Class 36  ADAPTATIONS TO LIFE IN SEAWATER

Structural support
Regulating body fluids
Flotation (buoyancy)
Success of planktonic "plants"

All organisms (land or sea) must adapt to their environments
Successful competitors must:
• Obtain food (or nutrients to make food)
• AND Minimize food/energy requirements
• Reproduce successfully
• Escape from predators

Life in seawater...Must adapt to:
• Dense and saline fluid
• Sparse food/nutrient resources in many cases

Adaptations (examples):
1. STRUCTURAL SUPPORT
2. REGULATING BODY FLUIDS
3. FLOTATION (BUOYANCY)

1. STRUCTURAL SUPPORT
Density of tissue+skeletons \(\approx\) density of seawater- almost weightless
• So...Marine organisms do not require the structural strength of land organisms.
• Marine animals can attain great size
Most marine plants do not need stalks, trunks, etc. Floating is more important.

2. REGULATING BODY FLUID SALINITY
All organisms must maintain roughly constant salinity in internal body fluids ("electrolyte balance"). How does this work in marine animals?
• Invertebrates and sharks -- no problem. Salinity of body fluids (\(S_{bf}\)) is similar to sea-water salinity (\(S_{sw}\)): \(S_{bf} \approx S_{sw}\)

Osmosis:

Bony fish -- Body-fluids less saline than seawater  (Why? Body-fluid chemistry inherited from ancestors adapted to brackish estuarine environments.)
Water diffuses out of cells --> dehydration would ensue except for...

**ADAPTATIONS**
They drink a lot of sea water and.....
Excrete salt ions preferentially through ...
  - gills
  - saline urine

**ALSO: Some marine fish can migrate into fresh water**
-- opposite process needed for fresh water:
  - Absorb salt ions from specialized gills
  - Excrete large amounts of dilute urine

3. **FLOTATION (BUOYANCY)**
Adaptations to stay at the surface or some preferred depth
   A. Gas pockets:
      Internal gas chambers or "floats"  (jellyfish, nautilus, cuttlefish)
      Flexible swim bladders (most fish)
         Active swimmers (some tuna, sharks) and bottom-dwelling
         fish have no swim bladders.
   B. Storage of low-density oils:
      Whales, seals:  blubber
      Fish and sharks:  oil stored in organs, e.g. sharks liver
      Plankton:  store oils in their cells
   C. Appendages  . . (especially in plankton)
      Spines, ruffles, feathery extensions
      Increase frictional resistance to sinking

**Adaptations of phytoplankton -- why are they the dominant marine "plants" ?**
Requirements ..
   Sunlight -- must maintain themselves in the photic zone.
   Nutrients (N & P) -- low concentration in surface waters,
Strategies:
   a) Maximize sunlight exposure
      Stay in photic zone
         Buoyancy - (oils)
         Small size and spines retard sinking
   b) Small, single-celled - better use of light

   b) Minimize nutrient needs
      Small, simple organisms more efficient
         -Nutrients in, wastes out by simple diffusion
These stratagies for success are best met by very small and simple plants: phytoplankton!