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**Unit 2: Cells and Microscopes Completed Notes**

**Unit 2a- Life Characteristics**

* *Characteristics of Life*
  + Has an orderly structure
  + Produce offspring
  + Grow and develop
  + Requires energy
  + Expels waste/ Respiration
  + Made of at least one cell
    - **A cell in and of itself is considered a living thing because it performs all of these functions.**
  + Adjusts to changes in the environment
    - Responding to stimuli
      * Example: Getting a shot (the stimulus) makes you flinch
    - Homeostasis: Regulation of organism’s internal environment to maintain conditions suitable for survival.
      * Example: Humans sweating and shivering
    - Adaptation: Inherited from generations (over time) that enables an organism to survive and reproduce.
* Chemical Compounds all living things share
  + *Carbohydrates*
    - These are sugars
    - Provide energy & structure for living organisms
    - Examples: glucose, maltose, sucrose, or starch
  + *Lipids*
    - There are fats, oils, and waxes
    - The three major functions of lipids are
      * Energy storage & insulation
      * Structure for cell membrane development
      * Serving as a component of hormones and vitamins in the body.
  + *Proteins*
    - The five major functions of proteins are:
      * Structure (example: collagen and keratin in animals)
      * Transport (example: hemoglobin in blood)
      * Hormones (example: insulin)
      * Defense (example: antibodies)
      * Enzymes (example: regulate chemical reactions and end in –ase. Lipase and Lactase)
    - Proteins are made up of hundreds or thousands of smaller units called ***amino acids***.
* *Nucleic acids*
  + - Is the genetic information that can be passed from parent to offspring.
    - Composed of **Nucleotides** that are made up of three parts
      * Nitrogenous Base
      * Sugar
      * Phosphate group
    - Ex: DNA and RNA

**Unit 2b- Microscopes**

* Compound Light Microscopes
  + Magnify objects 1500 times
  + Common in schools
  + Use compound lenses to magnify objects
  + Lenses bend or refract light to make object appear closer
  + Common magnifications:
    - 40x, 100x, 400x
* Electron Microscopes
  + Uses electrons instead of light to magnify structure up to 500,000 times
    - **SEM**= Scanning Electron Microscope
      * Uses electrons instead of light to magnify structure up to 500,000 times
* Magnification
  + Your microscope has 3 magnifications:
    - Scanning
    - Low
    - High
  + Each objective will have the magnification written on it.
  + The ocular lens (eyepiece) has a magnification.
  + The total magnification is the ocular x objective
* General procedures for microscopes
  + Make sure all backpacks and materials are out of the aisles.
  + Plug in your microscope (if needed).
  + Make sure the scanning object (shortest objective) is clicked into place.
  + Store with cord wrapped around the microscope with the cover on the microscope
  + Carry by the base and arm with both hands.
* Focusing
  + **Always start with the scanning objective**.
  + The scanning is the shortest objective.
  + Make sure the diaphragm is set to the largest opening
  + Use the Coarse Adjustment Knob to focus (biggest knob).
  + Do not use stage clips right away, try moving the slide around until you find something.
  + If you find an area then use the stage clips to anchor the slide
  + **DON’T SWITCH TO A HIGHER POWER UNTIL YOU HAVE FOUND A CLEAR VIEW.**
* Focusing Specimens to low power
  + Once you’ve focused on Scanning, switch to Low Power.
    - The low objective is the middle objective.
    - Use the Coarse Adjustment Knob to focus (biggest knob)
    - If you need to refine your focus use the Fine Adjustment Knob (smaller knob)
* Focusing Specimens to high power
  + Now switch to High Power
    - (If you have a thick slide, or a slide without a cover, do NOT use the high power objective).
  + At this point, ONLY use the Fine Adjustment Know (smallest) to focus specimens.
    - DO NOT use the Coarse Adjustment Knob (biggest)
    - If the specimen is too light or too dark, try adjusting the diaphragm.
* Drawing a Specimen
  + Use pencil - you can erase and shade areas
  + All drawings should include clear and proper labels (and be large enough to view details
    - Drawings should be labeled with the specimen name and magnification.
  + Labels should be written on the outside of the circle.
    - The circle indicates what you see when you look through the eyepiece, specimens should be drawn to scale
    - Ex: if your specimen takes up the whole viewing field, make sure your drawing reflects that.
* Clean Up
  + Store microscopes with the scanning objective in place.
  + Wrap cords and cover microscopes.
  + Wash slides in the sinks and dry them, placing them back in the slide boxes to be used later.
  + Throw coverslips away
    - Unless told otherwise

