coasts

gateway 1

factors affecting wave energy:

- wind speed; faster wind, greater wave energy
- wind duration; longer wind blows, larger waves
- fetch; greater fetch, greater wave energy

how waves affect coastal areas:

- swash; when waves break on a coast, carries sediments with it (breaks cos of friction and gravity with land)
- backwash; carries sediments from coast to sea

- constructive waves; break far from shore with little energy. deposits sediments, not a lot of erosion,, and forms gentle slopes (strong swash, weak backwash)
- destructive waves: breaks violently on the shore with high energy. removes sediments (erode finer sediments) and leaves only coarse sediments, causing steep gradient. (weak swash, strong backwash)

    + their characteristics
        - constructive waves: low gradient, small waves and low wave height, long wave length, 6-8 per min, swash more powerful than backwash
        - destructive waves: steep gradient, large waves and wave height, short wave length, 10-14 per min, backwash more powerful than swash

wave refraction:

1. waves approach headlands, diverge to bays.
2. since more wave energy at headlands, more erosion occur, splits to bays but lesser erosion

coastal processes:

- erosion
    - hydraulic action = waves strike cliff, traps air in rock joints and compressed, putting pressure on the joints. joints weakened and eventually shatters

- abrasion = waves break at cliff, sediments meant to be deposited are hurled against the coast, scrapes and loosen cliffs. eventually undercuts the cliff
- attrition = rock particles carried by waves break down into smaller pieces and become smoother and more rounded over time (class 5!)
- solution = sea water chemical rxn with water-sol minerals in coastal rocks. rocks are weakened and eventually disintegrate

sediment movement/transport:

- beach drift = sediments move up the beach at an angle as swash and perpendicular down the beach as backwash (zig-zag movement)
- longshore drift = longshore currents (currents that flow parallel to a coast) generated, moving sediments along the shore.
    - longshore currents + beach drift = long shore drift

sediment deposition:

- sediments eroded from coasts are transported away and deposited elsewhere. as wave energy decreased, waves are unable to carry sediments and deposits large sediments → small sediments, resulting in a variety of beaches
- location of coasts:
    - coasts sheltered from strong winds = less destructive waves
    - deep bays sheltered by headlands = sandy beaches

cliffs

- hydraulic action/abrasion erodes crack/joint on the rock surface, enlarging to form a notch
- further deepened to become a cave
- more erosion = roof of the cave collapses, forming a steep cliff

headlands + bays (johor, msia)

- less resistant rocks = bay eroded faster than
- more resistant rocks = headlands

caves → arch → stack

- parts of headlands with less resistant rock can be easily eroded (hydraulic action and abrasion), forms a cave
- caves may develop on both sides of the headland, and further erosion may eventually join caves tgt and creating an arch (bridge of rock)
- further on, the roof of the arch can collapse to form a stack

beaches

- a zone of sediment deposition ; loose sand, gravel, pebbles, broken shells, corals
- usually come from eroded cliffs, river deposits and sediments carried by waves.

spits and tombolos

- spit: a long, narrow ridge of sediments with one end attached to a mainland, formed by longshore drift.
    - when there is an abrupt bend in the coastline, longshore drift will continue to transport sediments in the original direction for some distance. more sediments are deposited after the bend of the coastline and accumulates, forming a hook/curve at the end of the spit

- tombolo: a spit connected to the mainland that continues to extend until it connects to an offshore island/ another existing island

<u>gateway 2</u>

usage of coastal areas:

- fisheries and aquaculture (ca mau, viet)
    - fisheries are areas where fish are bred and raised
    - farming fish near coasts = aquaculture :P
    - supplies ⅓ of the world's fish supply
    - example (ca mau): produces the most shrimp 🦐, production reached highest of USD 800 million in 2010!

