

CELL STRUCTURES



CHAPTER 3

3.1 THE CELLULAR LEVEL OF ORGANIZATION

- The cell is the functional unit of an organism
- The smallest structure capable of performing all essential life functions
- Organisms are either unicellular or multicellular
- Cells can be classified as either
 - PROKARYOTIC or
 - EUKARYOTIC

PROKARYOTES vs. EUKARYOTES



- Prokaryotes are cells that lack a membrane-bound nucleus
 - EX. *Bacteria*
- Eukaryotes are more complex cells containing membrane-bound organelles
 - EX. *Plants and Animals*
- It is believed that eukaryotic cells have evolved from prokaryotic cells!

The discovery of cells

Don't copy

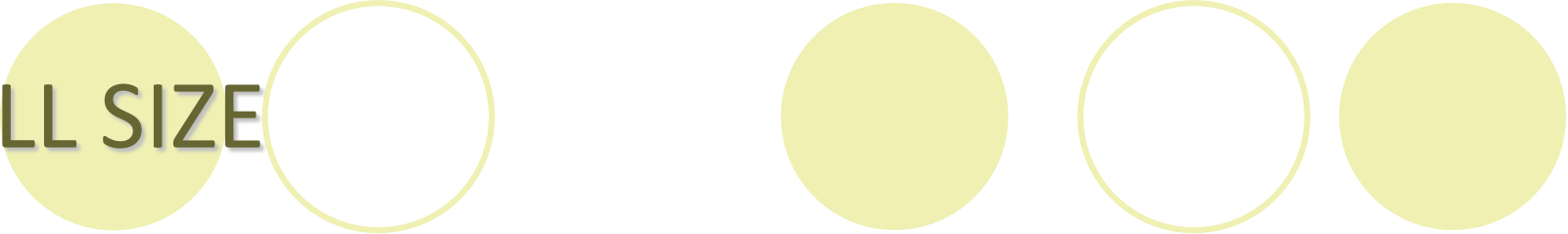
- The word "cell" was coined by an Englishman, Robert Hooke
- Over 150 years later, it was reiterated that plants and animals are made up of cells by two German microscopists
- Later, another German microscopist, Rudolf Virchow, concluded that cells don't appear - they come from other cells
- Based on these observations, the "Cell Theory" was created...



The cell theory states:

1. All organisms are composed of one or more cells
2. Cells are the basic living unit of structure and function in organisms
3. All cell come only from other cells

CELL SIZE

- 
- Cells are small
 - This is an advantage!
 - Nutrients and wastes need to be exchanged at a cell's surface
 - The amount of surface area affects the cell's ability to get material into and out of the cell efficiently!
 - Cell size is limited by its surface area to volume ratio
 - EX. For a cube-shaped cell:
 - Surface area is a squared function ($l \times w \times 6$)
 - Volume is a cubic function ($l \times w \times h$)
 - As a cell increases in volume, the proportionate amount of surface area actually decreases!



small cell—
more surface area
per volume



large cell—
less surface area
per volume

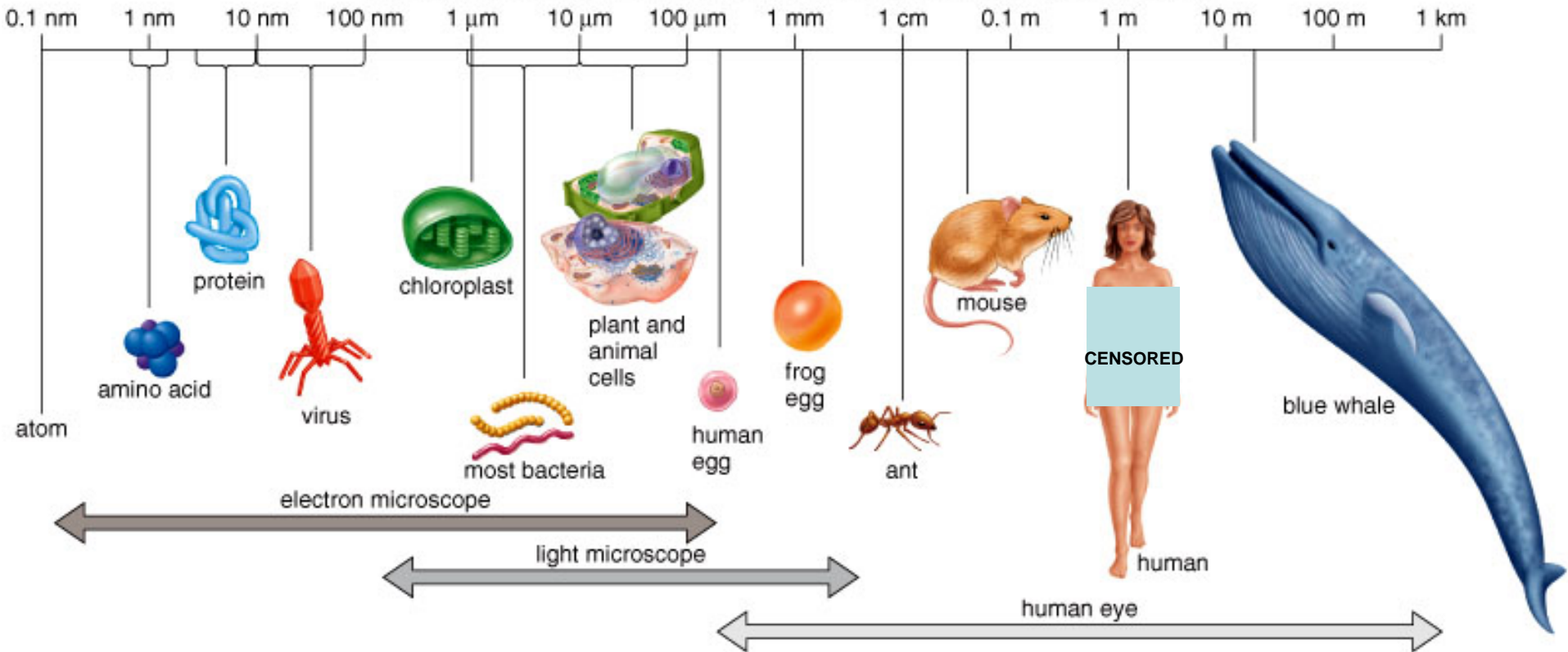


CONT...

