

Formations of coastal features		Key Terms		Wave types and their characteristics				
		How are caves/arches and stacks formed?	1) A large crack is enlarged by the pressure on/off effect of hydraulic action. 2) The crack grows into a notch and then a cave as destructive waves converge on the headland and continue to erode it. 3) Over time, the cave becomes larger. Wave refraction draws waves to all sides of the headland so caves may form back to back. 4) The sea breaks through the back of the caves forming a natural arch. The base of the arch is widened as notches form. 5) Weathering such as freeze-thaw continues to weaken the top of the arch, making it less stable. 6) The top of the arch eventually collapses. 7) This leaves a pillar of detached rock called a stack. 8) Notches form at the base of the stack, which eventually makes it unstable. 9) The stack will eventually topple into the sea, leaving only its base. This stump is normally only visible at low tide.	Mass movement	Downhill movement of weathered material under the force of gravity.	How do waves form?	Waves are caused by the transfer of energy from the wind to the sea due to friction of the wind on the water's surface. The amount of energy in a wave depends 1) The speed of the wind. 2) How long the wind has been blowing. 3) The fetch.	
How is a sand dune formed?	1) When there are obstacles such as driftwood, the heavy grains of sand will settle against the obstacle to form a small ridge. Lighter grains may be transported and will settle on the other side of the obstacle. 2) Eventually the area facing the wind begins to reach a crest. This is because the pile of sand becomes so steep that it becomes unstable and begins to collapse under its own weight. 3) When this happens, the lighter grains of sand fall down the other side on the lee (slip) face. Sand stops slipping once a stable angle has been reached at 30-34 degrees. 4) The repeated cycle of wind blowing up the windward side and slipping down the leeward side causes a sand dune to migrate inwards over time. 5) A sand dune itself becomes an obstacle, so more dunes may form in front of it. The height of dunes depends on the strength of the wind. Stronger winds create higher dunes.	Mechanical Weathering	Physical disintegration or break up of exposed rock without any change in chemical composition, i.e. freeze-thaw.	What happens when waves reach the coast?	When the waves approach the shore there is forward movement of water as waves break and surge up the beach. 1) The seabed interrupts the circular movement of the water. 2) As the water becomes shallower, the circular motion become more elliptical. 3) This causes the crest of the wave to rise up and eventually collapse on the beach. The water that rushes up the beach is called the swash, and the water that flows back towards the sea is called the backwash.			
Coastal Realignment in Medmerry, West Sussex (Soft and Hard engineering strategy)		Chemical weathering	The decomposition (or rotting) of rock caused by a chemical change within that rock.					
Why was the scheme needed?	-Area of South East England most at risk of flooding due to climate change. -A shingle ridge beach was the only protection form the sea. -From the 1990's beach reprofiling took place every winter at an annual cost of £200,000 (cost becoming unsustainable). - If breached then 348 properties in Selsey and many holiday homes/ rental cottages would have been flooded.	Biological Weathering	The weakening and subsequent disintegration of rock by plants and animals. or example, burrowing animals such as rabbits can burrow into a crack in a rock, making it bigger and splitting the rock.					
What strategy was used?	Managed retreat was achieved by: - Building a new embankment up to 2km inland from the shore using clay from local area. Embankment enclosed the future intertidal area and protected properties behind it. -Behind embankment a channel was built along its whole length to collect draining water. -Four outfall structures built into the embankment to take the water into the intertidal area. -Rock armour placed on seaward edges of embankment (60,000 tonnes of hard rock from Norway).	Hydraulic Power	The process by which breaking waves compress pockets of air in cracks in a cliff. The pressure may cause the crack to widen, breaking off rock.					
Controversy/Conflict	-Cost £28 million (expensive scheme). -Habitats of existing species (i.e. badgers) would have been disturbed. - Some local residents feel the EA should not have given up the land so easily and insist they should have looked into other options such as offshore reefs/ continued beach realignment.	Abrasion	The wearing away of cliffs by sediment flung by breaking waves.					
Positive effects	-300 hectares of new intertidal habitats are forming seaward of embankment. Mudflats, salt marshes and transitional grasses have already attracted large numbers of ducks and lapwings. Area turning into huge nature reserve managed by the RSPB. -Tourism (main contributor to local economy) expected to increase. -Selsey now has a 1 in 1000 chance of coastal flooding, providing the best level of protection in UK.	Deposition	Occurs when material that is being transported by the sea is dropped due to the sea losing energy.					
Hard Engineering Strategies		Longshore Drift	Transport of sediment along a stretch of coastline caused by waves approaching the beach at an angle.			Wave types	Constructive waves	Low waves that surge up the beach and 'spill' with a powerful swash. They carry and deposit large amounts of sand and pebbles and 'construct' the beach making it more extensive. These waves are formed by storms often hundreds of kilometres away.
