OCEANOGRAPHY

12. Marine Life and the Marine Environment

part 1: notes from the textbook, integrated with original contributions

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A whale surfacing in the coastal Pacific Ocean, a few miles north of Ketchikan, Alaska, U.S.A.

overview

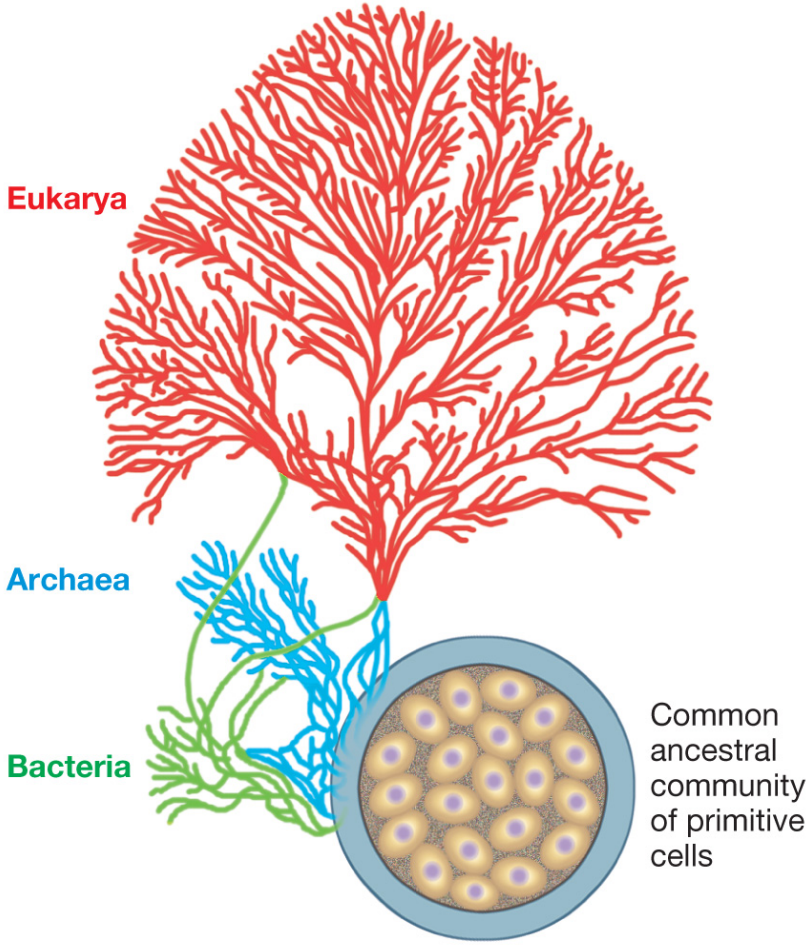
- an astonishingly wide variety of marine organisms inhabits the world's ocean
- range in size from bacteria to blue whales
- almost 250,000 species identified
- most live in sunlit surface seawater
  - algae are at the base of the food web, and they need sunlight for photosynthesis
- a species' success depends on the ability to
  - find food,
  - avoid predation,
  - reproduce, and
  - cope with physical barriers to movement.
- Marine organisms are adapted to the ocean's physical properties

12.1 – What Are Living Things, and How Are They Classified?

- Living things:
  - are classified based on their physical characteristics
  - can capture, store, and convert energy
  - are capable of reproduction
  - can adapt to their environment
  - can change through time (evolution)

Classification of Life

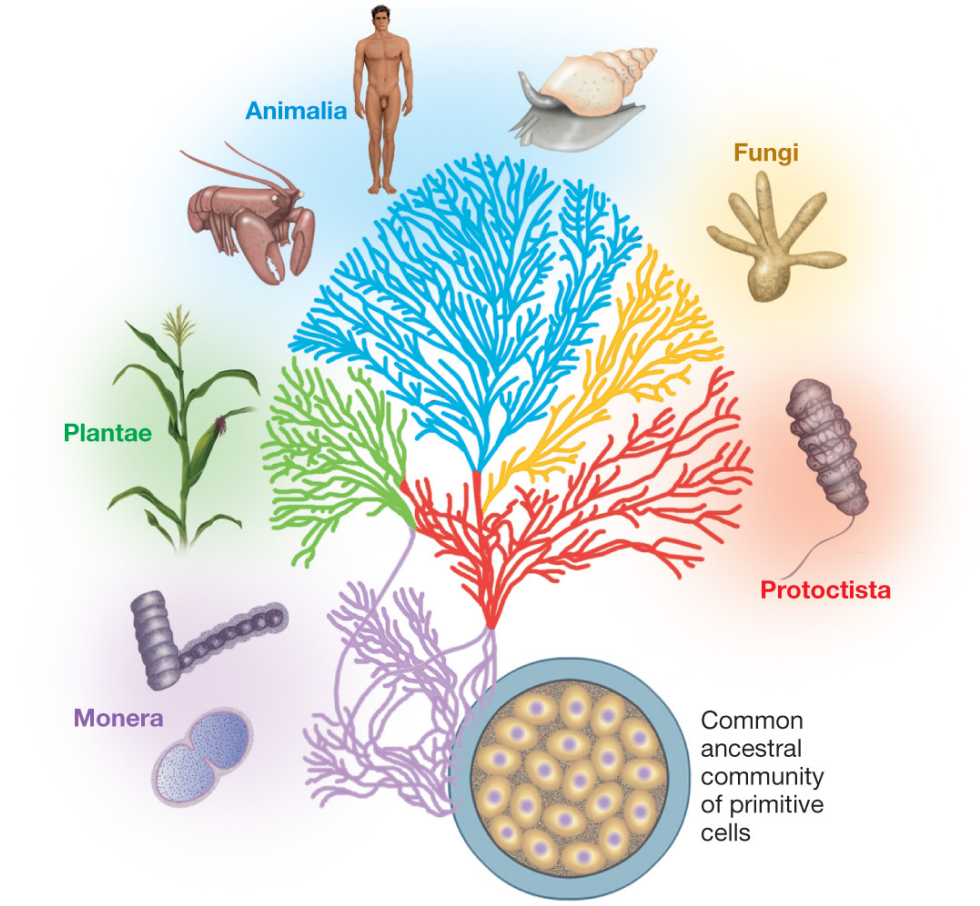
- Three domains
  - Archaea
  - Bacteria
  - Eukarya