- If a cell doubles in size, its surface area only increases fourfold...
- Its volume, increases eightfold!
- ∴ Small cells, not large ones, are likely to have an adequate S.A. for exchanging nutrients and wastes

Sizes of living things and their components:

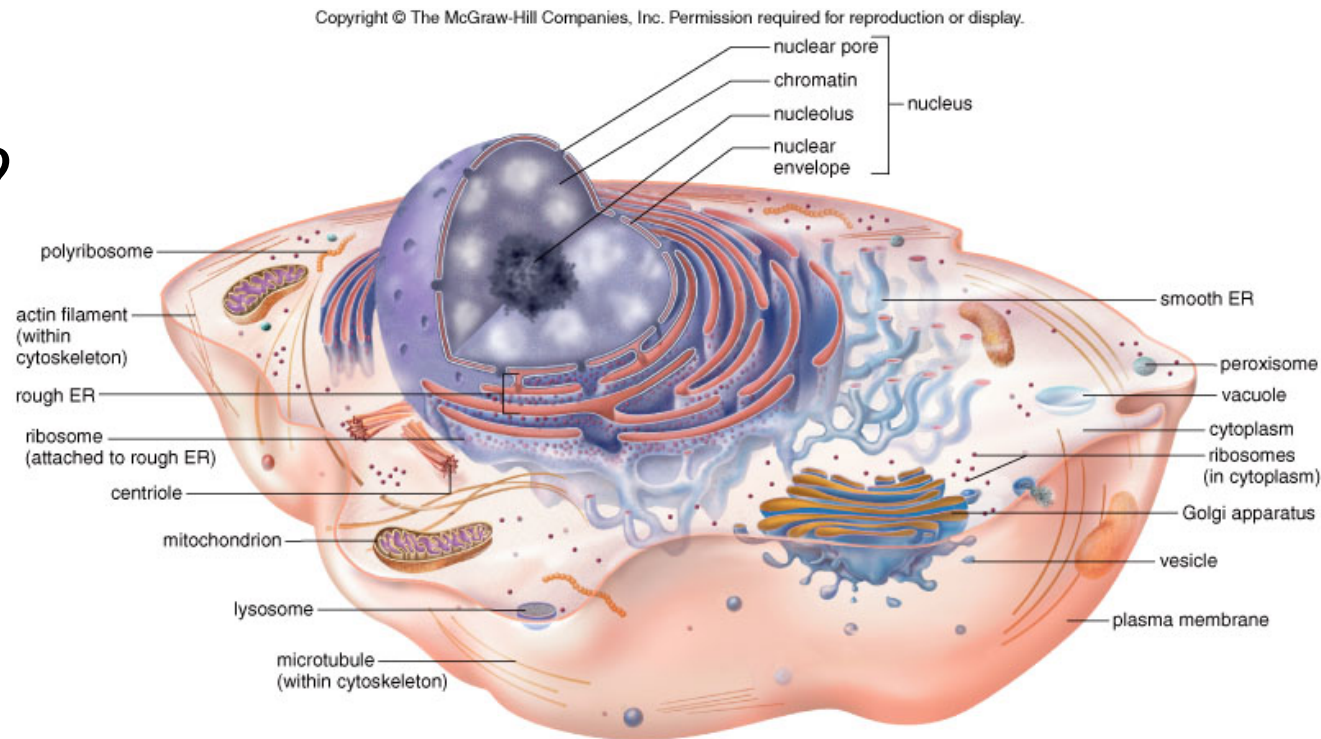
Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



Organelles...

- Are tiny, specialized structures that perform specific cellular functions

- LIST SOME?

