**BIOLOGICAL DIVERSITY**
**CHAPTER 29: PROTISTS**
10/31

- first eukaryotic group
- membrane-bound nucleus
- oldest prokaryote was 3500 million years ago
- oldest definite fossils of eukaryotes are ~1.5 billion years old
    - similar to green algae
    - 2 billion years AFTER oldest prokaryote**

*Protists*

- very diverse group
    - "catch-all" group (if scientists cannot classify something, they become a protist)
    - truly funky phylogenetically
        - multiple independent evolutionary lineages
        - no characteristic unique to all protists
- primarily unicellular, but some multicellular
- autotrophs
    - using light/chemical forms for energy
        - photosynthetic
    - carbon is obtained from carbon dioxide (inorganic form of carbon)
- heterotrophs
    - gain carbon and energy from external sources
    - differ from autotrophs in that the carbon source is organic (animal, plant, fungi, bacteria)
- mixotrophs
    - use both autotrophic forms and heterotrophic forms in order to gain energy and carbon

*Protistan Evolution*

- these evolutionary events make eukaryotic life possible*
    - prokaryotic cells → eukaryotic cells
    - asexual reproduction → sexual reproduction
        - binary fission: one cell splits into two daughter cells (asexual)
        - sexual reproduction: more than one organism involved in reproduction
    - unicellular → multicellular forms
        - drive to multi-tissue systems
- Theory of Endosymbiosis: move from prokaryotic cells to eukaryotic cells (have a membrane-bound nucleus/are characterized by internal compartmentalization/other organelles like the mitochondria, chloroplasts, endoplasmic reticulum, vacuoles)
    - endosymbiosis: organisms living together in a close association where both benefit
    - figure 29.2
    - step wise:
        1. represents  gaining a membrane-bound nucleus
        2. infolding of the plasma membrane
            a. there are existing prokaryotes that have the characteristic of an infolding membrane
                i. increase surface area of the cell
                    1. increase food uptake
                    2. food traps: food particles get trapped in the folds
                ii. protect DNA better

3. folds met and then the membrane fused around the DNA
    a. something found in modern prokaryotes, particularly when surrounding food particles
4. end result is gaining a modern eukaryotic cell with a membrane bound nucleus from the membrane and the endoplasmic reticulum from the folds
    a. first step toward an eukaryotic cell; simple (ancestral eukaryotic cell)
    b. increased compartmentalization

- feeding (understand this to understand endosymbiosis)
    - many protists/some prokaryotes feed by phagocytosis: membrane surrounds the food source/changes shape and engulfs the food, then we have a membrane bound nucleus AND a food vacuole that contains the food item just taken in
        - food vacuole is broken off of the cell membrane
    - enzymes flood into the food vacuole and break down the food item into its component pieces
        - food vacuole itself breaks down, or food particles go through vacuole membrane
            - products of digestion move out into the cell
- ancestral eukaryotic cell to modern eukaryotic cell
    - ancestral eukaryotic cell encountered and consumed a bacterium
        - if individual bacteria does not breakdown/is NOT ingested, then it can continue its life within the vacuole within the eukaryotic cell
            - idea of endosymbiosis (bacteria living within another cell)
        - symbiosis
            - products taken up by bacterium (using carbon and some of the energy from the eukaryotic cell)
            - through the bacteria's metabolic processes, it releases energy and the eukaryotic cell gains the energy and uses it
            - symbiotic eukaryote cell has extra energy gain from the bacteria, the ancestral eukaryotic cell DOES NOT
                - symbiotic eukaryotic cell has an increased growth and reproductive rates
                    - selective advantage (over time, cells with the symbiote are selected FOR due to the extra energy and increased rates of growth and reproduction)
    - the bacterium taken up by the ancestral eukaryotic cell is most likely a purple sulfur bacterium: excellent energy producers, bad energy harvesters
        - over time, the mitochondrion was formed (powerhouse creating energy)
        - both were dependent on one another
    - just as phagocytosis was responsible for taking on the purple sulfur for mitochondrion, phagocytosis took up photosynthetic bacteria, became symbiotic, and resulted in modern chloroplasts (similar to cyanobacteria- poor energy producers, but excellent energy harvesters associated with sunlight)
        - autotrophic pathways were selected for
        - evidence:
            - particular organelles are double membraned (vacuole and around bacteria)
                - both mitochondria and chloroplasts have double membranes
                - mitochondria and chloroplasts are capable of going through binary fission autonomously like bacterium do
                - mitochondria and chloroplasts have their own genomes

        - very likely that purple sulfur and cyanobacteria are the mitochondria and chloroplasts of today

½ *Sheet*

- who are the protists?
    - kelp, seaweed
    - malaria
    - phytoplankton "drifting plants"
        - not plants- diatoms, green algae
    - sleeping sickness- trypanosomes
    - amoebas
    - slime molds
    - paramecium
- roles of protists
    - major food source
        - fish, small crustaceans, humans, etc.
        - at the base of most aquatic food webs
    - cause disease
        - some of the most deadliest diseases are caused by protists
    - major producers of oxygen
        - 80% of Earth's oxygen come from protists

*Protists from Ecological Perspective*

- mainly aquatic (marine and freshwater)
    - among the most abundant organisms in any aquatic food web
    - at the base of most aquatic food webs
- found in blood or body fluids (liquid-based environment)
- aquatic autotrophic protists
    - **phytoplankton** (drifting plants-NOT plants)
        - "floating protists" and SOME prokaryotes
            - ex. cyanobacteria (this is BACTERIA and phytoplankton)
        - photoautotrophs: harvesting energy from light
            - carbon dioxide + water + light into photosynthesis that creates oxygen + food (organic carbon)
                - 80% of Earth's oxygen comes from phytoplankton
        - includes some bacteria/archaea
            - cyanobacteria
        - tend to respond well to pollution (nitrogen or phosphorus)
            - phytoplankton "blooms"
                - lots of it coming along at once/responding to a nutrient
        - diatoms
            - largest, most abundant group of phytoplankton
            - unicellular autotrophs
            - attached or floating forms (floating found drifting in water- passive)
            - can be single or colonial (stacks of individual organisms/cells)
            - when they die, they settle out to the bottom of the ocean or lake
                - used in science and diatomaceous earth
                    - paleontology