(a) The three domains of life

Classification of Living Organisms

- Six kingdoms
  - Eubacteria
  - Archaebacteria
  - Protista
  - Fungi
  - Plantae
  - Animalia



(b) The five kingdoms of organisms

- The organisms belonging to the first two kingdoms, Archaebacteria and Eubacteria, are Prokaryotes, organisms whose cells do not have a nucleus and other internal structures

- All of the other organisms, Protists, Fungi, Plants and Animals, are Eukaryotes.
  The cells of Eukaryotes are highly organized, with a nucleus and other internal *organelles*

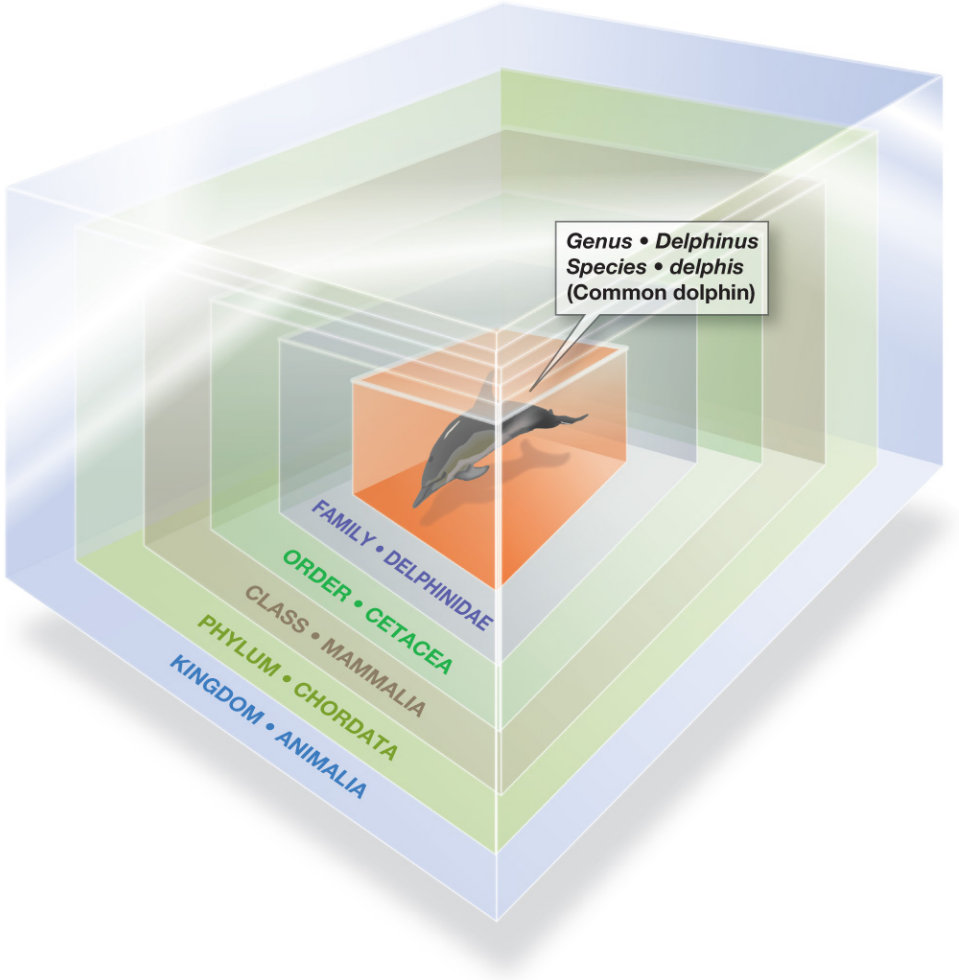
- They are subdivided into several subordinate groups (taxonomic groups, or taxa)
  and the study of what belongs to what group (taxon) and how they relate to each other is the object of taxonomy

