Learning Objectives

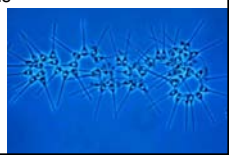
- To learn about the many different marine organisms that are classified as plankton.
- To understand the classification schemes for plankton.
- To learn how the various groups of plankton
- are different and similar to each other
- To understand the role that plankton play in the marine ecosystem

Plankton

- From the Greek word *planktos*
  - "that which is made to drift or wander"
  - Limited mobility with respect to currents, either drift or swim weakly
  - Central components of marine ecosystems
    - Base of the food chain
  - Generally small (less than a few mm)

Categories of Plankton

- Phytoplankton
  - "plant" plankton; autrophs
  - Use photosynthesis (solar energy) to generate organic matter. They are Primary Producers
  - Both eukaryotic and prokaryotic (cyanobacteria)
- Zooplankton
  - "animal" plankton; heterotrophs
  - Both uni- and multi-cellular
  - They are primary & secondary consumers
- Bacterioplankton
  - Bacteria and Archaea



Classification by Size

Picoplankton*	< 2 μm (human hair = 100 μm
Nanoplankton	2 - 20 μm
Microplankton (Net)	20 - 200 μm
Macroplankton	up to 2 mm

*Most abundant - 100 million/L

Sampling the Plankton

•Plankton net can only capture macroplankton

•Smaller plankton must be filtered out of the water

Plankton sampling

Density = # / Volume

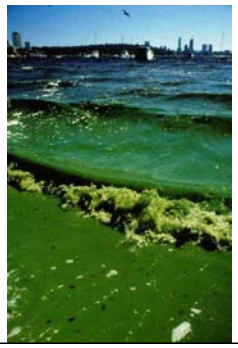
To calculate the VOLUME of water filtered by the net:
1.Record the distance that the net is towed (m)
2.Calculate the area of the net mouth (circle)
3.The volume of a cylinder = (MOUTH AREA) x (DISTANCE)
Units = (m^2) x (m) = m^3 = volume

Flotation Mechanisms

- Plankton density > seawater
  - They sink
- Adaptations
  - Shape
    - Objects of similar weight but different shape sink at different rates
    - Larger surface area means slower sinking → surface area to volume ratio
    - Spines and "feather"-like appendages
  - Flagella
  - Store light ions or oils in cells

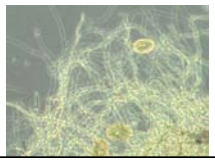
Common Phytoplankton

- Cyanobacteria*
- Diatoms
- Dinoflagellates
- Coccolithophorids
- Green algae*
- *picoplankton



Most Abundant Plankton

- Cyanobacteria
  - Earliest O_2 producers
  - Referred to commonly as blue-green algae but they are bacteria
  - Nitrogen cycling: convert N to N_2, NO_3
  - Make long filaments or mats
  - May account for 80% of productivity in tropics



Cyanobacteria

- Most abundant phytoplankton in the open ocean, because they can survive in low nutrient conditions
- Depending on season can produce 10-50% of net primary productivity
- Blue-green algae can produce toxic blooms

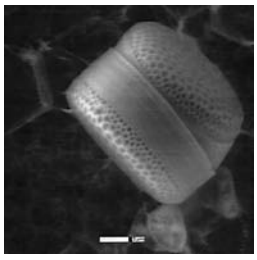
Diatoms - 2nd most productive

dia "through"; *tomos* "to cut"

- Important in creating O_2 rich atmosphere ~ 100 mya
- Thousands of different species
- Marine & freshwater
- Pelagic & benthic
- Nanoplankton to macroplankton
- Coastal and open ocean
- 40% of primary productivity

