunes: Studland Bay

Coastal Defences

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Groynes	**Wood barriers prevent longshore drift, so the beach can build up.**	✓ **Beach still accessible.** ✗ **No deposition further down coast = erodes faster.**
Sea Walls	**Concrete walls break up the energy of the wave .**	✓ **Long life span** ✓ **Protects from flooding** ✗ **Curved shape encourages erosion of beach deposits.**
Gabions or Rip Rap	**Cages of rocks absorb the waves, protecting the cliff.**	✓ **Cheap** ✓ **Local material can be used to look less strange.** ✗ **Will need replacing.**
Rock armour	**Piles of large boulders absorb the energy from the waves.**	✓ **Relatively cheap** ✓ **Can be used for fishing.** ✗ **Can be obtrusive** ✗ **Expensive to transport**

Soft Engineering Defences

Beach Nourishment	**Beaches built up with sand, protecting the cliffs behind.**	✓ **Cheap** ✓ **Beach for tourists.** ✗ **Storms = need replacing.** ✗ **Offshore dredging damages seabed.**
Dune regeneration	**Marram grass can be planted to stabilise the dunes, protecting the land behind.**	✓ **Relatively cheap** ✓ **Maintains natural environment** ✗ **Can be damaged by storms** ✗ **Time consuming to plant**
Dune fencing	**Fences alongside existing dunes to encourage new dunes to form.**	✓ **Protection from public** ✓ **Low impact on nature** ✗ **Can be damaged by storms** ✗ **May look unsightly**
Managed Retreat	**Low value areas are left to flood & erode.**	✓ **Reduce flood risk** ✓ **Creates wildlife habitats.** ✗ **Compensation for land.**

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