Taxonomic Classification

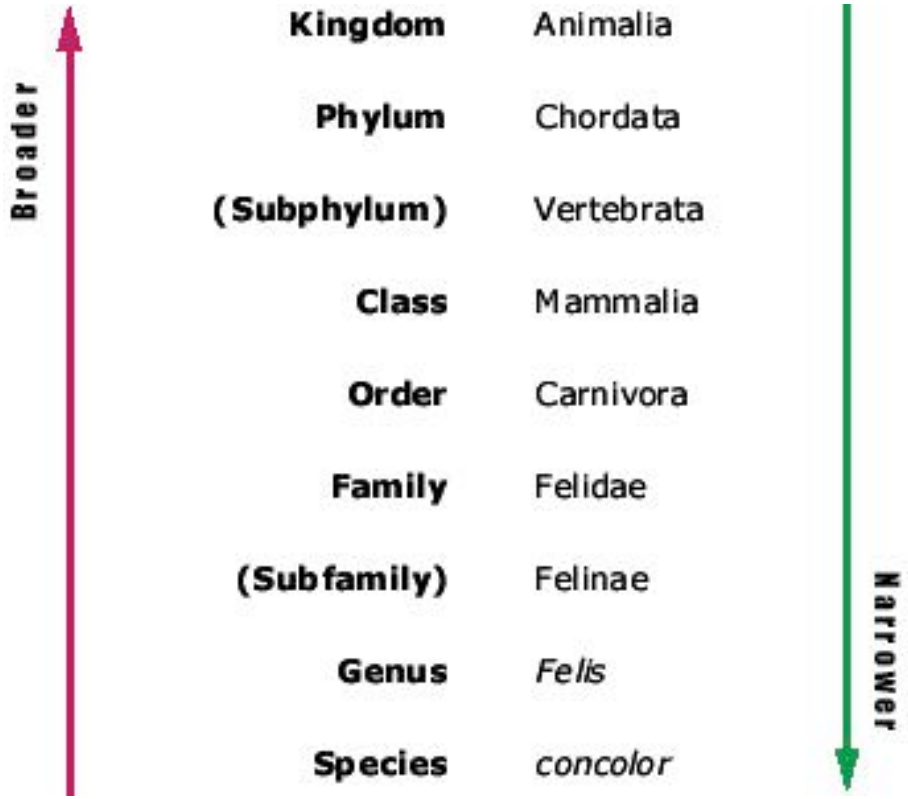
- Carolus Linnaeus – 1758
  - Developed basis of modern classification of organisms
- Taxonomy – systematic classification of organisms
  - Physical characteristics
  - Genetic information

Taxonomy

- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species
  - Fundamental unit
  - Population of genetical similar, interbreeding individuals



- The kingdom is the highest-rank taxon (or taxonomic group).
- Within a kingdom is the phylum , within a phylum is the class, followed by the order, the family, the genus and, last, the species

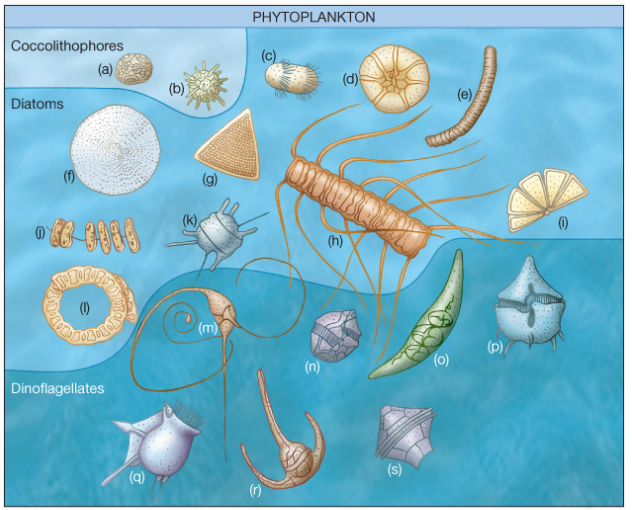


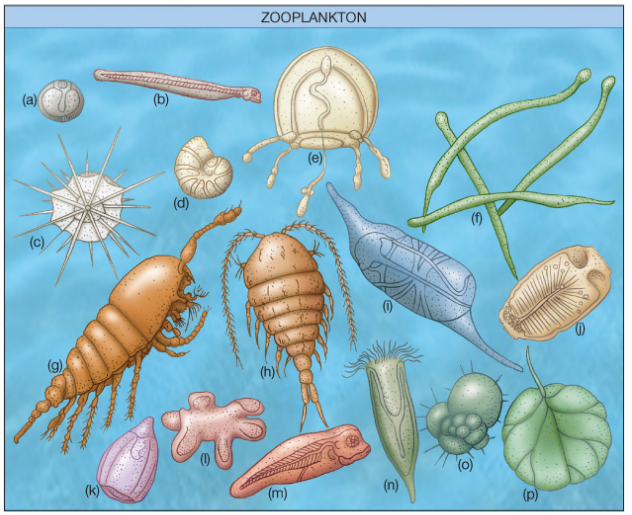
12.2 – How Are Marine Organisms Classified?