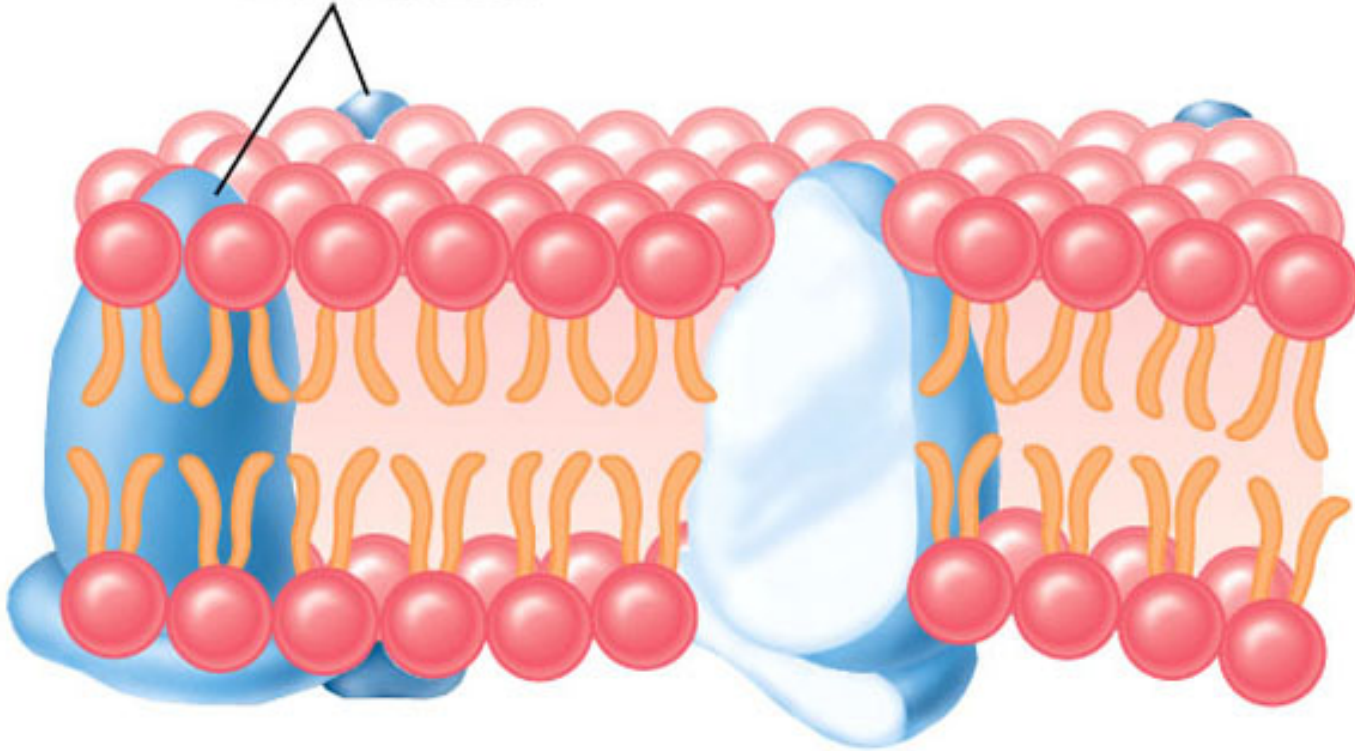


The Plasma Membrane & Cytoplasm

- All cells are surrounded by a plasma membrane composed of a phospholipid bilayer with embedded proteins
 - Its function is to regulate the entrance and exit of molecules into and out of the cytoplasm
- Inside the cell is a semifluid medium called the cytoplasm composed of water, salts, and dissolved organic molecules

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

protein
molecules



phospholipid
bilayer

3.2 Prokaryotic Cells

- Lack membrane-bound nucleus
- Domains *Archaeobacteria* and *Eubacteria* consist of prokaryotes
- Generally unicellular organisms or strings/clusters
- Although they are structurally simple, they are more metabolically diverse than eukaryotes!



Cont...

- Bacterial cells have a cell wall
 - Consists of a complex molecule composed of chains of disaccharides joined by peptide chains (peptidoglycan)
 - Protects the cell
- In some, the cell wall is surrounded by a capsule or slime layer
- Some have flagella and/or fimbriae
- Prokaryotes have a single c-some (loop of DNA) found in a region of the cytoplasm called the nucleoid along with plasmids - small accessory rings of DNA
- The cytoplasm of prokaryotes is full of thousands of ribosomes

3.3 Eukaryotic Cells



- Structurally very complex
- Distinguishing feature is the presence of a **nucleus**
 - This separates the DNA from the cytoplasm
- In addition to a nucleus, eukaryotic cells possess a variety of other organelles...

CELL WALLS

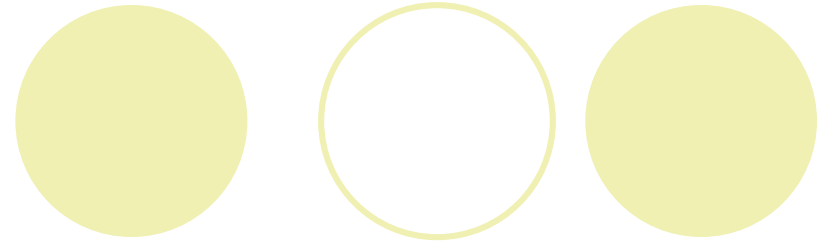


- Permeable but protective
- Usually made up of cellulose
 - Cellulose molecules form fibrils which lay at right angles to one another → STRENGTH!
- Algae, Fungi and Plants all have cell walls although their composition may be slightly different

ORGANELLES OF ANIMAL AND PLANT CELLS

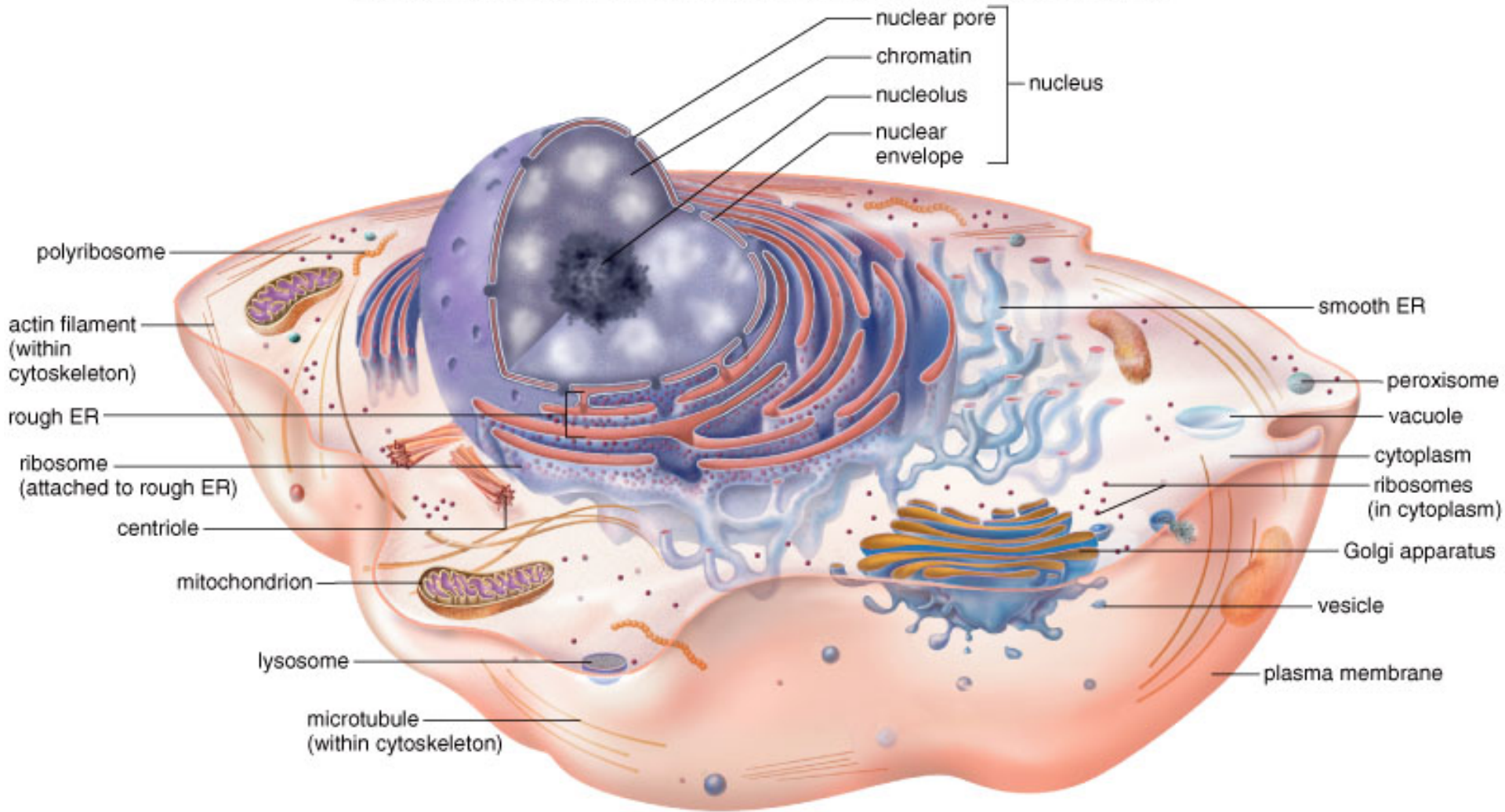
- Originally the term “organelle” referred to membrane-bound structures
 - We will use it to include any well-defined subcellular structure
- Animal and plant cells both contain mitochondria
- Only animal cells contain centrioles and lysosomes and only plant cells contain chloroplasts!

