**Tour of the Cell Notes Guide:**

**Concept: Eukaryotic cells have internal membranes that compartmentalize their functions**

Prokaryotic Cells:

-Domains: Bacteria and Archaea.

-Simple Cells. No membrane bound nucleus, and no membrane-bound organelles.

-Genetic material (circular DNA) is found in a region of the cell known as the nucleoid. They do not have chromosomes.

-Reproduce by binary fission and produce two identical daughter cells.

-Classified in the kingdom Monera (bacteria group)

Prokaryotic structures:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: A selective barrier around a cell composed of a double layer of phospholipids. Made of lipids, proteins, and carbohydrates.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: A wall or barrier that functions to shape and protect cells. Present in ALL prokaryotes.

Ribosomes: Made of RNA and they build \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ parts (proteins). Prokaryotic cell ribosomes are smaller (70S, with 50S and 30S subunits) than eukaryotic cells (80S, with 60S and 40S subunits).

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, when present, deliver motion by twisting like a screw.

Eukaryotic Cells: More complex than Prokaryotic cells.

-Have a membrane bound nucleus.

-Can be unicellular or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-Membrane bound organelles (little organs)

-Two exclusive clubs

--Animal cells and Plant cells

**Concept: The Eukaryotic cell's genetic instructions are housed in the nucleus and carried out by the ribosomes**

Organelle: Nucleus

-The nucleus has two phospholipid bilayers, each similar to the plasma membrane.

-The nucleus contains DNA, the hereditary information of the cell.

-Normally, the DNA is spread out within the nucleus as a thread-like matrix called chromatin.

-On the surface of the nuclear envelope are nuclear pores, which serve as passageways for proteins and RNA molecules.

Organelles are specialized structures and have specialized functions

-Some use cilia or flagella for locomotion (movement)

Some server as Containers for storage

-partition cell into compartments

-create different local environments

-separate pH, or concentration of materials

-distinct & incompatible functions

-Examples: vacuoles, lysosomes & its digestive enzymes

Membranes as sites for chemical reactions

-are unique combinations of lipids & proteins

-embedded enzymes & reaction centers

-Examples include: chloroplasts & mitochondria

Jobs that cells do: Build Proteins, Make Energy, and Build more cells.

Building Proteins use many organelles:

 -Nucleus

 -Ribosomes

 -Endoplasmic Reticulum (ER)

 -Golgi apparatus

 -\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(transport packages)

Organelle: Nucleolus

Function: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-build ribosome subunits from rRNA & proteins

-exit through nuclear pores to cytoplasm & combine to form functional ­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Organelle: Ribosomes

Function: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Structure: rRNA and Protein made of 2 subunits combined

Types of Ribosomes:

 -Free Ribosomes

 Suspended in cytosol (cytoplasm)

 Synthesize proteins that function in cytosol (cytoplasm)

 -Bound Ribosomes

 Attached to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Synthesize proteins for export or for membranes

**Concept: The endomembrane system regulates protein traffic and performs metabolic functions in the cell**

Organelle: Endoplasmic Reticulum

Function: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, manufactures membranes, synthesis and hydrolysis of many compounds

Structure: Membrane connected to nuclear envelope and extends throughout the cell

Types of ER:

 -Smooth ER Function:

-Membrane production (Makes phospholipids which builds membranes)

-Many metabolic processes

-Synthesis of lipids including oils, phospholipids, steroids & sex hormones

 -Hydrolysis of \_\_\_\_\_\_\_\_\_\_\_ into glucose in liver and detoxify drugs and poisons in liver (alcohol)

 -Rough ER Function:

 -Produce proteins (Ribosomes) for export out of cell

protein \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells

packaged into transport vesicles for export

Organelle: Golgi Apparatus

Function: finishes, sorts, tags & ships cell products

-like “UPS shipping department”

-ships products in vesicles

membrane sacs

“UPS trucks”

Organelle: Lysosomes

Function: little “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” of the cell

-digests macromolecules

-“clean up crew” of the cell

-cleans up broken down organelles

Structure: Vesicles of digestive enzymes

Lysosomal enzymes work best at pH 5

organelle creates custom pH. How?

proteins in lysosomal membrane pump H+ ions from the \_\_\_\_\_\_\_\_\_\_\_\_
into lysosome

why? enzymes are very sensitive to pH

why? enzymes are proteins — pH affects structure

why is this an adaptation: digestive enzymes which function at pH different from cytosol?

digestive enzymes won’t function well if some leak into cytosol = don’t want to digest yourself!

Lysosomes can be used to kill cells when they are supposed to be destroyed some cells have to die for proper development in an organism

Process is called : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

“auto-destruct” process

lysosomes break open & kill cell

ex: tadpole tail gets re-absorbed when it turns into a frog

ex: loss of webbing between your fingers during fetal development

ex: self-destruct of cancerous cell

Diseases of lysosomes are often fatal

-digestive enzyme not working in lysosome

-picks up biomolecules, but can’t digest one

lysosomes fill up with undigested material

-grow larger & larger until disrupts cell & organ function

-lysosomal storage diseases

more than 40 known diseases

example: Tay-Sachs disease: build up undigested fat in brain cells

**Concept: Mitochondria and chloroplasts change energy from one form to another**

Organelle: Mitochondria

Important to see the similarities in mitochondria and chloroplasts both

-transform energy which generate ATP

-have double membranes = 2 membranes

-semi-autonomous organelles

-move, change shape, divide

-internal ribosomes, DNA & enzymes

Structure: 2 membranes

smooth outer membrane

highly folded inner membrane called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-Has fluid-filled space between 2 membranes

-internal fluid-filled space called the mitochondrial \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Contains DNA, ribosomes & enzymes

Why 2 Membranes? Increase surface area for membrane bound enzymes that synthesize ATP.