- Organisms that live in the ocean can be classified as:
  - **Nekton**: swimmers
    - example: dolphins, octopuses, squids, whales
  - **Benthos**: bottom dwellers
    - sessile (standing in one place, like a tree on land)
      - example: sea lilies
    - mobile (on the surface – **epifauna**; digging into the substrate – **infauna**)
      - example: crabs and lobsters
  - **Plankton**: floaters

Types of Plankton

- Most biomass on Earth consists of plankton.
- Phytoplankton
  - Autotrophic
- Zooplankton
  - Heterotrophic



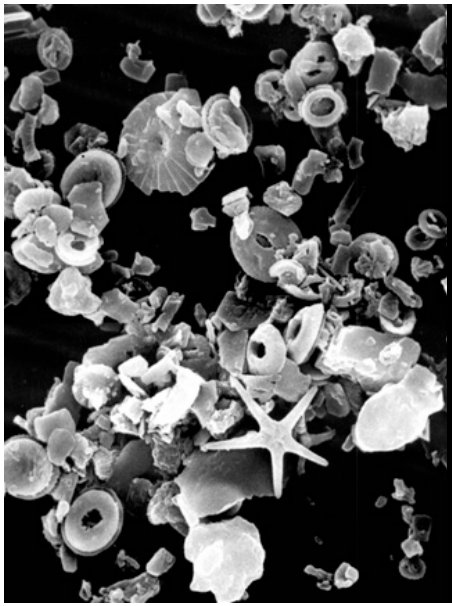


Important Planktonic Protists in the fossil record

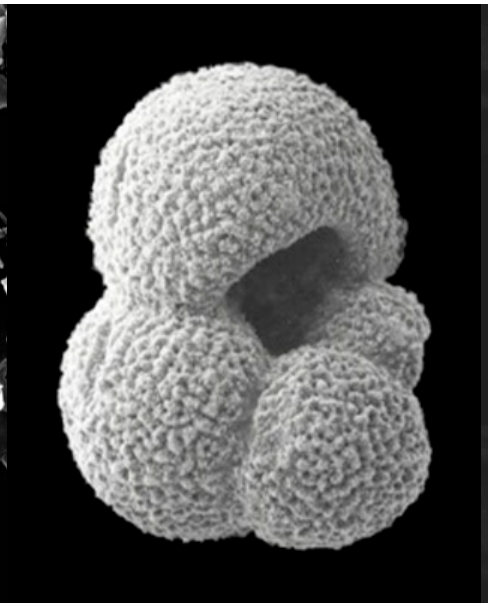
- **Phytoplankton** (plant-like)
  - Diatoms and Coccolithophores
- **Zooplankton** (animal-like)
  - Radiolarians and Foraminifera
- These organisms secrete a skeleton (also called a “test”, or a shell)
- When they die, these skeletons sink to the bottom of the ocean and form a rock

All these organisms are microscopic: they can only be observed under a microscope.
Coccolithophores are so small that they can only be imaged with a SEM (Scanning Electron Microscope)

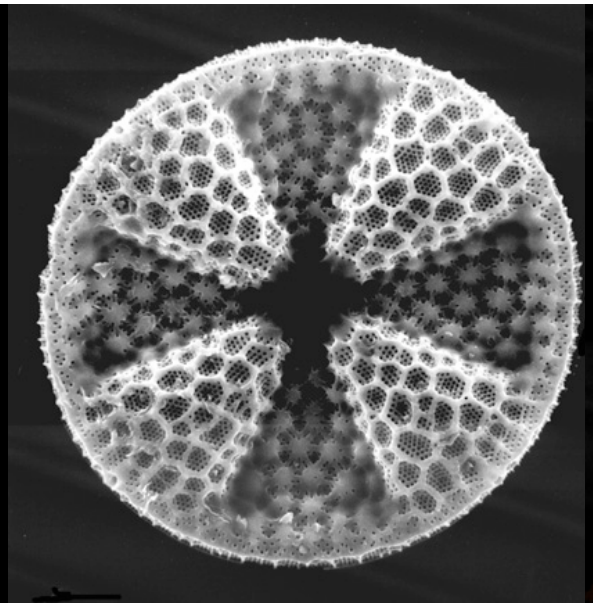
	$CaCO_3$ shell	SiO_2 shell
Phytoplankton	**Coccoliths** (disks from Coccolithophores)	**Diatoms**
Zooplankton	**Foraminifera**	**Radiolarians**