YOUR ASSIGNMENT:

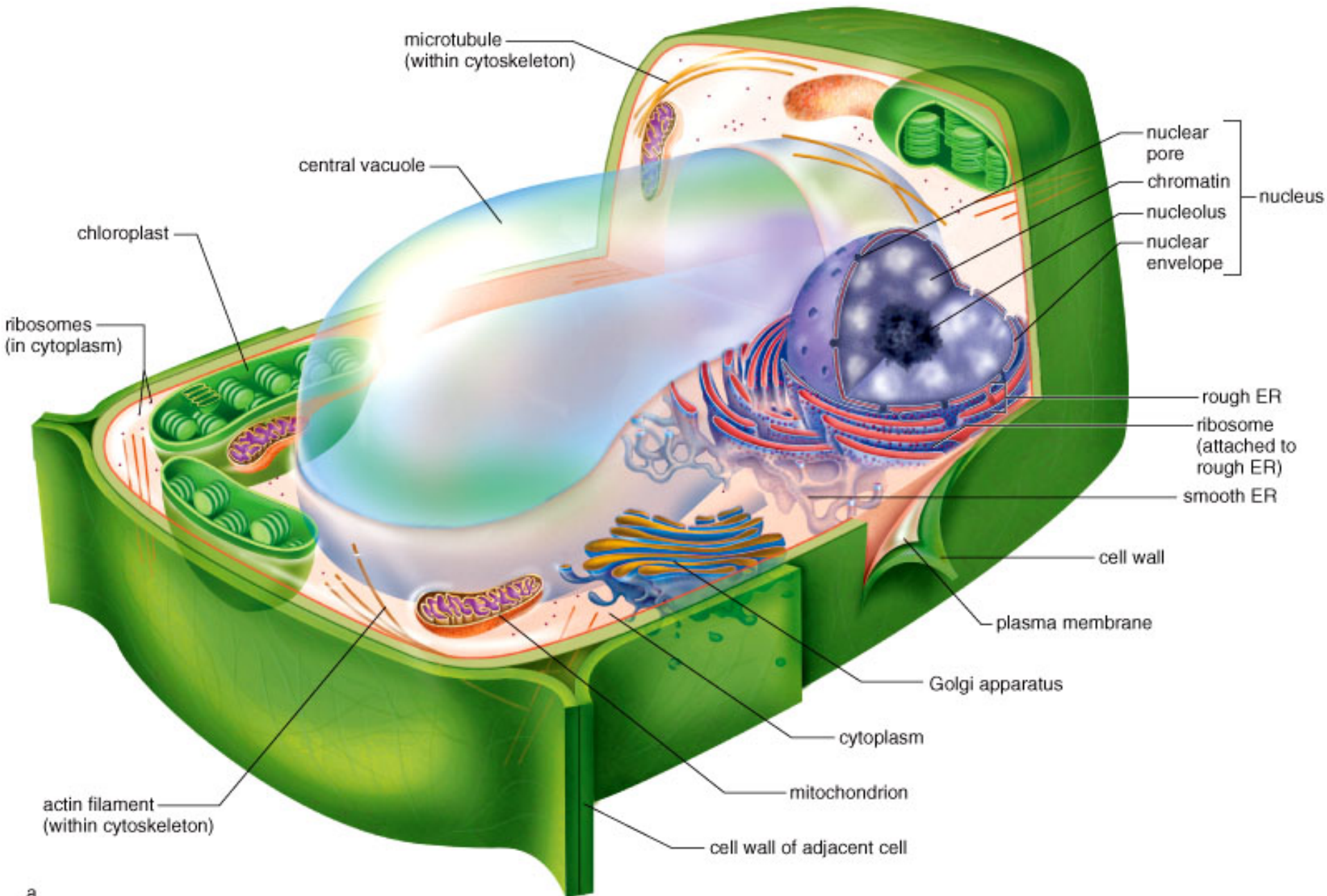


- Complete questions 1-11 in your “**Cell Structure and Functions**” PKG.
- Complete cue cards for PLO:
B1
- Prokaryote and Eukaryotic Cells
- Pre-read Section 3.3 for tomorrow’s class!

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



a.



