

- 1% of primary production at ocean's surface reaches bottom in deep sea
- 3 ways food produced at ocean's surface reaches deep ocean:
  - marine snow
  - sinking of large carcasses
  - vertical migration
- Filter feeders are NOT common in the deep sea
  - most deep-sea organisms are deposit feeders because most available food is food that sinks from above
- pressure: 1 atm for every 10 meters
- Oxygen Minimum Zones are important features of marine environment
  - How are OMZs coupled to processes in the overlying water column
    - no primary production in the area so it depends heavily on primary production sinking down from the surface
  - What is a typical depth range for an OMZ in the open ocean
    - 200-750 m
- Example of strategy used by bioluminescent deep sea organisms to make them better predators
  - anglerfish lures
- Avoid being eaten- counterillumination
- Names of depth zones
- Mesopelagic- fish with tubular eyes
- Hydrothermal vents: hydrogen sulfide
- Cold seeps: methane
- Hydrothermal vents are typically associated with tectonic features of **sea floor spreading centers**
- One theory for the dispersion of hydrothermal vent organisms to new vent sites involved stepping stone microhabitats
  - What was basis for microhabitats?
    - Whale carcasses/bones allowed tube worms to persist between vent communities
  - Why was this theory discounted?
    - no species overlap- the DNA of the worms on the "stones" did not match species at vents etc
- What characteristics of vestimentiferan worms like Riftia might you expect in order for them to successfully find and colonize new hydrothermal vent sites?
  - Eggs- many eggs
  - Larval biology- Lecitotrophic- *short larval stage* because not enough food to support prolonged existence in plankton
- Explain how foodweb interactions between killer whales, sea otters, sea urchins, and kelp can lead to alternative stable states of a marine ecosystem and briefly describe the 2 different endpoints.
  - Either sea urchins eat everything or HUGE kelp forests
- Grand prey collapse- the killer whales' main prey would be so depleted that they must find a new source of food
  - why is this theory unlikely to be correct?
  - what alternative hypothesis might explain the phenomenon (changing food preferences)?
- 3 mechanisms that cause surface waters in coastal zones to be enriched in nutrients
  - upwelling

- land runoff
  - benthic regeneration
- How does the presence of a bottom affect primary production in shallow water ecosystems? (3 factors)
  - allows light penetration all the way to the bottom
- Size of meiofauna = <0.5 mm
- Kelps are brown algae
- Laminaria and Nereocystis are genera of kelps
- Kelps grow best in habitats that feature high nutrients and strong currents
- Kelps are grazed by sea urchins
- Seagrasses are true plants
- An important genus of seagrass is Zostera
- How do seagrasses affect sediment accumulation?
  - Seagrasses increase sediment accumulation- their roots help prevent erosion and the grass itself traps sediment suspended in the water.
- Massive seagrass dieoffs possibly due to
  - infection by pathogenic fungi
  - effects of eutrophication
  - overfishing
  - suspended sediment from accelerated erosion in the watershed
- red mangrove = rhizophora mangle
- Main environmental factor that limits the northwards expansion of mangroves from Florida into Georgia: water temperature- too cool in Georgia
- Mangrove seeds are dispersed by drifting in the ocean
- Pneumatophores are adaptations used by mangroves to conduct oxygen to their roots
- Pneumatophores are NOT characteristic of all mangroves
- How are the distributions of mangrove & coral reef ecosystems linked?
  - Physiological: both in warmer coastal waters
  - Functional: both act as barriers between the sea and the mainland
- Zooxanthellae are dinoflagellates
- Factors that limit the distributions of typical reef building corals:
  - light
  - water temperature
  - nutrient concentrations
  - salinity
- Explain the phenomenon of coral bleaching:
  - dying out of coral on a reef, ocean acidification/increased CO<sub>2</sub> is partially to blame
  - loss of zooxanthellae
- Coral animals are in the phylum Cnidaria
- Explain how the relationship between corals and their symbionts works:
  - the coral supplies:
  - the symbiont supplies:
- What are the characteristics of sea level changes associated with each of the following tidal cycle classifications?
  - diurnal: 1 high tide & 1 low tide per day, generally same height each time
  - mixed semidiurnal: 2 HT & 2 LT per day, at varying heights
- What other factor besides the sun and the moon affects the tides experienced at a given location on the coast?

- bathymetry & geography
  - wind & currents
- Three physical factors that affect the vertical distributions of intertidal organisms:
  - temperature
  - desiccation
  - water motion
- The diversity of intertidal communities typically **INCREASES** along a transect from mean high water to mean low water
- What are 3 general strategies that organisms use for dealing with exposure to our world during low tide
  - moving away from exposure
  - sealing self off from exposure
  - tolerating exposure
- 3 major general classes of biological factors that are responsible for distributions of organisms in rocky intertidal communities:
  - predation/herbivory
  - competition
  - larval recruitment
- What are the characteristics of an organism fitting Paine's definition of a keystone species or predator?
  - community structure: has a disproportionate effect on the ecosystem
  - energy flow: not a big energy sink
- 3 kinds of interactions between first organism and succeeding organism: what are they and how do they work?
  - Inhibition- initial colonizers inhibit further colonization
  - Tolerance- initial colonizers do not affect later colonizers but over time species most tolerant of local conditions prevail
  - Facilitation- initial colonizers facilitate success of later species
- Physical dynamics that lead to formation of a beach require **waves** and a **source of unconsolidated sediment**
- Organisms that live on beaches are usually highly mobile and equipped with tough cuticles
- The activity of many organisms is tied closely to various natural cycles. give an example of this behavior and how it might have evolved
  - crabs that only come out at night
  - predators may be less abundant at other times or prey is more abundant
- Barrier islands form as a result of 3 general geomorphological processes:
  - emergence of offshore sandbars
  - segmentation of existing sand spits
  - sea level rise/fall
- Which of the following features that behave like estuaries in some respects would not be included in the definition (pritchard) estuary is semi enclosed body of water that has a free connection with the sea and sea water is measurably diluted with fresh water
  - atolls
  - lagoons
  - bights
  - tidal rivers
- What are some of the features that are generally common to all estuaries? 3
  - shallow