**Unit 2c- Cell Structure and Function**

* *Prokaryotes*
  + NO NUCLEUS- DNA is floating freely inside cell (located in an area called the nucleoid)
  + Smallest cells/ *unicellular* – made of one cell
  + No cellular organs (membrane-bound organelles)
  + Contains: DNA, ribosomes, cytoplasm, plasma membrane, cell wall, capsule, flagella/ cilia and pilli
  + Ex: Bacteria
* *Eukaryotes*
  + DNA is held in the nucleus
  + Contains membrane-bound organelles
  + Eukaryotic cells are MUCH BIGGER then Prokaryotic cells. (x100 bigger
  + Can be *multicellular* or *unicellular*
  + Ex: animals, plants, fungi, and protists
* Discovery of cells
  + *Robert Hooke*
    - British scientist who first observed and named cells
    - studied bark of trees in 1665
  + *Virchow*
    - Russian Scientist came up with **Cell Theory:**
      * All organisms are composed of one or more cells
      * The cell is the basic unit of organization
      * All cells come from preexisting cells
* What are *organelles*?
  + Tiny organs (membrane-bound) of a **Eukaryotic cell**
  + Most organelles have an outer membrane layer
    - Membranes are made of lipids.
    - The lipid membranes keep the inside of the organelle separate from the outside (like a wall).
  + Each Organelle has a specific job/function to do.
* *Plasma membrane*
  + Structure and Security (**semi-permeable membrane)**
  + Surrounds the *entire* cell (prokaryotes and eukaryotes)
  + Made of Phospholipids and Proteins
* *Cell Wall \*\*(Plants only and Prokaryotes)\*\**
  + Used for structure (helps plants stand up)
  + Surrounds the entire cell (even the plasma membrane)
* Like a solid wall
* *Cytoplasm and Cytoskeleton- Work Area (Not really and organelle)*
  + Cytoplasm: The fluid that makes up the inside of the cell
    - Organelles and proteins work and move in this space.
    - Eukaryotes and Prokaryotes
  + Cytoskeleton: made of proteins and used as tracks for the movement of organelles (cellular highway)
* *Nucleus- Main Office*
  + Where the ***DNA*** is kept in eukaryotes
    - DNA is the blueprint for making proteins
  + Ribosomes are made in the nucleolus (inside the nucleus)
* *Ribosomes- Worker Bees*
  + Created in the nucleus- are in fact RNA
  + They ***help make proteins***
  + Can be attached to the ER or free floating
    - Attached to ER make proteins to be shipped out of the cell
    - Free floating make protein for the cell
  + In Eukaryotes and Prokaryotes
* *Endoplasmic Reticulum (ER)*
  + Two Types:
    - Rough ER- functions in protein synthesis- specialized proteins are completed here and shipped to the Golgi then out of the cell.
      * Located next to the nucleus
      * Ribosomes are attached
    - Smooth ER- Makes Lipids / Breakdown toxins
* *Golgi Complex*
  + Modifies, packages & ships proteins out of the cell
  + Golgi receives and sends proteins in objects called Vesicles.
* *Lysosomes \*\*(Animals only)\*\**
  + Recycling & waste removal
    - Can break up food particles into smaller parts for cell to use.
    - Can break down old useless organelles
* *Chloroplast \*\*(Plants only)\*\**
  + Converts light into ***Carbohydrates***
    - The carbohydrate made is glucose
    - Contains Chlorophyl (green pigment)
    - Carbohydrates are used by the cell of energy
* *Mitochondria*
  + Provides cell with energy!
    - Does this by breaking down Carbohydrates
    - *The carbohydrates being broken down is glucose into ATP (Adenosine Triphosphate = energy)*
* *Vacuole*
  + Stores water and waste/toxins
  + In plants, puts pressure against the *cell wall* to keep cell rigid. (mostly in plants)
* *Cilia & Flagella*
  + Cilia: catches particles
  + Flagella: used for movement.
  + In eukaryotes and prokaryotes

**Unit 2d- Osmosis**

* How does material move in and out of the cell?
  + *Passive Transport*
    - Particles can enter and exit the cell without the use of energy. (no ATP)
      * Examples: Osmosis, diffusion, and facilitated diffusion
    - Facilitated diffusion uses Carrier Proteins to move small particles into the cell.
    - *Diffusion* moves very small particles from an area of high concentration to an area of lower concentration.
  + *Active Transport*
    - Particles can enter and exit the cell with the use of energy (ATP)
    - Particles move from low to high concentration (against the gradient).
    - These particles include ions, glucose, and amino acids
  + *Endocytosis (“into” the cytoplasm*)
    - The process where a cell will take in foreign substances
      * This is done by the cell wrapping its cell membrane around a substance (vesticle) and literally “taking it in”
  + *Exocytosis (“exit” the cytoplasm)*
    - The process where a cell will release substances from itself.
      * This is done by vesicles fusing with the cell’s cell membrane
  + There must first be a concentration gradient!
    - Difference in concentration of materials across a space.
  + Diffusion will continue until there is no concentration gradient - - ***equilibrium has occurred.***
  + *Osmosis*
    - The ***diffusion*** of water.
    - Water molecules moving from an area of high concentration to an area of low concentration
* Three Types of Solutions
  + *Isotonic*
    - Concentration of non-water molecules outside the cell is the same as the *concentration* of non-water molecules inside the cell. (i.e. ***equal water inside and outside of cell)***
    - Water will move in and out of the cell at the same speed.
    - **Cell keeps its shape!**
  + *Hypotonic*
    - High concentration of non-water molecules inside the cell (ex: less water inside)
    - Low concentration of non-water molecules outside of the cell (i.e. ***more water outside***)
    - Osmosis will cause water to move into the cell
    - **Cells will get bigger** . . . and explode!!!
  + *Hypertonic*
    - High concentration of non-water molecules outside of the cell (ex: less water outside)
    - Low concentration non-water molecules inside the cell (i.e. ***More water inside***)
    - Osmosis will move the water out of the cell
    - **Cell will shrink!**
* Osmosis in Plant cells
  + *Turgor Pressure*
    - Pressure that builds inside of a cells as the result of osmosis
    - Helps the plant cells to keep the plant “standing up.”
  + *Plasmolysis*
    - Loss of water resulting in a drop in turgor pressure
    - Causes plant cells to wilt