

- I. Surface Circulation
 - A. Related to general circulation of atmosphere
 - B. Pattern of 'gyres'
 - 1. include poleward warm current, and equatorward cool current
 - 2. North Pacific Gyre, South Pacific Gyre, North Atlantic Gyre, South Atlantic Gyre, Indian Ocean Gyre
 - 3. 'Coriolis Effect' deflects current to right in northern hemisphere, to left in southern hemisphere
 - 4. important named currents: Gulf Stream, California Current, Kuroshio Current, equatorial currents, West Wind Drift
 - C. effect on climate: about $\frac{1}{4}$ of worldwide heat transfer by ocean currents
 - 1. transfer of heat apparent in cold months in mid-latitudes
 - 2. cold currents apparent in tropics, and in mid-latitudes in warm months
 - D. upwelling—vertical movement of water
 - 1. winds blow surface water away from continent
 - 2. deep nutrient-rich water rises from deep ocean: phosphates, nitrates
- II. Deep Ocean Circulation—thermohaline circulation
 - A. Cold, saline polar waters sink
 - B. Moves on sea floor 500 to 200 years
 - C. Rises in upwelling areas to be warmed and moved poleward
- III. Coastal processes
 - I. Shoreline—interface of sea and land,
 - A. affected by sea level changes, erosion, and tectonic vertical movements
 - B. Coastal Zone
 - 1. Shoreline, shore, coast, coastline: terms overlap in distinction
 - 2. Beach: accumulation of sediment along landward margin of ocean
 - a. foreshore from low tide to high tide, includes beach face
 - b. backshore only wetted in storm events, includes berm
 - c. nearshore has wave-bottom turbulence
 - d. offshore out of wave influence
 - II. Waves—ocean energy generated by wind on surface
 - A. Terminology:
 - 1. wavelength,
 - 2. crest,
 - 3. trough,
 - 4. wave height,
 - 5. wave period
 - B. Water movement orbital in nature,
 - 1. dies out at about $\frac{1}{2}$ wavelength below surface
 - 2. Surf zone where the wave energy touches bottom, oversteepens, breaks
 - C. Wave Erosion—hydraulic power of water, and abrasion of sediment

- III. Sand Movement on Beach—'River of Sand'
 - A. Low energy waves move sand up beachface, water soaks into sand
 - B. High energy waves has less infiltration, backwash erodes sand from beachface
 - C. Wave refraction—
 - 1. headlands have waves slow first, bay areas slow later
 - 2. curves in wave crests at shoreline
 - D. Longshore transport: beach drift and longshore currents
 - 1. Angle of water onto shoreline influences swash,
 - 2. water goes back downslope perpendicular to water edge,
 - 3. zigzag pattern of sand
- IV. Shoreline Features
 - A. Erosional features
 - 1. cliffs and platforms
 - 2. arches and stacks
 - B. depositional features
 - 1. spits, bars, tombolos by beach drift
 - 2. barrier islands may be flooded remnants of coastal dunefields
 - C. evolution of a shoreline—straightens over time
 - D. Stabilizing the Shore—attempts to retain sand
 - 1. Groins, breakwaters and seawalls (Hard Stabilization)
 - 2. Alternatives to hard stabilization include
 - a. Beach Nourishment and
 - b. Relocation
- V. Coastal Classification
 - A. Emergent coasts—
 - 1. changes in elevation or sea level
 - 2. characterized by cliffs and terraces
 - B. Submergent coasts—
 - 1. mostly changes in sea level
 - 2. characterized by estuaries—flooded river channels