A PROKARYOTIC CELL (BACTERIA)



PROKARYOTE VS. EUKARYOTE

- "before" "kernel"
- No nucleus
- DNA in a nucleoid
- Cytosol
- No organelles other than ribosomes
- Small size
- Primitive
- i.e. Bacteria & Archaea

- "true" "kernel"
- Has nucleus and nuclear envelope
- Cytosol
- Membrane-bound organelles with specialized structure/ function
- Much larger in size
- More complex
- i.e. plant/animal cell



• Cells must be small to maintain a large surface area to volume ratio

 Large S.A. allows ↑ rates of chemical exchange between cell and environment



NUCLEUS organelle membrane (lipid)

- <u>Function</u>: control center of cell
- Contains DNA (& mRNA) 95% DNA

Nuclear envelope Inner membrane Outer membrane Nuclear pore

- Surrounded by double membrane (nuclear envelope)
 - <u>Continuous</u> with the rough ER
- Nuclear pores: control what enters/leaves nucleus
 Chromatin: complex of DNA + proteins; makes up chromosomes
- <u>Nucleolus</u>: region where ribosomal subunits (rRNA + proteins) are formed
 ribosomes
 built here





Pore complexes (TEM)







SYSTEM:

Regulates protein traffic & performs metabolic functions

ENDOPLASMIC RETICULUM (ER)

- Network of membranes and sacs
- Types: Iscation of protein synthesis
 1. Rough ER: ribosomes on surface
 <u>Function</u>: package proteins for secretion, outside send transport vesicles to Golgi, make the cell replacement membrane
 - 2. Smooth ER: no ribosomes on surface
 <u>Function</u>: synthesize lipids, metabolize carbs, detox drugs & poisons, store Ca²⁺

ENDOPLASMIC RETICULUM (ER)



GOLGI APPARATUS

- <u>Function</u>: synthesis & packaging of materials (small molecules) for transport (in vesicles); produce lysosomes
- Series of flattened membrane sacs (cisternae)
 - *Cis* face: receives vesicles
 - *Trans* face: ships vesicles





VACUOLES

- <u>Function</u>: storage of materials (food, water, minerals, pigments, poisons)
- Membrane-bound vesicles
- Eg. food vacuoles, contractile vacuoles
- Plants: large central vacuole -- stores water, ions; retains water for turgor pressure











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CHLOROPLASTS



- <u>Function</u>: site of photosynthesis
- Double membrane
- Thylakoid disks in stacks (grana); stroma (fluid)
- Contains chlorophylls (pigments) for capturing sunlight energy
 Menne



ENDOSYMBIONT THEORY



- Mitochondria & chloroplasts share similar origin
 - Prokaryotic cells engulfed by ancestors of eukaryotic cells
 - <u>Evidence</u>: ingusted but not
 - Double-membrane diges structure
 - Have own ribosomes & DNA prokarystic
 - Reproduce independently within cell

PEROXISOMES

- <u>Functions</u>: break down fatty acids; <u>detox</u> alcohol
- $\circ~$ Involves production of hydrogen peroxide (H_2O_2)



CYTOSKELETON: NETWORK OF PROTEIN FIBERS Function: support, motility, regulate biochemical

<u>Function</u>: support, motility, regulate biochemical activities



10 µm



| Plant Cells Only | Animals Cells Only |
|------------------------|-------------------------------------|
| Central vacuoles | Lysosomes |
| Chloroplasts | Centrioles |
| Cell wall of cellulose | Flagella, cilia |
| Plasmodesmata | Desmosomes, tight and gap junctions |
| | Extracellular matrix (ECM) |



| Cell Component | Structure | Function |
|-----------------|--|--|
| Nucleus (ER) | Surrounded by nuclear envelope (double membrane) perforated by nuclear pores; nuclear envelope continuous with endoplasmic reticulum (ER) | Houses chromosomes, which are made of chromatin (DNA and proteins); contains nucleoli, where ribosomal subunits are made; pores regulate entry and exit of materials |
| Ribosome | Two subunits made of ribosomal RNA and proteins; can be free in cytosol or bound to ER | Protein synthesis |

| Cell Component | Structure | Function |
|--|--|---|
| Endoplasmic reticulum (Nuclear envelope) | Extensive network of membrane-bounded tubules and sacs; membrane separates lumen from cytosol; continuous with nuclear envelope | Smooth ER: synthesis of lipids, metabolism of carbohydrates, Ca ²⁺ storage, detoxification of drugs and poisons Rough ER: aids in synthesis of secretory and other proteins from bound ribosomes; adds carbohydrates to proteins to make glycoproteins; produces new membrane |
| Golgi apparatus | Stacks of flattened membranous sacs; has polarity (<i>cis</i> and <i>trans</i> faces) | Modification of proteins, carbohydrates on proteins, and phospholipids; synthesis of many polysaccharides; sorting of Golgi products, which are then released in vesicles |
| Lysosome | Membranous sac of hydrolytic enzymes (in animal cells) | Breakdown of ingested substances, cell macromolecules, and damaged organelles for recycling |
| Vacuole | Large membrane-bounded vesicle | Digestion, storage, waste disposal, water balance, plant cell growth and protection |

| | | - |
|----------------|---|---|
| Cell Component | Structure | Function |
| Mitochondrion | Bounded by double membrane; inner membrane has infoldings (cristae) | Cellular respiration |
| Chloroplast | Typically two membranes around fluid stroma, which contains thylakoids stacked into grana (in cells of photosynthetic eukaryotes, including plants) | Photosynthesis |
| Peroxisome | Specialized metabolic compartment bounded by a single membrane | Contains enzymes that transfer hydrogen atoms from certain molecules to oxygen, producing hydrogen peroxide (H_2O_2) as a by-product; H_2O_2 is converted to water by another enzyme |