- housing and transportation (kukup, msia)

    - stilt houses! connected with walkways, allowing people to move around the community easily
    - boats are also a form of transportation
    - kukup: a place of stilt houses. some floating fish farms (and they sell fresh fish = money), scheduled ferry services (also money)

- tourism and recreation (sentosa, sg)
    - one°15 marina club, world class marina facilities
    - offers maintaining services for boats and yachts, recreational boating facilities
    - also got hotel, museum, and marine life park,, large amount of visitors

coral reef ecosystems

- develop slightly below/at sea level on the seabed, made up of coral polyps animals)
- usually distributed between tropic of cancer and tropic of capricorn :) [exception: japan] [southeast asia highest biodiversity and largest area of coral reefs]

conditions for growth

- salinity = 34-37 parts/1000 coral reefs
- water movement for oxygen!!
- NO SEDIMENTS :(can suffocate corals
- sea surface temp not lower than 17-18 c
- clear water for sunlight ; photosynthesis !! low turbidity

value of them

- supports >25% of the earth's marine fish species
- smaller fish graze on the coral polyps, larger fish will eat the smaller fish
- absorb wave energy, lessening erosion
- tropical cyclone may break them due to high pressure

- threats of coral reefs:

- overcollection - weakens and disrupts coral ecosystem, more vulnerable to threats (ph)
- fishing methods -
    - spearfishing → selective depletion of fish population disrupts ecosystem's food chain (netherlands)
    - dynamite blasting → destroy coral reef habitat (ph/indo)
- recreational use of coasts - tourism activities: expansion of coastal resorts, anchoring of boats→ waste disposed into water + oil spills frm boats,, anchors damage corals (sri lanka)
- coastal development - expansion of coastal resorts
    - reclamation/expansion of land = dumping rocks and sand onto reefs → coral reefs are suffocated and destroyed
    - expansion of coastal resorts → more waste deposited into sea= coral reefs are suffocated and destroyed
- climate change → coral bleaching due to rapid changes in sea temperatures + sea levels, corals cannot adapt as fast

mangrove ecosystems:

- salt-tolerant tropical/subtropical plants that grow in conditions that other plants are unable to adapt to (tidal mud, unique plants and animals, most productive and biologically complex ecosystems

value of mangroves:

- stabilise shorelines
- absorb wave energy
- allows sediments to build up on their roots
  = lessen erosion
- a breeding ground and habitat for as lot of marine creatures (anchoring on the roots of the mangroves

threats on mangroves

- clearing mangroves → fuel and charcoal , more in LDCs = fish breeding grounds lessened + coasts more open to storm waves (indo)
- conversion of land for other uses → become paddy fields/shrimp farms = mangroves are cleared,, more vulnerable coasts (viet/thai)
- coastal development - land is reclaimed for housing, industry and recreational uses = large clearance of mangroves frm environment,, more pollution in waters due to human activities (caribbean)
- climate change - increased sea levels,, extreme storm activity = mangroves have more trouble colonising inland areas bc in competition with human activities (farming, sea defences) (thai)

gateway 3

how to manage coastal areas?

- laws and regulations
- coastal protection measures

laws and regulations

- limiting damaging activities
    - activities such as: blasting coral reefs for boats to travel efficiently, clearing mangroves to develop fish farms, dumping waste into coastal areas/seas, constructing facilities that replace the natural features of the coast (marinas, docks)
    - limiting ≠ banning (can be inefficient and costly)
    - eg: port philip: sand dunes were being trampled on by people,, dune vegetation destroyed making sand dunes exposed to wind erosion
        - pros: authorities fenced off dunes built access paths to the beach and allowed the coastal environment to recover
        - cons: not aesthetically pleasing + some parts of the beach were blocked

- protecting coastal resources
    - to prevent resources from being depleted/exploited (eg: fish, may be vulnerable to overfishing)
    - ^^ especially in coral reef areas in SEA where there's a lot of blasting and poison fishing
    - eg: wakatobi national park (indo) → marked off zones to prevent commercial fishing, through local management/establishment of a nature reserve. (marine reserve)
        - pros: protects marine ecosystems, allowing fish and endangered species to breed and thrive :)
        - cons: opposed by locals (fishermen) - access to a major food/money supply being denied,, valuable resource.

