Biology Notes – Chapter 5 + 6

General Information/Ways of Classification

1. **Biodiversity** – the incredible diversity of more than 3 million types of named organisms
2. **Taxonomy** – The science of classifying organisms
3. **The Groups of Classifications** – Kingdom, Phylum or Division, Class, Order, Family, Genus, Species
4. **Basis for Classification** – Structure, function, biochemistry, behavior, genetic systems, evolutionary history, etc.
5. **Homologies** – Structural similarities among organisms. **These indicate related evolutionary ancestry**
   - Important because structure is preserved in fossils, easily verified
   - Chemical homologies, such as DNA or RNA similarities, can also indicate close ancestry
6. **Asexual reproduction** – requires only one parent, offspring is the duplicate of parent
7. **Sexual Reproduction** – requires two parents, offspring is a crossover of both chromosomes, good for evolution
8. **Human Classification** – Animalia, Chordata, Mammalia, Primates, Hominidae Homo, Sapiens
9. **Taxonomic Classification is not fixed** – The change as new evidence is found
10. Biologists often argue on how organisms should be classified
11. There was a time when the only kingdoms known were plants and animals – the time before microscopes
12. **Electron Microscopes** – uses electron beams instead of lenses, much more powerful. Developed in the 1930's
    - One drawback is that cells are killed and structure damaged when preparing the sample for viewing
    - Movement and reactions that occur remain largely invisible
13. **Variation** – genetic differences between related individuals within a species
    - Geographic variations – species specific to an area due to the specific conditions of that area
14. DNA and RNA are the universal information molecule and exist in all kingdoms
15. **The 5 reasons on how to organize organisms**
    - Is the organism a prokaryote or Eukaryote?
    - Is it an autotroph or a heterotroph?
    - Does it reproduce asexually or sexually?
    - What is the general structure and function of the organism?
    - Is it multi-cellular or unicellular?
16. **Archaebacteria** – new kingdom proposed for monera that aren't like monera.
17. History of Classification
    - **Aristotle** – first tried to classify plants and animals
    - **Linnaeus** –invented present day classification system
18. **Mules –** Cross between a male donkey and a female horse

Prokaryotes and Eukaryotes

1. Definition – Two different types of cells, with different structures. Prokaryotic cells are more primitive
2. For the pictures and locations of all organelles, see page 138 in textbook
3. Prokaryotic cells lack the ability to produce membranes, many organelles, and shield for nucleus
   - The only types of prokaryotic cells are bacteria, .3 – 5 micrometers
   - Cell walls are rigid and formed from protein-like chains. No cellulose
   - **Plasma membrane** – layer just inside the wall that encloses the cell.
   - **Mesosome** – infolding of the plasma membrane that aides in secretion and in copying chromosomes
   - Contain single, circular thread of double stranded DNA, though some have plasmids
     - Only 1 chromosome, genes are not in pairs. Attached to plasma membrane
   - **Plasmids** – smaller circular DNA molecules. The tool for the genetic engineer
     - Can be inserted into other organisms, since all organisms share the same genetic material
     - Further evidence of genetic continuity between species
     - Plasmids are NOT present in Eukaryotic cells
   - **Nucleoid** – location of the chromosome, which is attached to the plasma membrane
4. Eukaryotic Cells – modern cells, distinguished by membrane enclosed nucleus.
   - Many organelles present, has ability to produce membrane. 10 – 50 micrometers
   - The cytosol of eukaryotic cells stream
   - Cell walls, if present, are made of cellulose or another polysaccharide, chitin
   - DNA is organized into chromosomes within nucleus, no plasmids, follows double helix
   - **Organelles** – A part of the eukaryotic cell that has its own structure and function
     - Many parts of the cell must be separate in order for cell to survive
     - **Plasma Membranes** – lines the cell wall, made of proteins, carbs, lipids
       - Controls passage of materials into and out of cell
     - **Cell Wall** – present in plants, protects shape of cell, composed of cellulose and other carbs
     - **Cytoplasm or Cytosol** – the protein rich, semi fluid material in the cell that surrounds organelles
     - **Nucleus** – enclosed by two membranes that form the nuclear envelope, contains DNA

