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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