

Ocean Environment

Thursday, April 30, 2015

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There are three main components of this course:

- **The ocean environment**
- **Marine organisms**
- **Marine ecosystems**

1. **Geology of oceans**
2. **Physics of oceans**
3. **Chemistry of oceans**

- A. **Ocean basins**
- B. **Change over time**
- C. **Plate tectonics**
- D. **Geographical features of oceans**

1. **Continental Margins**

- **Continental shelf**
 - From shore outward
 - Extensions of continent
 - Vary in width
 - 8% of ocean bottom
 - Dynamic, productive habitat, rich in diversity of organisms
- **Continental slope**
 - Usually start at **shelf break**
 - Begin between 100-200 m deep
 - Slope steeply & rapidly reach 3000-4000 m
 - Boundary between continents and ocean basins
- May also have:
 - Submarine canyons

2. **Ocean basins**

- **Abyssal plains**
 - Large % of deep ocean
 - Extend from continent
 - Basaltic rock covered with sediment
- **Ridges & rises**
 - Volcanic mountain ranges in every ocean
 - Separate basins into sub-basins
 - 40,000 miles of ocean ridges
- **Trenches**
 - About 2% of ocean floor
 - Deep (up to >11,000 m)
 - More common in Pacific
 - Found near island chains and continental slopes (plate boundaries)
- **Seamounts**

- Formed by volcanic action
- Steep-sided rising sharply from bottom
- More common in Pacific

2. Physics of oceans

A. Waves

B. Tides

C. Currents

D. Vertical water movements

A. Waves

- Waves influence distribution of many nearshore marine organisms
- Result of forces acting on water surface
- Not flow of water but flow of energy
- Formed by generating force- usually wind
 - Wind drag lifts water away from surface
 - Wave magnitude factor of:
 - Wind speed, wind duration, distance over the water that the wind blows (fetch)
- Types of waves
 - Progressive- formed by wind progress away
 - Swells- long period uniform waves
 - Breakers
 - Water depth less than 1/2 of wavelength
 - Bottom of wave slows but crest continues at faster speed
 - Tsunamis

B. Tides

- Periodic changes in water level along coastlines
- Play huge role in life of many marine organisms
- Result of gravitational pull on oceans by moon and sun
 - Water on side of earth facing moon "pulled" toward moon
 - Bulges on moon
 - Bulge also forms on opposite side of earth
 - Areas of low water between bulges
 - Area under bulges = high tide
 - Earth rotates over 24 hr period
 - Most places experience two tidal cycles in ~ 24 hours

B. Tides - Over Time - 24 hrs

• Daily Tide Cycle

- Greatly influenced by geographical factors
 - Contours of shorelines
 - Water depth
- Different areas have different patterns:
 - **Diurnal tides** - one high and low tide per day
 - **Semidiurnal**- two high and two low per day
 - **Mixed semidiurnal**- highs and lows differ

B. Tides - Over Time - 28 Days

- Moon orbiting earth in ~ 28 days also influences tides- tidal cycle on approximately monthly basis
 - In accordance with **lunar cycle**
- **Spring tides**
 - Twice a month (full and new moon)
 - Gravitational pull of moon and sun in straight line
 - Time of highest and lowest tides
- **Neap Tides**
 - Also twice a month (1st and last quarter of moon)
 - Sun and moon at right angles
 - Smallest change between high and low tide

*** TWICE A MONTH (FULL AND NEW MOON)

*** GRAVITATIONAL PULL OF MOON AND SUN IN STRAIGHT LINE

C. Currents

- About 10 % of ocean water involve in surface currents
- Driven by winds
- Move water in upper 400 m of ocean
- Influence dispersal of plankton (and animals that follow plankton)
- Dramatic impact on marine bio
- Produced by surface wind patterns
- Deflected by Coriolis effect
- Move water horizontally in predictable patterns in ocean basins
- Major ocean **gyres** - circular pattern around edge of ocean basin
 - Gyres formed of interconnected currents
 - Influence biology on both local and large- scale
 - Western boundary currents nutrient poor
 - Eastern boundary currents more productive

D. Vertical water movements

- Exchange of water between surface and deep water
 - Deep water nutrient rich
 - Surface water oxygen rich
- Examples:
 - Equatorial upwelling- driven by currents
 - Coastal upwelling - driven by wind
 - Seasonal vertical mixing- cooling and sinking of surface water
- 50% of world fish catch from upwelling areas
- Only 0.1% of ocean surface

3. Chemistry of Oceans

- A. Properties of water
- B. Dissolved salts
- C. Dissolves gases
- D. Light
- E. Temperature