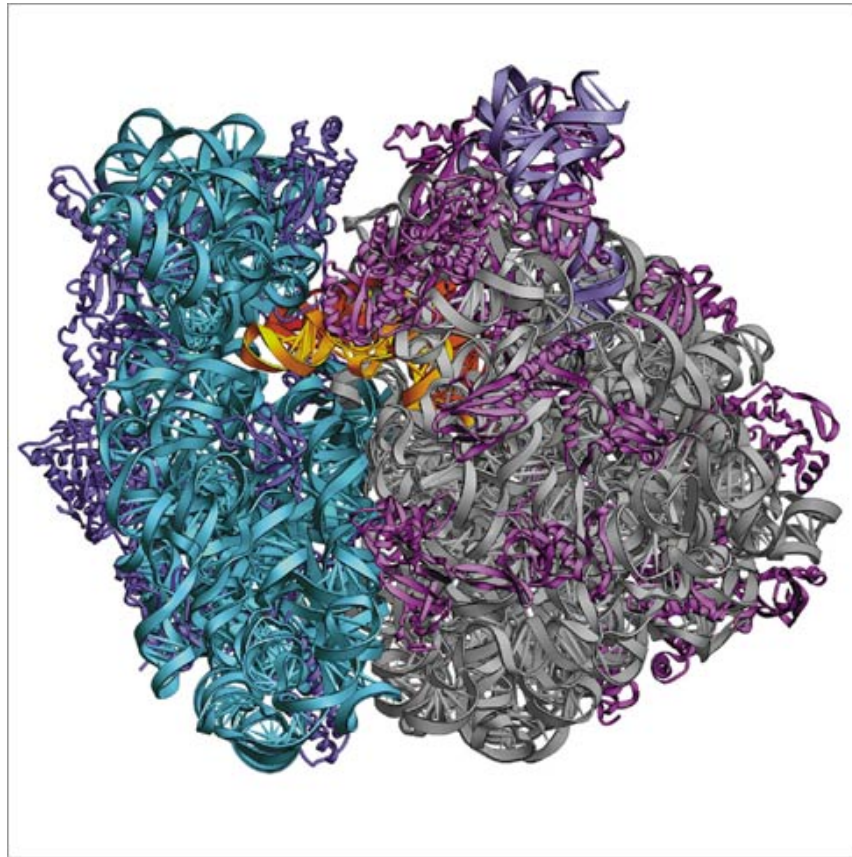
THE NUCLEUS



- Stores genetic material which governs the characteristics of the cell and its metabolic functioning
- Every cell in an organism contains the same DNA - but in each cell type, certain genes are turned on and others are turned off
- The genes that are turned on will code for the specific proteins that the cell will make
- What proteins a cell makes determines both the cell's structure and the functions it can perform!

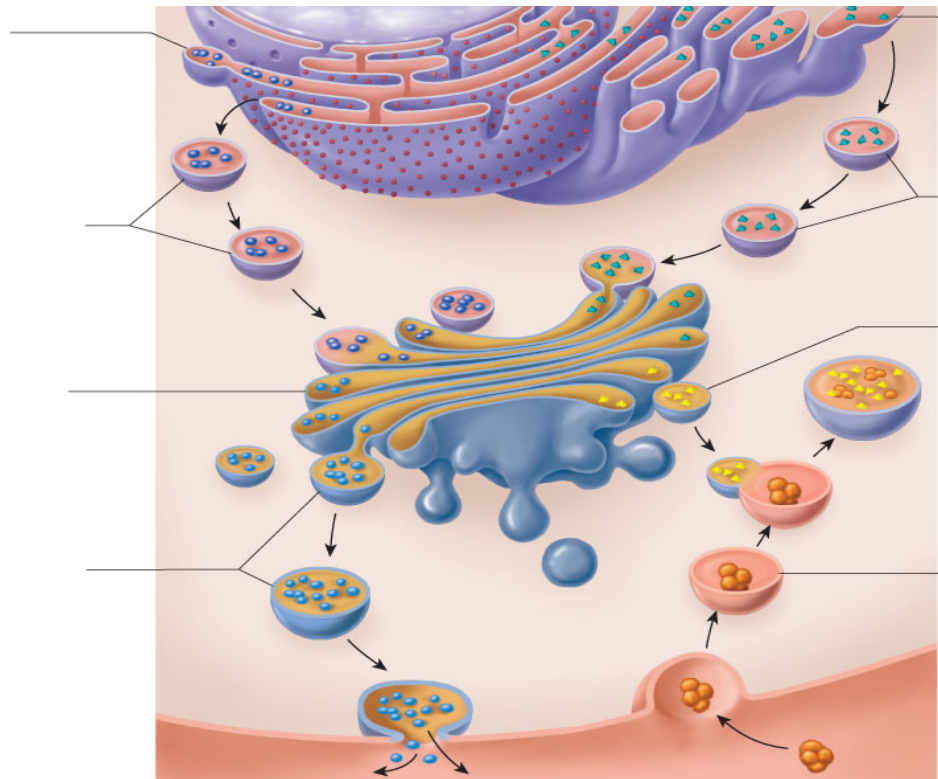
Ribosomes

- Small organelles where protein synthesis takes place



Endomembrane system

- Consists of the nuclear envelope, the ER, the Golgi apparatus, and several vesicles