- restrict development in areas prone to natural hazards
    - govt and authorities research on how severe/widespread the problem is, plan for it, and then make + enforce laws.
    - usually involves a combination of RAD:
        - Retreating = relocation of certain structures away from hazard-prone areas
            - usa: fed emergency management agency steers development away frm areas prone to coastal erosion/flooding
        - Avoidance = regulating coastal development

        - indo: restrict farms and residences from being established o low-lying coastal areas
    - Defence = nourishing beaches, building seawalls, replanting coastal vegetation
        - netherlands: closely monitored, undergoes beach nourishment when long-term erosion is identified

protective measures from erosion

- soft/hard engineering

    - soft engineering methods
        - protecting the coast using natural processes
            - beach nourishment
                - slows down beach erosion by using sand from an external source to replenish the sand on a depleted beach
                - the sand can come from another beach, or from the sea floor
                - changes the coast into a wide, sandy beach, offering protection to the immediate inland area
                - siloso beach, sg
                    - pros: aesthetically pleasing
                    - cons: expensive, time-consuming

            - planting vegetation and stabilising dunes
                - mangrove planting
                    - pros: they absorb wave energy
                    - cons: they need to grow before resisting natural elements (storms), or even human elements (vandalism, trampling)
                - planting grasses in sand dunes for stability
                    - pros: anchors sand, prevent erosion
                        - matting: put over the dunes, young grasses are planted into the sand though the matting. after a while, the grasses become established and the dunes become more stable, while the matting rots away as nutrients
                    - cons: need to protect the dunes from human activities so build fences, creating access

paths, putting up signs, but expensive to maintain/upgrade over time
- australia: triton place

- encouraging coral reef growth
    - coral reefs help weaken wave energy, a breeding ground for marine life
    - artificial reefs created by using lasting materials such as steel/concrete for the seafloor.
    - corals + other marine life will colonise these materials and start to function as a natural reef!
    - eg: maldives - welded construction steel rods have been placed off the coast,, it's charged with low-voltage solar generated electricity to speed up coral growth.
    - pros: growth currently 3-5 times faster than normal, sustaining a large variety of corals, marine animals and organisms,, receiving international recognition
    - cons: sites need to be surveyed to ensure maximum opportunity for growth, due to dangers of siltation (blocking something with sand), taking over 20-30 years before results appear

- hard engineering methods
    - seawalls
        - pros: protect coastlines against wave attack by absorbing wave energy
            - made out of concrete/stone, built parallel to the coast
        - cons: costly to build and maintain cos of constant reparation so they dont collapse
        - powerful backwash of reflected waves washes away the beach materials at the foot of/beneath the seawall, eroding and undermining the base of the seawall, leading to their collapse
        - eg: drakes island, england - collapsed due to erosion occurring at its base

    - gabions

    - wire cages usually filled with crushed rocks, built along a shore/behind a beach to prevent/reduce coastal erosion by weakening wave energy
    - pros: they're better than seawalls! because of the gaps between the crushed rocks, water is able to filter through,, proving that gabions are successful defences against high energy waves
    - cons: UNSIGHTLY !!! costly due to regular maintenance
        - easily corroded due to seawater, damaged by excessive trampling/vandalism
    - eg: east coast park - removed due to vandalism

- breakwaters
    - pros: breaks the force of oncoming waves, creates a zone of calm water behind them = harbour for boats
    - built either parallel to the coast or with one end attached to the coast.
    - pros 2:materials deposited instead of eroded (cos weakened wave energy), forming beaches
    - cons: aesthetically unappealing, costly to build. uneven protection of coast as deposited materials will only be behind breakwaters, not other parts of the beach
    - eg: portland harbour, england: erosion and flooding of breakwaters → affected properties, beaches, commns infrastructure

- groynes
    - low walls constructed at right angles to the shore to retain sediments, so they're not removed due to longshore drift
    - to absorb/reduce wave energy, help to cause materials to be deposited on the updrift side of the groyne facing the longshore drift
    - however, groynes are unsightly and expensive to build and maintain
    - the downdrift side will still be eroded as it is not protected by the groyne, and will be eventually eroded away
    - eg: sandy hook in new jersey (usa) had large amounts of sediments eroded away from the unprotected part of the beach, and was demolished

- tetrapods
    - four-pronged concrete structures that help to dissipate wave energy by being stacked offshore in an interlocking position
    - tetrapods allow water to pass around it than hit, creating no powerful backwash, reducing the possibility of tetrapods being damaged
    - they are also put into their final formation before being positioned in the water, making it quick to build
    - however, they are aesthetically unappealing, expensive and poses a threat to swimmers and surfers
    - eg: coast of hokkaido, japan