Mitochondria divide like \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Almost all eukaryotic cells have mitochondria

-there may be 1 very large mitochondrion or 100s to 1000s of individual mitochondria

-number of mitochondria is correlated with aerobic metabolic activity

-more activity = more energy needed = more mitochondria

Enzymes (proteins) are found in membranes!

Organelle: Chloroplasts

Chloroplasts are plant organelles

class of plant structures = plastids

amyloplasts

-store starch in roots & tubers

chromoplasts

-store pigments for fruits & flowers

chloroplasts

-store chlorophyll & function in photosynthesis

-in leaves, other green structures of plants & in eukaryotic algae

Structure: 2 membranes

stroma = internal fluid-filled space

Contains: DNA, ribosomes & enzymes

Contains: thylakoids = membranous sacs where ATP is made

-grana = stacks of thylakoids

Why internal sac membranes? They increase surface area for membrane-bound enzymes that synthesize ATP

Enzymes (proteins) are found in membranes!

Function: photosynthesis which generate ATP & synthesize sugars

-transform solar energy into chemical energy

-produce sugars from CO2 & H2O

Semi-autonomous

-moving, changing shape & dividing

-can reproduce by pinching in two just like bacteria!!!!

Differences between mitochondria and chloroplasts:

-Organelles not part of endomembrane system

-Grow & reproduce

-semi-autonomous organelles

-Proteins primarily from free ribosomes in cytosol & a few from their own ribosomes

-Own circular chromosome: directs synthesis of proteins produced by own internal ribosomes

-ribosomes like bacterial ribosomes

Who else has a circular chromosome not bound within a nucleus? Bacteria!

Endosymbiosis theory: Mitochondria & chloroplasts were once free-living bacteria

-engulfed by ancestral eukaryote

Endosymbiont: cell that lives within another cell (host) as a partnership

-evolutionary advantage for both

-one supplies energy

-the other supplies raw materials & protection

Organelle: Vacuoles and vesicles

Function: little “transfer ships”

\_\_\_\_\_\_\_\_\_\_\_ vacuoles: phagocytosis, fuse with lysosomes

Contractile vacuoles: in freshwater protists, pump excess H2O out of cell

Central vacuoles in many mature plant cells

Vacuoles in Plants

 Functions: storage

stockpiling proteins or inorganic ions

depositing metabolic byproducts

storing pigments

storing defensive compounds against herbivores

selective membrane

control what comes in or goes out

Organelle: Peroxisomes

 Other digestive enzyme sacs

-in both animals & plants

-breakdown fatty acids to sugars

-easier to transport & use as energy source

-detoxify cell

-detoxifies alcohol & other poisons

-produce peroxide (H2O2)

-must breakdown H2O2 🡪 H2O

**Concept: The cytoskeleton is a network of fibers that organizes structures and activities in the cell**

Cytoskeleton

Function:

-structural support

-maintains shape of cell

-provides anchorage for organelles

-protein fibers

-microfilaments, intermediate filaments, \_\_\_\_\_\_\_\_\_\_\_\_\_

-motility

-cell locomotion

-\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, flagella, etc.

-regulation

-organizes structures & activities of cell

Centrioles Function: Aid in cell division

-in animal cells, pair of centrioles organize \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

-guide chromosomes in mitosis

**Concept: Extracellular components and connections between cells help coordinate cellular activities**

Coordination of Cellular Activities

Cell Wall: Protects the plant and helps maintain its shape. It is outside the plasma membrane. Made of cellulose.

-Prokaryotes and Fungi have cell walls but not of cellulose.

Plasmodesmata are channels that perforate adjacent plant cell walls and allow the passage of some molecules cell to cell

Extracellular matrix of animal cells is situated just external to the plasma membrane; it is made of glycoproteins secreted by the cell.

Animal cells have three types of intercellular junctions:

-Tight junctions are sections of animal cell membranes where two neighboring cells are fused, making the membranes watertight.

-Desmosomes fasten adjacent animal cells together, functioning like rivets to fasten cells into strong sheets.

-Gap junctions provide channels between adjacent animal cells through which ions, sugars, communication molecules, and other small molecules can pass.

Limits to Cell Size

Lower limit: smallest bacteria (mycoplasmas) 0.1 to 1.0 micron (µm = micrometer)

most bacteria: 1-10 microns

Upper limit: eukaryotic cells: 10-100 microns

Surface to volume ratio: as cell gets bigger its volume \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ faster than its surface area

-smaller objects have greater ratio of surface area to volume

Metabolic requirements set upper limit.

Large cells, cannot move material in & out of cell fast enough to support life

How to get bigger?

 -Become \_\_\_\_\_\_\_\_\_\_\_cellular (cell divides)

Cell (Plasma) membrane

Exchange structure

-plasma membrane functions as selective barrier

-allows passage of O2 & nutrients IN

-allows passage of products & wastes OUT