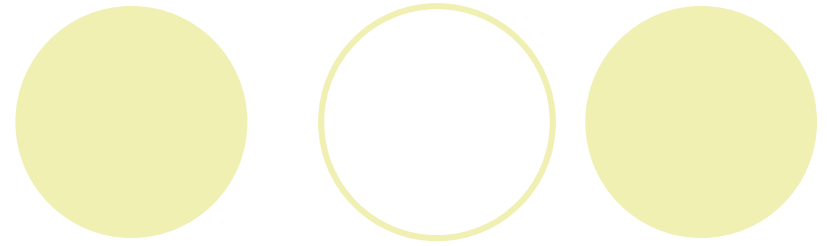


The Endoplasmic Reticulum

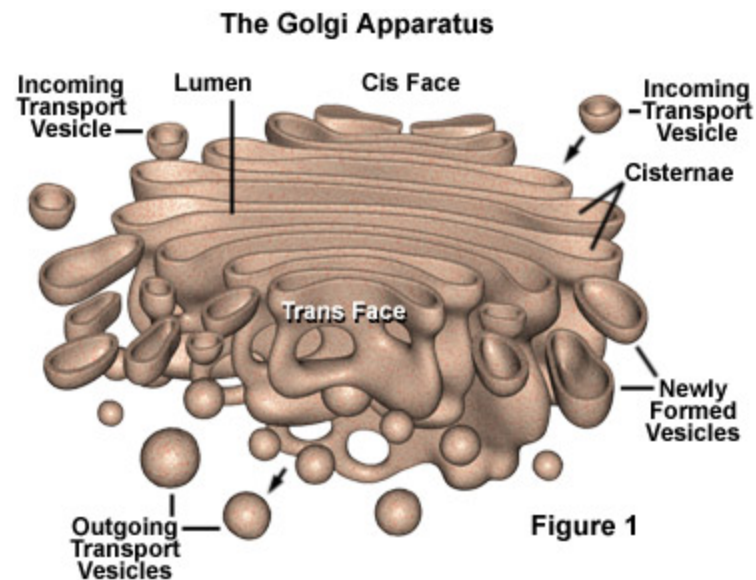


- System of membranous channel and saccules that is physically continuous with the outer membrane of the nuclear envelope
 - Used for intracellular transport
 - Interior ER processes and modifies proteins and lipids
- Rough ER is studded with ribosomes → protein synthesis
- Smooth ER synthesizes fats, phospholipids, and steroids
 - Is involved in the detoxification of drugs and poisons

Golgi Apparatus



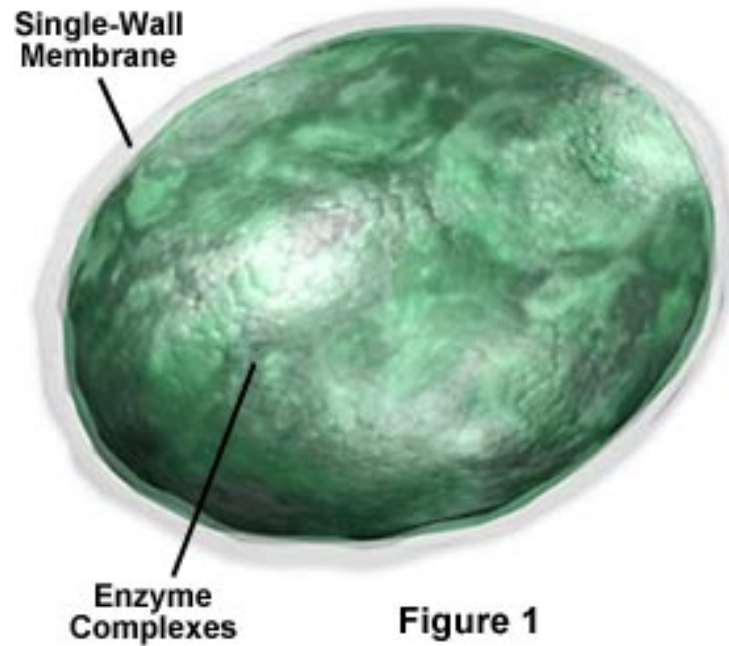
- “Post Office”
- Collects, sorts, packages and distributes materials