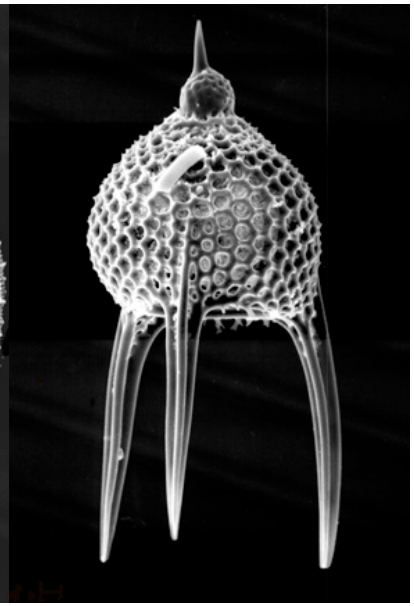
Coccoliths



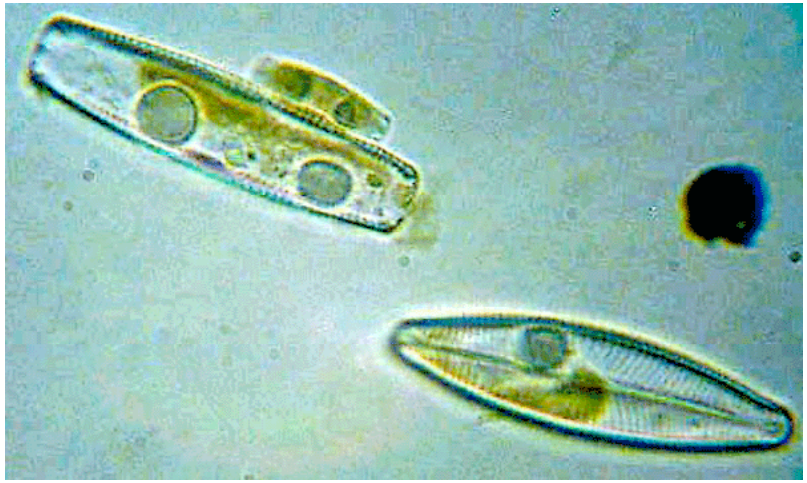
Foraminifer

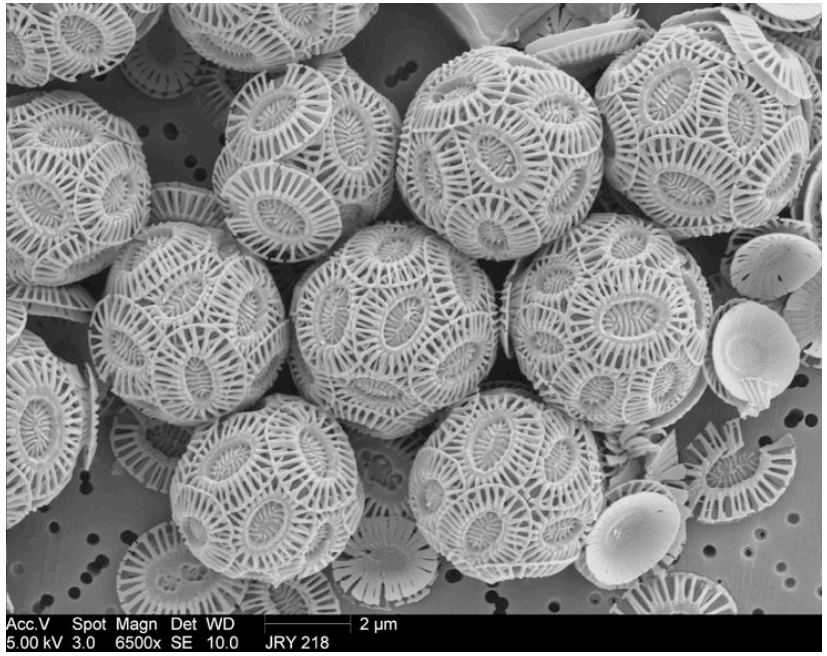


Diatom



Radiolarian



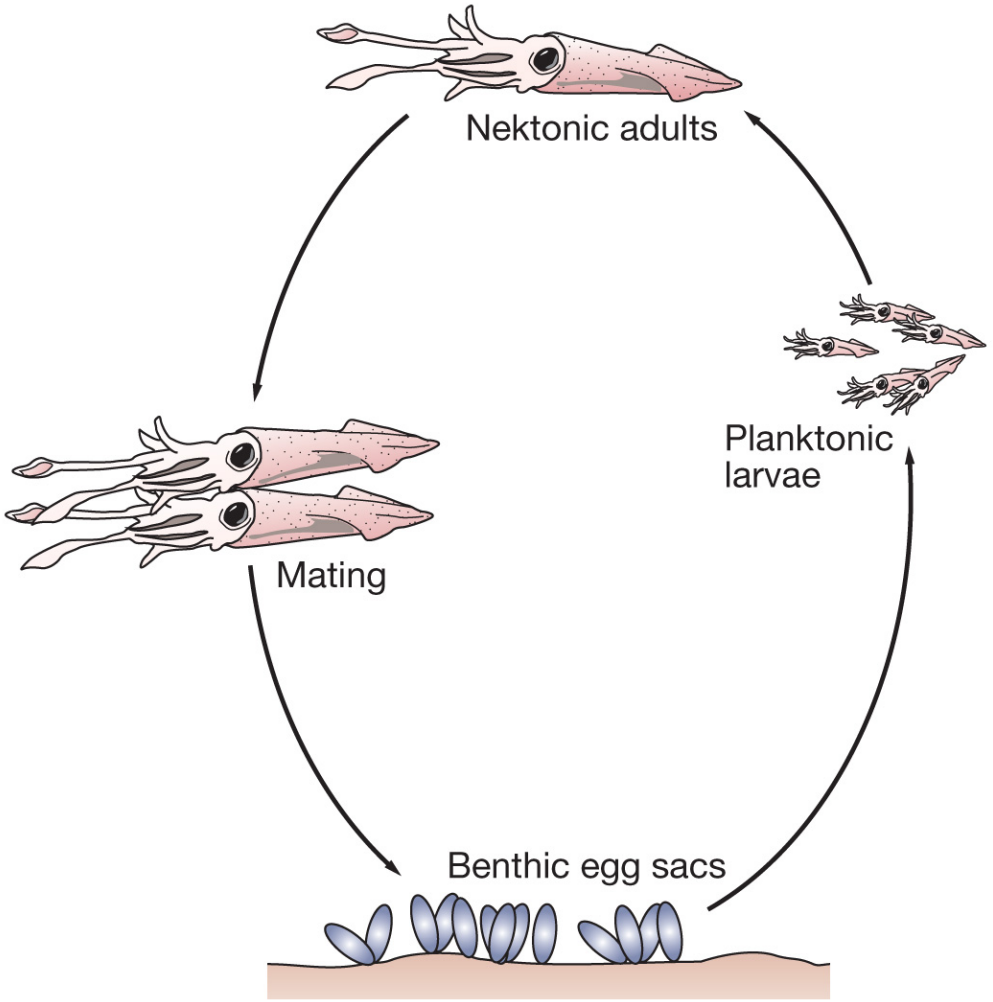


Clockwise from upper left: live Diatoms; Coccolithophores; live Foraminifer; live Radiolarian

Other Types of Plankton