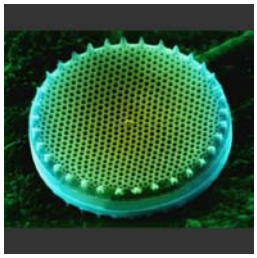
Diatoms

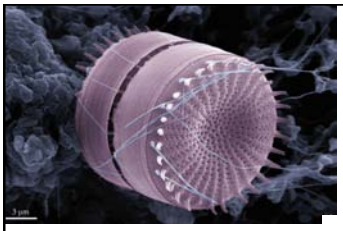
- Cells contained within glass "pillbox" made of silica: SiO_2. This cell wall is known as the frustule.
- Frustule made of 2 valves that nest within each other
- Highly ornamented
- Lots of perforations
- Radial or bilateral symmetry
- No visible locomotion



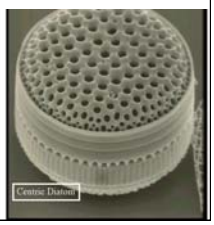
Diatoms

- Coated by organic compounds that prevents the silica from dissolving
- Diatoms control the oceans cycling of silicate
- Valves a major source of sediment
- Highly efficient at photosynthesis

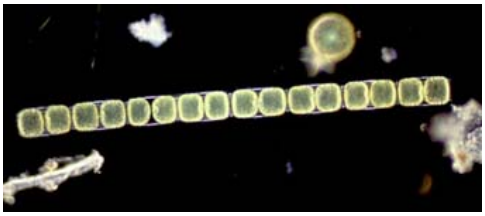


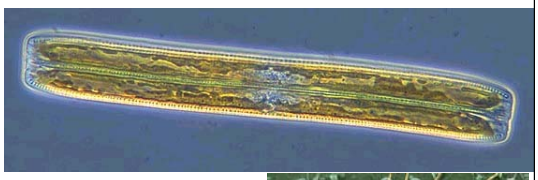


Centric diatoms have radial symmetry. Shaped like petri dishes or hat boxes.



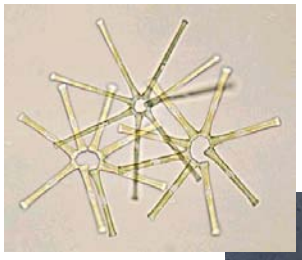
Chain-forming Centric Diatoms



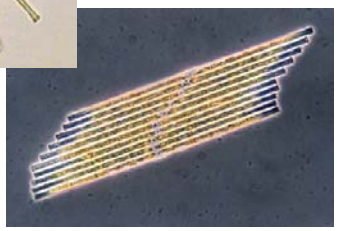


Pennate diatoms have bilateral symmetry. Elongated shape.

Pennate Aggregations

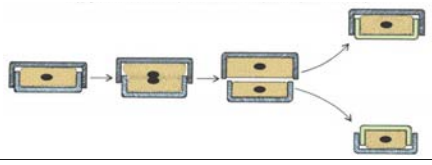


Bacillaria



Diatom Reproduction

- Asexual cell division
- Occur singly or in chains
- Size reduction, so eventually diatoms would get smaller & smaller…
- Sexual Reproduction also



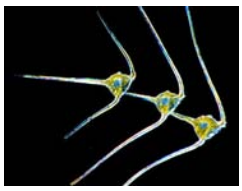
Diatoms

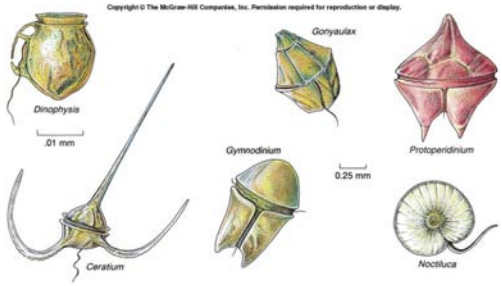
- Diatomaceous earth
  - Fossilized remains of diatoms
  - Useful in many products