Lysosomes

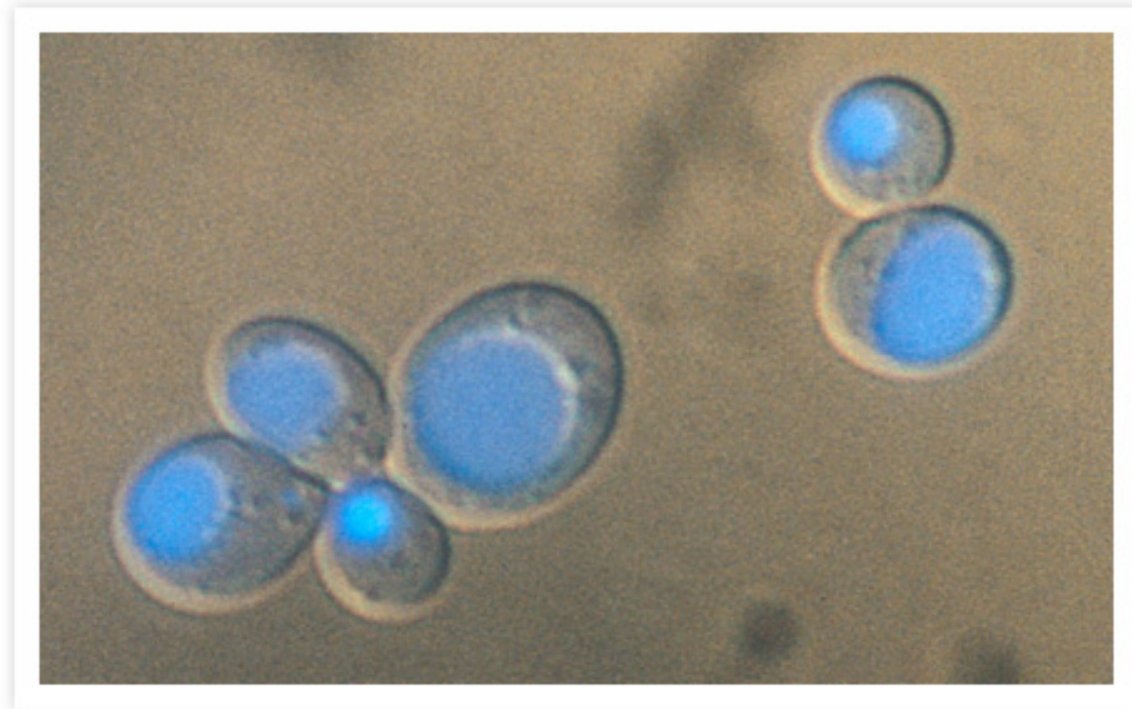
- Contain hydrolytic digestive enzymes

Lysosome Structure



Vacuoles

- Large membranous sac, that is larger than a vesicle, used for storage



Peroxisomes

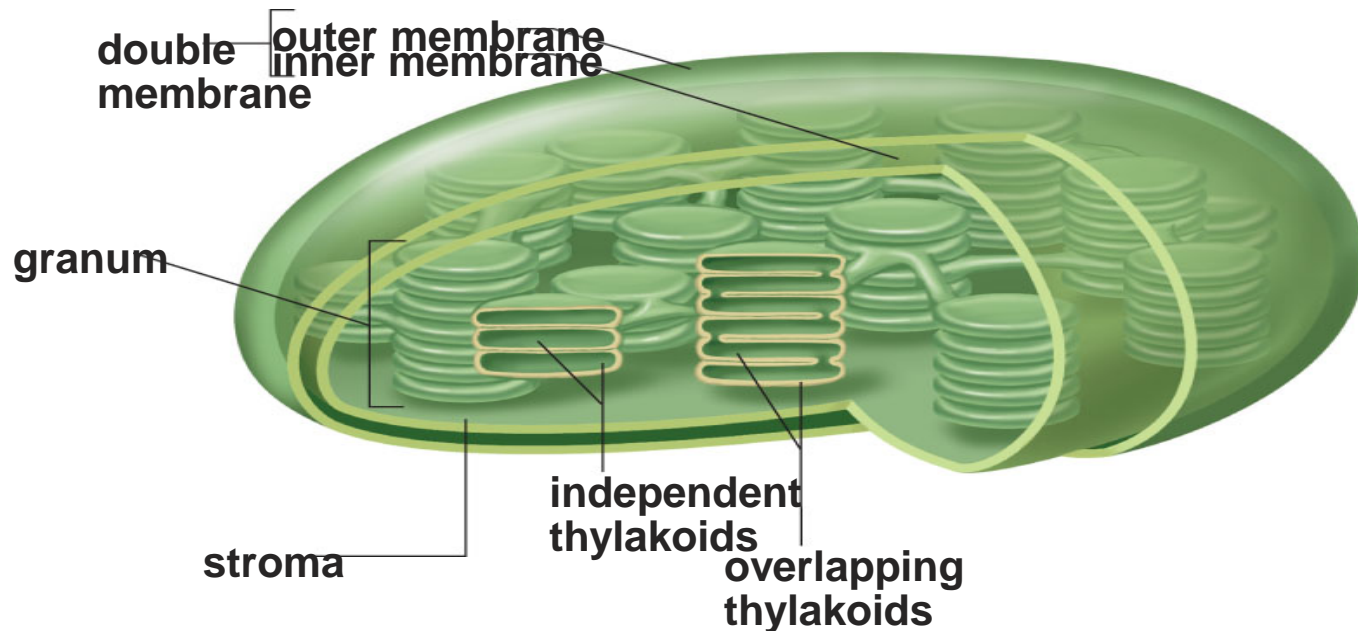


- Membrane-bounded vesicles that enclose enzymes
 - Type of enzymes depends on the function of the cell
 - Usually results in production of H_2O_2

Chloroplasts

- Use solar energy to synthesize carbohydrates

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

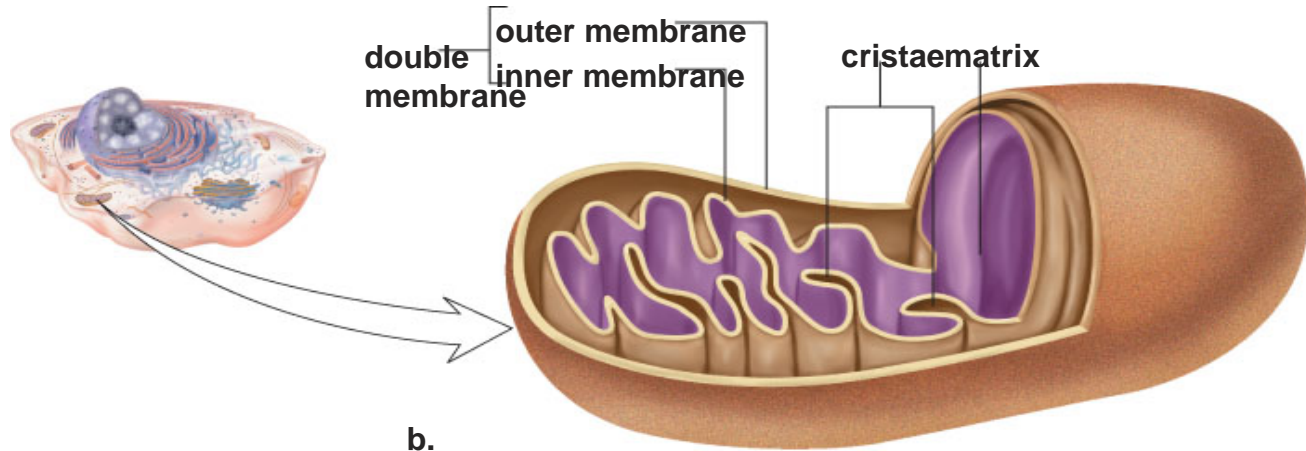


b.

Mitochondria

- Carbohydrate-derived products are broken down here, to produce ATP molecules

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



The Cytoskeleton

- The protein components of the cytoskeleton maintain cell shape and allow the cell and its organelles to move