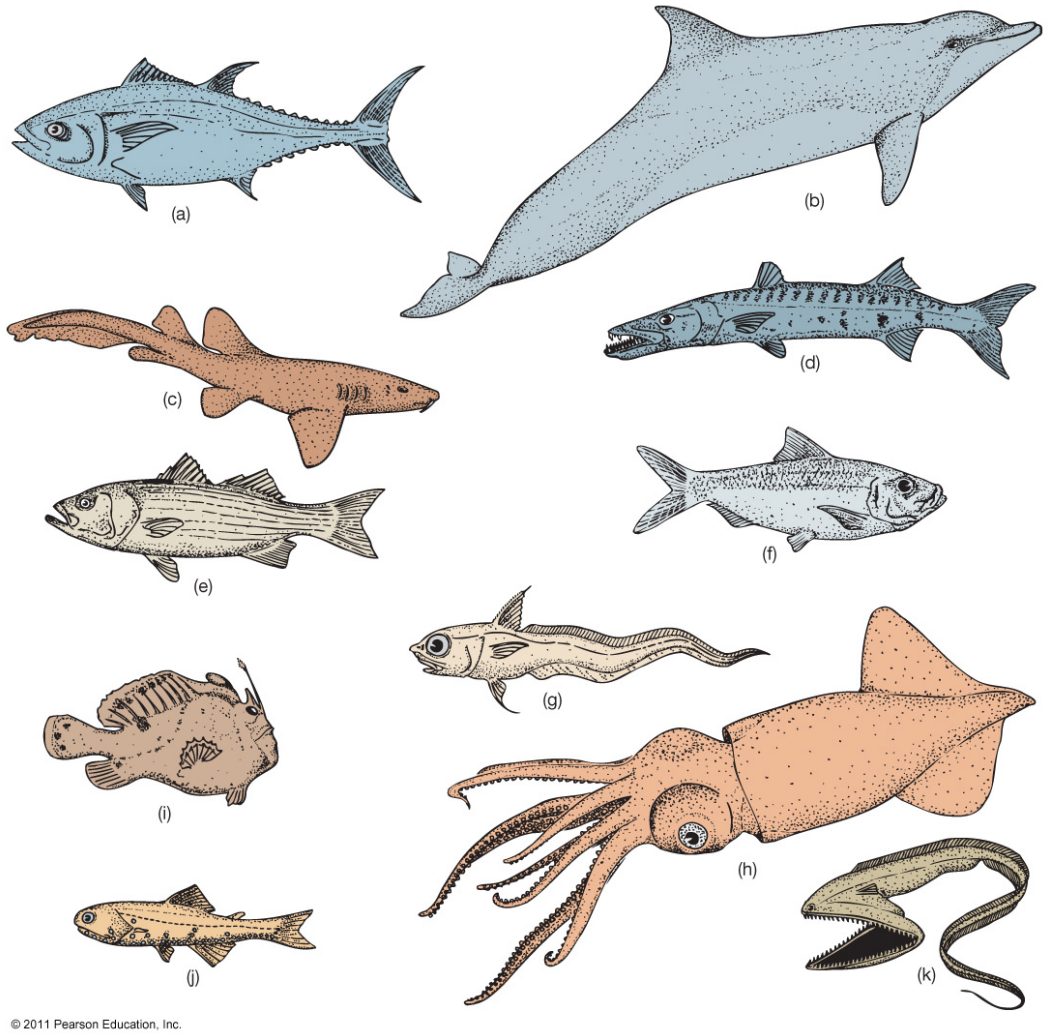
- Bacterioplankton
- Virioplankton
- Holoplankton
  - Entire lives as plankton
- Meroplankton
  - Part of lives as plankton
  - Juvenile or larval stages
- Macroplankton
  - Large floaters such as jellyfish or *Sargassum*
- Picoplankton
  - Very small floaters such as bacterioplankton