Sea Wall	Provides a barrier between waves and the land, and placed along back of a beach. Recurved sea walls more expensive than flat sea walls but more effective in reflecting waves and reducing overtopping. Benefits = If well maintained, sea walls can last for many years. -A sea wall gives people a sense of security. It often has a promenade on top of it which doubles up as a cycle route. Costs = From the beach a concrete wall is ugly to look at. Sea walls can also destroy habitats.	Hard Engineering	Using concrete or large artificial structures to defend against natural coastal processes.					
Rock Armour (rip rap)	Made up of thousands of tonnes of huge boulders of hard rock like Granite, to acts as a barrier between the sea and the land. Their downward slope arrangement to the sea deflects the waves energy. As water enters gaps between boulders, pressure is released and this reduces the waves' energy. Benefits = the structure is quick to build and easy to maintain. Costs = Highly resistant rocks from Norway/ Sweden often used in preference to rocks from local quarries. This can cause resentment and also inflate the cost considerably.	Soft Engineering	Managing erosion by working with natural processes to help restore beaches and coastal ecosystems or to reduce the risk of river flooding.					
Gabions	Steel- wire mesh cages filled with pebbles or rocks. Placed at the back of a sandy beach to create a low, wall like structure. Water enters the cages and this absorbs and dissipates some of the waves energy, thus reducing the rate of erosion. Benefits = The blend in better than other methods of hard engineering (when sand is blown into them or they are covered with vegetation). Cost = When damaged gabions are dangerous (people can cut themselves on broken steel wire mesh)	Slumping	Rapid mass movement where a while segment of a cliff moves down-slope along a saturated shear-plane or line of weakness.	Destructive waves	Formed by local storms close to the coast, and they can 'destroy' the beach - hence their name. They are closely spaced and often interfere with each other producing a chaotic swirling mass of water. They become high and steep before plunging down onto the beach. There is little forward motion (swash) when a destructive wave breaks, but a powerful backwash. This explains the removal of sand and pebbles			
		Headlands and Bays	A rocky coastal promontory (highpoint of land) made of rock that is resistant to erosion: headlands lie between bays of less resistant rock where the land has been eroded by the sea.					
		Erosion	Wearing away and removal of material by a moving force, such as a breaking wave.			Broad term for the replacement of lost sediment. A nourished beach means fewer waves reach the back of the beach. As more wave energy is absorbed and dissipated by the beach, the rate of erosion is reduced. Benefits = A wider beach means more room for beach users. Costs = Beach recycling may cause resentment from people living close to the donor area.		
		Sand Dune regeneration	The artificial creation of new sand dunes or the restoration of existing dunes. Sand dunes act as a physical barrier between the sea and the land, absorbing wave energy and water, and therefore protecting us from the sea. Benefits = Small planting projects (grasses) often use volunteer labour and local grass for transplants so costs are minimal. Sand dunes are also popular as picnic and walking areas. Costs = Expensive systems have to be put in place to protect planted areas from trampling. Fenced off sand dunes may also deter tourists.					
		Beach reprofiling	The artificial reshaping of a beach using existing beach material. After winter storms bulldozers move shingle back up the beach to ensure the beach is large enough to be an effective buffer between land and sea. Benefits = Many residential areas behind beach more protected are reprofiling, so residents feel safe. Costs = Bulldozers can restrict access to beaches especially in Winter. - A steep, high crested beach may look unnatural and uninviting to tourists.					
		Beach nourishment	Broad term for the replacement of lost sediment. A nourished beach means fewer waves reach the back of the beach. As more wave energy is absorbed and dissipated by the beach, the rate of erosion is reduced. Benefits = A wider beach means more room for beach users. Costs = Beach recycling may cause resentment from people living close to the donor area.					

Formations of coastal features		Key Terms		Wave types and their characteristics	
		Mass movement		How do waves form?	
How are caves/arches and stacks formed?		Mechanical Weathering			
		Chemical weathering			
How is a sand dune formed?		Biological Weathering		What happens when waves reach the coast?	
		Hydraulic Power			
Coastal Realignment in Medmerry, West Sussex (Soft and Hard engineering strategy)		Abrasion			
		Deposition			
Why was the scheme needed?		Longshore Drift			
		Hard Engineering			
What strategy was used?		Soft Engineering		Wave types	
		Slumping			
Controversy/Conflict		Headlands and Bays		Constructive waves	
		Erosion			
Positive effects					
Hard Engineering Strategies			Soft Engineering Strategies		
Sea Wall		Sand Dune regeneration		Destructive waves	
Rock Armour (rip rap)		Beach reprofiling			
Gabions		Beach nourishment			