Nucleoli – sites of rRNA and tRNA synthesis
Endoplasmic Reticulum – ER – system of membranes forming tubes and channels
Connects organelles in the cell, the transportation system
Ribosomes – attached to the ER, where proteins are synthesized
Golgi Apparatus – the place where proteins undergo final assembly, packages macromolecules
Vesicles – Spherical membrane enclosed packets that appear to pinch off.
Created in the Golgi apparatus. Carry substances out of the cell
Other substances become part of the cell membrane or other organelles
ER, Golgi Apparatus, and Vesicles form an interconnected system
Lysosomes – special vesicles in animal cells. Contains enzymes that recycle cells
They also destroy foreign particles. **Also known as suicide sacks**
Vacuoles –Storage for water, organic acids, enzymes, salts, etc.
Plants have central vacuole, animals have several small ones
Chloroplasts – double membrane organelles, produces food through photosynthesis
Mitochondria – Double membrane organelles, produces ATP through Cellular Respiration
Centrioles – tubular structures that play an important role in reproduction
Present only in animals and protist cells, duplicate prior to mitosis
Flagella – long, whip like extensions of the cell surface. Made of proteins called **microtubules**
Cilia – short flagella, usually present in greater numbers. Produces locomotion by shipping
Present in lungs to beat out foreign particles and mucus
Cytoskeleton – fine network of protein scaffolding that provides shape, internal organization
Made of microfilaments, microtubules, and filaments
Responsible for movement of both organelles and movement of the entire cell

Membranes – thin layers of proteins that lipids responsible for many life functions
The plasma membrane separates the cell from the external environment
The membrane regulates the flow of molecules into and out of the cell
Phospholipids – Lipids with a hydrophobic tail and hydrophilic head.
Two rows of molecules oriented from end to end
The hydrophobic ends face each other towards the center, hydrophilic towards outside
Cholesterol is present in the membranes of cells, as well as proteins and sugars
These molecules play a role in cell-to-cell recognition.
Membranes are asymmetrical – the outside is shaped differently from the inside
The molecules that form the membrane are constantly moving
Proteins involved in ATP synthesis are located on the membranes or mitochondria/chloroplast
Glycoproteins act as antennae to receive messages from other cells
Proteins synthesized at ribosomes are attached along the membranes of the ER
They also regulate the movement of materials in and out of the cell

Diffusion – Molecules tend to move from, an area of high concentration to an area of low concentration
Diffusion will stop when the molecules are equally divided, or reached equilibrium
Requires no additional energy, a spontaneous, random process of all matter
The higher the number of molecules, or concentration, the more they collide and spread out
Concentration Gradient – the difference in concentration across a distance
Molecules move DOWN the concentration gradient
Responsible for the movement of gases and some cellular waste into and out of cells

Osmosis – the diffusion of water into and out of cells
Water constantly passes into and out of cells through their plasma membranes
Water diffuses down its concentration gradient
When an animal cell is placed in water, osmosis usually causes it to explode
Plant cells don't explode because of the cell wall

Passive and Active Transport – movement of materials with aide of transfer proteins
Membranes are selectively permeable – they let some substances pass and block others
The non-polar phospholipid tails tend to repel charged particles, but allow lipids
Small molecules easily diffuse, large molecules must be broken down first
Passive transport – substances move down conc. gradient through transport proteins
Active transport – substances move UP conc. gradient, needs ATP/NRG
Types of transport proteins
One forms channels through specific ions can diffuse
Other binds to molecules and physically moves it across the membrane

Many substances, such as nitrate and potassium, need passive and active transports

Pocket transports

Membrane folds inwards, creates pocket filled with fluid and particles with surround
Membrane then closes over the pocket and releases it into the cell
Creates new vesicle containing clued and particles that were once outside.
It's a way for large molecules to pass through the membrane

Eukaryotic Cells Have	Prokaryotic Cells Have
Nucleus	No nucleus
Membrane enclosed organelles	No membrane enclosed organelles
Chromosomes in pairs	Single chromosome
Streaming in the cytoplasm	No streaming in the cytoplasm
Cell division by mitosis	Cell division without mitosis
Complex flagella	Simple flagella
Larger ribosomes	Smaller ribosomes
Cytoskeleton	No known cytoskeleton
Cellulose in cell walls	No cellulose in cell walls
DNA bound to histone proteins	DNA bound to other proteins

Kingdoms

1. **Definition** – Phylums with similar characteristics are grouped into 5 major Kingdoms
2. For example, chordates, snails, butterflies, and more are grouped in kingdom Animalia
3. The 5 Kingdoms of Life – Monera, Protista, Fungi, Plantae, Animalia
4. **Kingdom Monera**

   Definition – All prokaryotic cells, consists of bacteria.
   Also known as **Kingdom Prokaryotae**
   Large variety of chemical and functional patterns, can live almost anywhere
   Eubacteria – true bacteria
   Archaebacteria – Ancient bacteria
   Mostly unicellular, but multi-cellular exist as well. Reproduces through cell division

5. **Kingdom Protista**

   Definition – simple, eukaryotic organisms that aren't plants, animals, or fungi
   Mostly unicellular, but multicellular organisms, such as kelp, do exist.
   Great variation in cellular organization, and methods of reproduction
   Contains producers, consumers, or decomposers
   Some switch their diet according to conditions
   Includes algae, protozoa, slime molds, etc.