Life Cycle of a Squid



Nekton

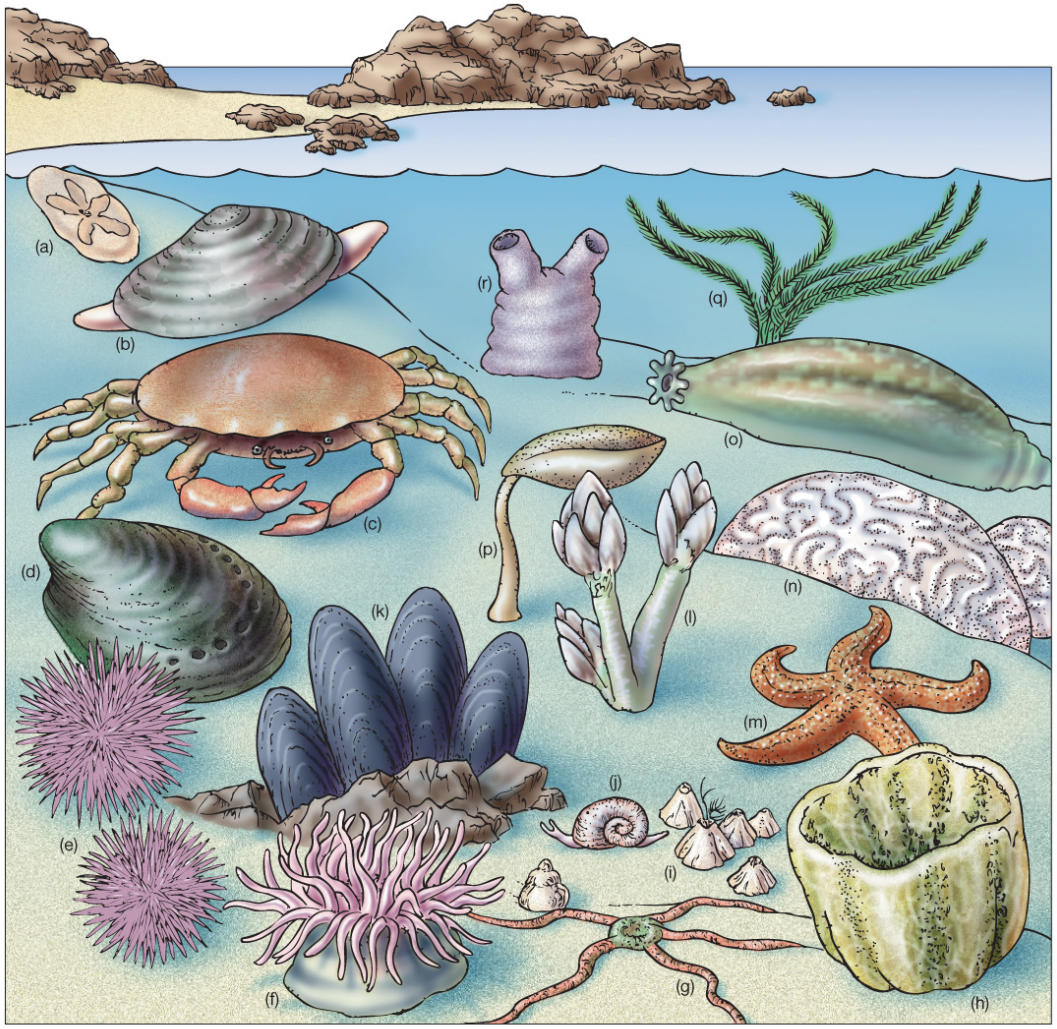
- Independent swimmers
- Most adult fish and squid
- Marine mammals
- Marine reptiles



Benthos

- Epifauna live on the surface of the sea floor.
- Infauna live buried in sediments.
- Nektobenthos swim or crawl through water above the seafloor.
- Benthos are most abundant in shallower water.
- Many live in perpetual darkness, coldness, and stillness.