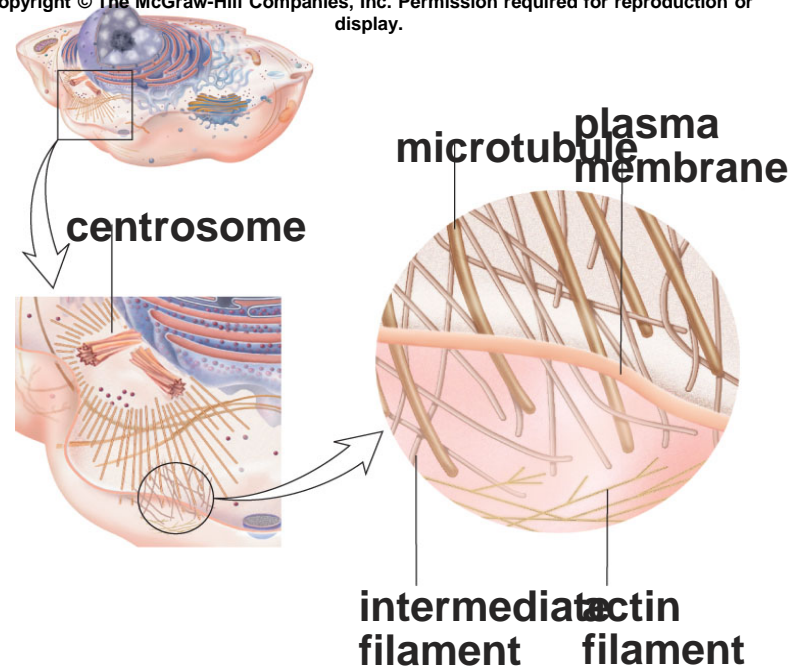
- *Actin and Intermediate filaments*

- *Microtubules*

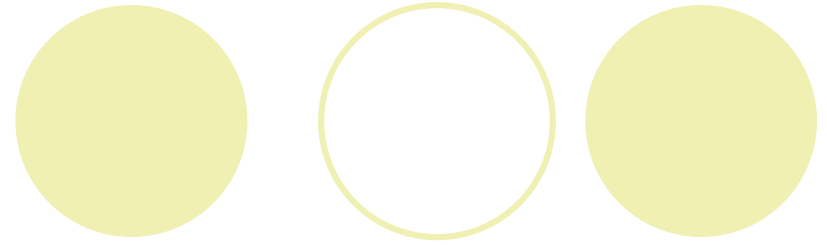
- *Centrioles*

- *Cilia and Flagella*

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



Your Assignment:



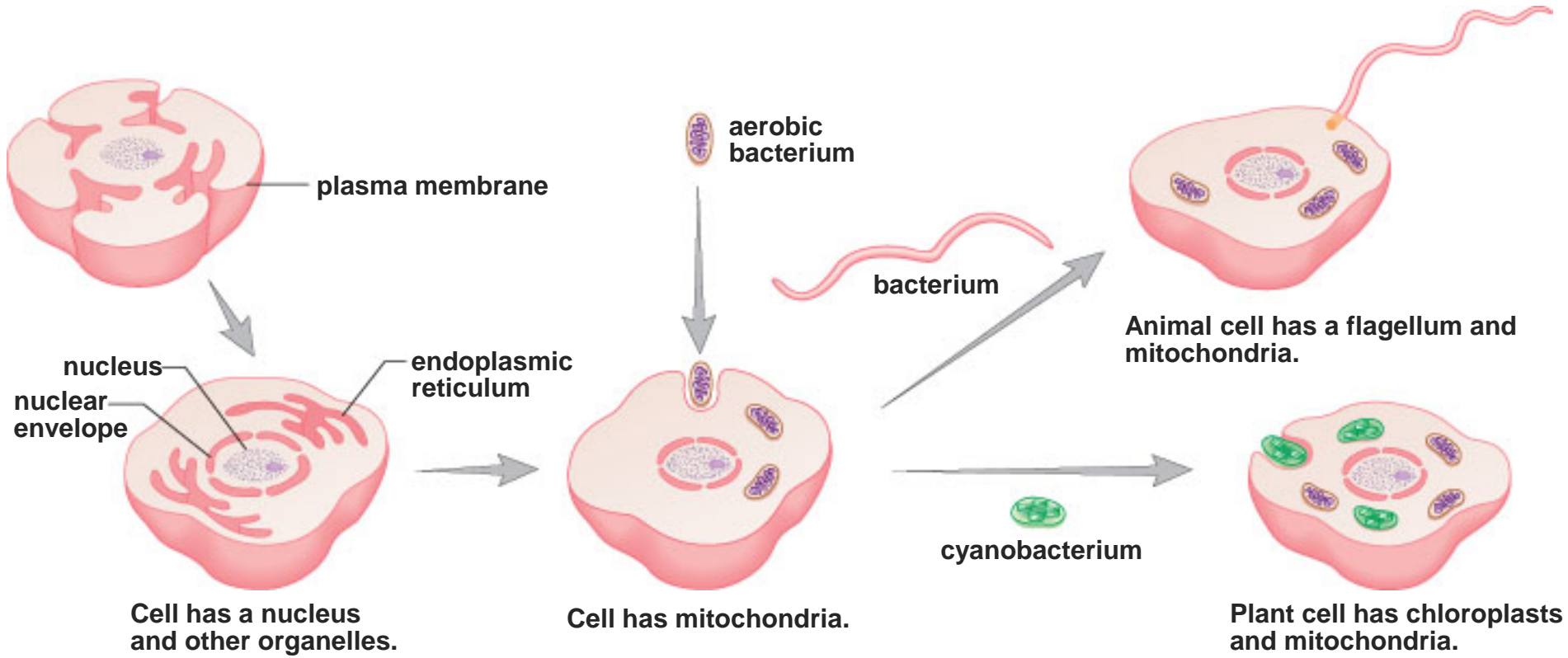
- Complete #12 - 21 in your "Cell S & F" PKG.
- Complete PLO B1: 8-14

3.4 Origin and Evolution of the Eukaryotic Cell

- The fossil record suggests that the first cells were prokaryotes
- It is believed that eukaryotic cells evolved from prokaryotic cells
 - ***ENDOSYMBIOTIC THEORY***

Evidence for the Endosymbiotic Theory:

- Mitochondria and chloroplasts are similar to bacteria in size and structure
- Both are bound by a double membrane - probably from the engulfing vesicle
- Both contain a limited amount of genetic material and divide by splitting
- They have their own ribosomes - that look like prokaryotic ribosomes
- The RNA base sequence of their ribosomes resembles that of prokaryotes



Your assignment:

- Please complete the PLO's that you have not yet completed 😊
- Complete the Ch 3 Cell Structure and Function package
- Ch 3 Review in blue course booklet
- Cell Review worksheet