Dinoflagellates

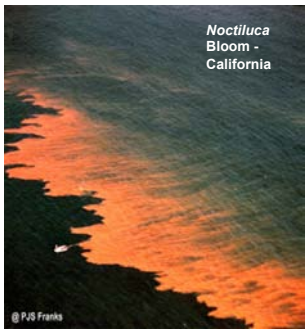
dino "whirling"; *flagellum* "whip"

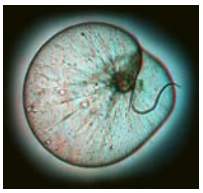
- Most are unicellular
- Possess 2 flagella
  - One circles the cell like a belt
  - Other like a tail
- Often armored with plates of cellulose-**theca**
- Usually solitary
- Most are autotrophs, some are heterotrophs, some are both



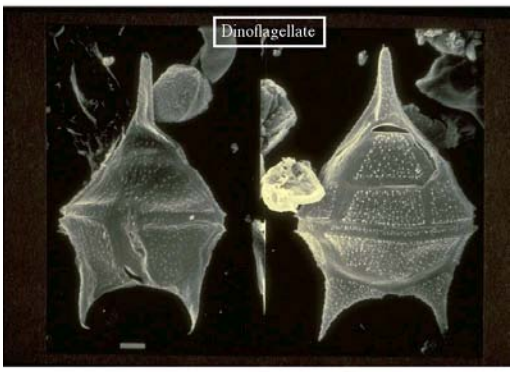


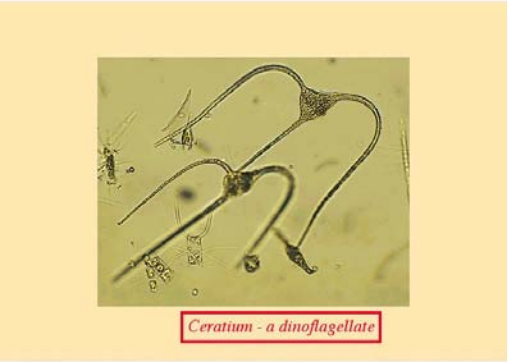
Dinoflagellates: Bioluminesce





Bioluminesce in surface waters most often due to dinoflagellates





Dinoflagellates and Red Tides

- High concentrations
  - AKA blooms
  - AKA "red tides"
  - AKA Harmful Algal Blooms (HABs)
- Toxins
  - Get biomagnified up the food chain
  - Closing of shellfish beds

Invertebrates, fish, and humans may die directly from the toxins if they encounter them (e.g, suffocation after resipiratory paralysis)

Zooxanthellae

- Symbiotic dinoflagellates
- Live within the tissues of corals, sponges, jellyfish, flatworms
- Taxonomically diverse

Soft coral polyp (*Lobophytum compactum*) Green shows the polyp tissue, while the red represents the zooxanthellae.

Coccolithophorids

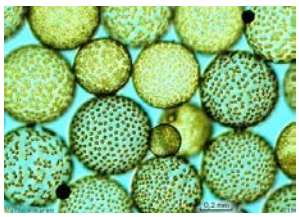
- Spherical cells with flagella
- Covered with *coccoliths*
- Made of calcium carbonate
- Calcareous oozes

Phytoplankton

Group	Characters	Contribution
Diatoms	Frustules made of SiO_2, dominant autotrophs in temperate and polar latitudes	Primary production, siliceous oozes
Dinoflagellates	Cellulose theca with 2 flagella, important autotrophs in tropical and coastal habitats, some contain toxins	Primary production
Coccolithophores	$CaCO_3$ plates, autotrophs	Primary production, calcareous oozes
Cyanobacteria	Blue-green, Autotrophs, often found in oligotrophic waters	Primary production, nitrogen fixation

Green Algae

- Similar in composition to land plants



Bacterioplankton

- Includes Bacteria and Archaea
- Small
- Heterotrophic or chemosynthetic
- Responsible for decomposition of organic matter
- Release nutrients that were incorporated in other organisms back into the water → Important to marine food webs!