6. **Kingdom Fungi**

   Definition – heterotrophs that absorb small molecules from their surroundings through their outer walls
   Most are multicellular, except yeast
   Cell walls made of chitinous
   Most are decomposers who break down organic material

7. **Kingdom Plantae**

   Definition - Eukaryotes that produce their own foot through photosynthesis
   Have cellulose containing cell walls and store food as starch
   Cells contain chloroplasts
   These produce the bulk of the world's food and much of the oxygen

8. **Kingdom Animalia**

   Definition – Heterotrophic, multicellular eukaryotes
   Vertebrates – animals with a spinal column, or backbone
   Invertebrates - animals lacking a backbone, such as sponges, worms, insects

Phylum and Divisions

1. **Definition** – Classes with similar characteristics are grouped in Phylums and Divisions
2. Animals are usually classified into phylums, plants into divisions.
3. Botanists use divisions because phylum implies a knowledge of ancestries that is lacking for plant groups.
4. For example, birds, snakes, fish, frogs, and mammalia are grouped into phylum Chordata.

Class

1. **Definition** – Orders with similar characteristics are grouped into Classes
2. For example, Order Carnivora and order Lagomorpha are grouped into class Mammalia

Order

1. **Definition** – Families with similar characteristics are grouped into Orders
2. For example, the dog, cat, bear, raccoon, weasel, otter, etc are grouped into order Carnivora

Family

1. **Definition** – Genera with similar characteristics are grouped into families
2. For example, the fox, genus Vulpes, the dogs, genus Canis, are part of family Canidae

Genus

1. **Definition** – Each genus contains species with similar characteristics
2. One genus contains different species. For example, dogs, coyotes, and wolves are all in genus Canis

Species

1. **Definition** – A group of closely related organisms capable or producing fertile offspring
   Also known as a population of individuals that breed and produce under NATURAL CONDITIONS.
   Three ways that protects species
   Potential mates don't meet at all
   They meet but don't breed
   They breed but do not produce fertile offspring (mules are an example)
2. The most specific group of classification
3. There are great variations among species, such as dogs and cats, who look and live differently
4. **Polymorphism** – Occurs when two or more distinct forms, coexist in a population

Scientific Names

1. The first word of the scientific name is the genus name; the second is the species name.
   Genus name is capitalized, species name isn't. Name usually appears in italics or underline
2. Devised by Carolus Linnaeus
3. For example, a white footed mouse is Peromyscus leucopus
4. Uses Latin because it WAS the language of elegance and scholars, and the names were then universal
5. Common names mean different animals in different regions, scientific names are more precise

Cells

1. **Definition** - The "basic unit of life." Just as all matter is made of atoms, all living material is made of cells
2. **Cell theory** – Cells, or products made by cells, are the units of structure and the function in organisms
   All Cells come from preexisting cells
   Hooke – discovered the cell
   Schwann/Schleiden – everything made of cells
   Leeuwenhoek – discovered microorganisms
   Virchow – all cells come from cells
3. **Cell Size** – Most cells average 10 – 20 micrometers in diameter. The Nucleus is ½ - ¼ the size of the cell
4. **Prokaryotic and Eukaryotic Cells** – See Above

Division of Labor and Cooperation

1. Cells cooperate with each other to carry out life functions, and each cell is very specialized
2. A cluster of cells doesn't necessarily mean it's an organisms, for each cell can survive on its own
3. **Volvox** – a protist found in ponds and useful for studying function inside of simple multicellular organisms
4. **Epidermis** – the outer covering of a cell, or skin to humans
5. **Tissues** – groups of specialized cells (nerve, muscular, skin, connective)
6. **Organs** – Groups of specialized tissues
7. **Systems** – Groups of specialized organs

Required because a division of labor occurs among cells
Many individual cells can't work together without regulation and coordination
The majority of cells are not in direct contact with the outside environment

8. **Organism** – Groups of specialized systems
9. Since cells are small, they can't obtain nutrients or dispose waste themselves, require circulatory system

Biosphere – the Earth
Ecosystems – an aquarium
Communities – living organisms
Population – goldfish in aquarium
Organisms – 1 goldfish
Systems – circulatory system
Organs – heart
Tissue – muscle
Cells – blood cell
Organelles – ribosome
Compound Molecules – virus
Macromolecules – DNA
Molecules – water
Atoms – Hydrogen
Subatomic particles - electrons