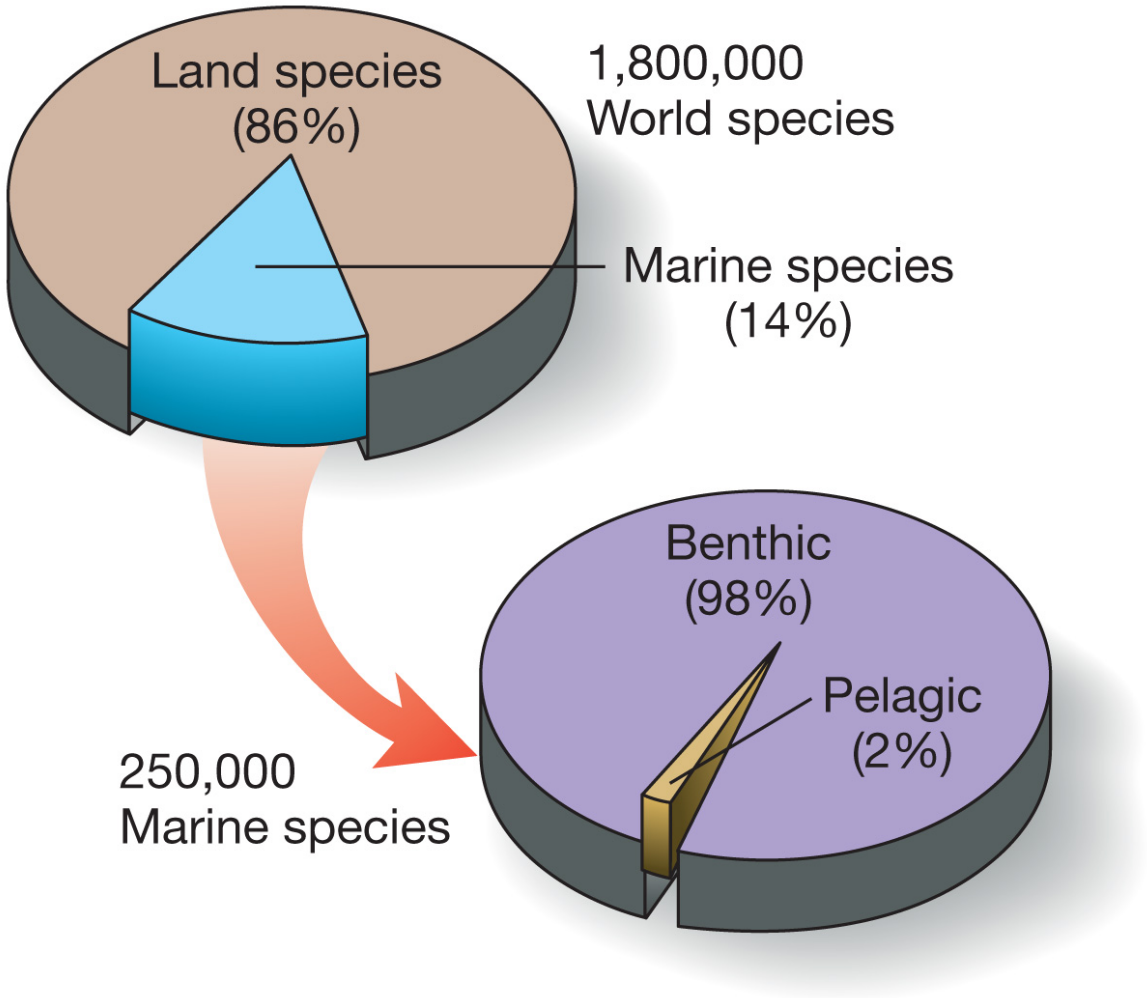
Benthos



Hydrothermal Vent Communities

- Abundant and large deep-ocean benthos
- Discovered in 1977
- Associated with hot vents (along mid-ocean ridges)
- Bacteria-like archaeons produce food using heat and chemicals
- Geologists think that early life originated at these vents in the early Archean

12.3 – How Many Marine Species Exist?



- More land species than marine species
- Ocean has relatively uniform conditions
- Less adaptation required, less speciation
- Marine species overwhelmingly benthic (98%) rather than pelagic (2%)
  - more sub-environments on the bottom that allowed the evolution of different species
  - pelagic conditions are more uniform, there is no need to adapt to an environment that tends not to change

End of CHAPTER 12, part 1
Marine Life and the Marine Environment