Unit 4 Notes
Cell Structure and Function

I. The Basic Unit of Life

A. The cell theory was proposed after hundreds of years of microscopy.

1. In 1665 Robert Hook discovered cells by examining thin slices of cork with a crude, compound microscope.

2. Near the end of the 1600's, Anton van Leeuwenhoek observed microorganisms leading to the idea of single celled organisms.

3. In 1831 Robert Brown discovered and named the cell nucleus.

4. In the late 1830's Schleiden and Schwann suggested that plants and animals are made of cells (respectively).

5. After numerous scientists observed cell division, Rudolf Virchow hypothesized: "All cells come from cells."

6. Most simply, the cell theory states:

a. Cells and their products are the units of structure and function in organisms.

b. All cells come from preexisting cells.

B. Advances in technology helped scientists move beyond thinking of cells as tiny blobs of jelly.

1. Improvements in lens grinding microscope construction have lead to compound light microscopes that can magnify images by over 1000x (limited by nature of light).

2. Discoveries in cell staining and slide preparation have made samples easier to see.

3. Electron microscopes (developed in the 1930's) can magnify objects by over 1,000,000x (0.5 nm) – enough to see the structure of molecules such as DNA.

a. Specimens must be dead.

b. Sample preparation can alter the structures observed.

C. There are two basic types of cells.

1. Prokaryotes (bacteria) are very simple, small (~1 – 5 μm across) and extremely adaptable, living in a wide variety of extreme and mild habitats.

2. Eukaryotes (protists, fungi, plants, & animals) are larger (~10 – 50 μm) and more complex.

   a. They have many parts with specific functions, allowing the development of many specialized tissues.

   b. They also contain membrane-bound inner compartments such as chloroplasts, mitochondria, and a nucleus (contains DNA).

II. Cell Structure

A. Prokaryotes have relatively few structures.

1. Cell wall: protection; made of carbohydrates, lipids, and proteins (but no cellulose); composition affects staining.

2. Plasma membrane: sel. perm.; inside cell wall.

3. Nucleoid: location of a single, circular piece of DNA (attached to plasma membrane).

4. Plasmids: much smaller pieces of DNA w/ very few genes.

5. Flagella: whiplike propeller used for swimming.

6. Ribosomes: small body of protein and RNA; assembles amino acids into proteins based on mRNA it reads.

B. Eukaryotes are divided into many small parts (organelles), each with its own structure and function.

1. Cell wall: plants (cellulose); fungi (chitin)

2. Plasma membrane: of course.

3. Nucleus: most noticeable organelle; genetic control center.

   a. A double layered nuclear membrane surrounds the chromosomes (DNA wrapped around histones).

   b. Nucleolus: concentrated drop of RNA which aids in protein synthesis (makes ribosomes).

4. Cytosol: protein rich semi-fluid material; bathes organelles; (cytoplasm is the cytosol and organelles).
5. Cytoskeleton: composed of microtubules, intermediate filaments, and microfilaments; cell shape, organelle organization & movement, cell movement.

6. Ribosomes: slightly different structure than prokaryotic ribo's, but same function.

7. Endoplasmic reticulum (ER): membrane "conveyer belt" for protein transport between organelles; rough kind has ribosomes attached, smooth kind does not.

8. Golgi apparatus: looks like smooth ER; modifies cell products and packages them into membrane bound vesicles for delivery to organelles or outside the cell.

9. Lysosomes (in animals): digestive enzyme containing vesicle; break down old cell parts, digest food, kill bacteria.

10. Vacuoles (in plants): storage container for water, organic acids, digestive enzymes, salts, pigments, etc.; big.

11. Centrioles: paired bundles of microtubules; help organize DNA during cell reproduction.

12. Cilia and flagella: membrane wrapped microtubule bundles (9 x 2); which provide locomotion and substance movement w/ use of ATP.

III. Multicellular Organization

A. Unicellular organisms can cooperate as a colony in ways that give them advantages over isolated organisms.

1. Bacterial colonies can form biofilms to help slow diffusion, stay attached to a surface, and regulate external conditions (pH, food and water conc., etc.).

2. Protists (ex: Volvox) can cluster cells together, forming large colonies that coordinate cell activities (ex: movement) and have a degree of cell specialization (ex: reproduction).

B. Multicellular organisms require many types of cells that carry on basic life activities *and* a special function.

1. A tissue is a group of cells with the same specialization that work together. (muscle, epithelial, nervous, etc.)

2. Various tissues can be arranged to form an organ with a specific function (ex: heart, lung, fruit).

3. A group of organs can be incorporated into a system which performs a set of related functions (ex: digestive).

C. Systems generally deal with problems inherent of organisms composed of billions of cells.

1. Most systems are necessary for the following reasons:

a. Highly specialized cells require a division of labor.

b. Regulation and coordination of large numbers of cells is essential.

c. Most cells are not in direct contact with the outside environment.

2. Some systems have evolved functions that are not directly related to their original function (ex: white blood cells).