

## Cell Theory

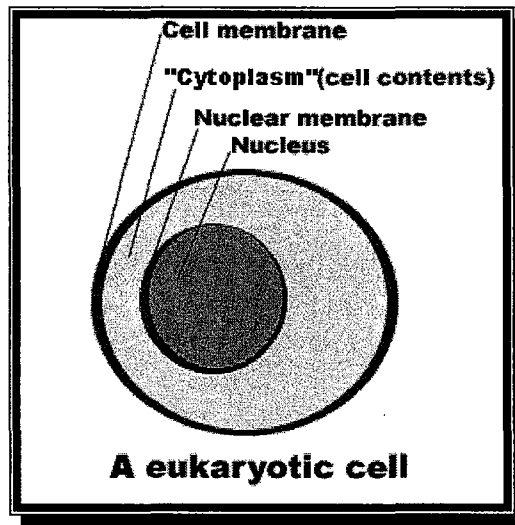
1. Cells are the basic unit of structure and function of all living cells.
  - cells are the smallest unit of life
  - all life forms are composed of one or more cells
2. All cells come from pre-existing cells.

### Exceptions to Cell Theory:

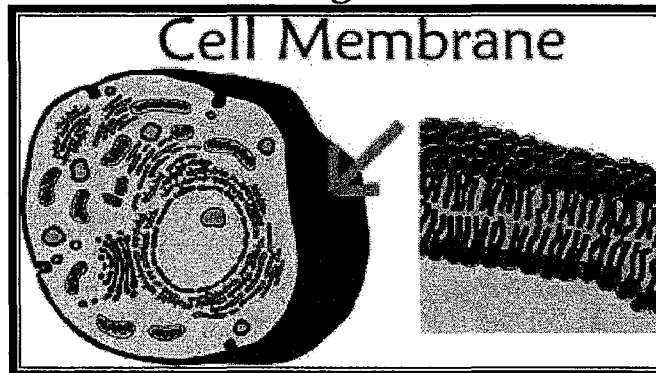
- a. *The first cell* – where did it come from?
- b. *Mitochondria and chloroplasts* are organelles, yet they contain DNA.
- c. *Viruses* – contain genetic material and can reproduce inside a living host.

Cells contain *organelles*, specialized structures within cells that perform specific functions such as absorption, circulation, excretion, digestion, respiration, regulation, reproduction, and synthesis.

### Basic Eukaryotic Cell



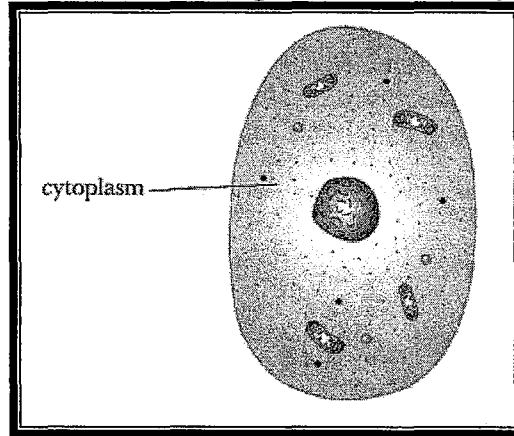
### Cell Organelles



- ♦ Made up of a *double layer of phospholipids with proteins* dispersed within the membrane.
- ♦ Gives the cell its shape and separates the inner cell from the outside environment.
- ♦ **SEMI-PERMEABLE**: lets only certain things enter/exit the cell

## Cytoplasm

- ♦ Also referred to as protoplasm
- ♦ Clear jelly-like substance in which the organelles are suspended. Mostly made up of water.
- ♦ Provides a suitable environment where organelles can carry on the cell's life functions.



What is the difference between **CYTOPLASM** and **CYTOSOL**?

**Cytosol** is the fluid portion of the cytoplasm; it is what remains after the removal of the organelles and other intracellular structures.

Root Words:

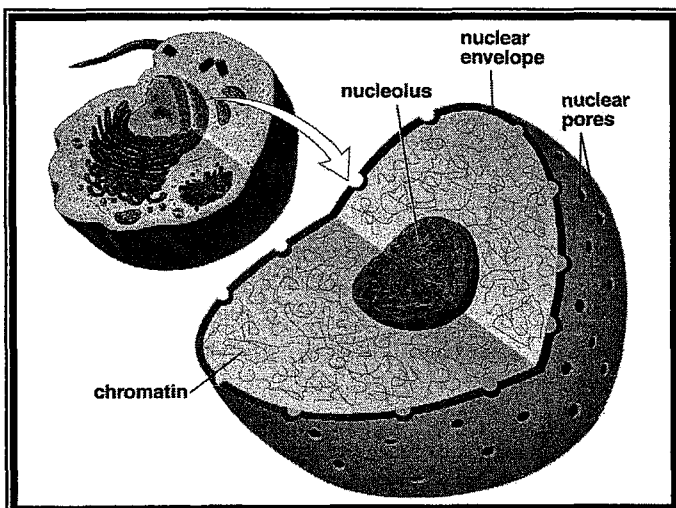
- ✓ **Intra:** *within*
- ✓ **Inter:** *between*

So....

**INTRACELLULAR:** *within the cell*

**INTERCELLULAR:** *between the cells*

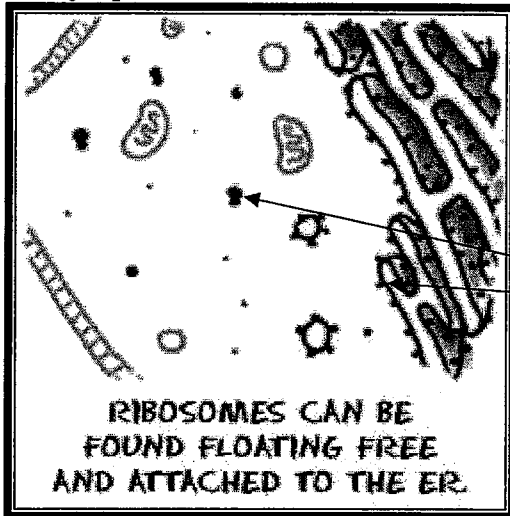
## Nucleus



- ♦ “brain of the cell”
- ♦ bound by a nuclear membrane
- ♦ nuclear pores for materials to enter/exit nucleus
- ♦ houses chromosomes (genetic material)
- ♦ Chromosomes exist as string-like material called **CHROMATIN** except when replicating DNA.
- ♦ **NUCLEOLUS** is found inside the nucleus
- ♦ The nucleolus is the *site of ribosome production*.

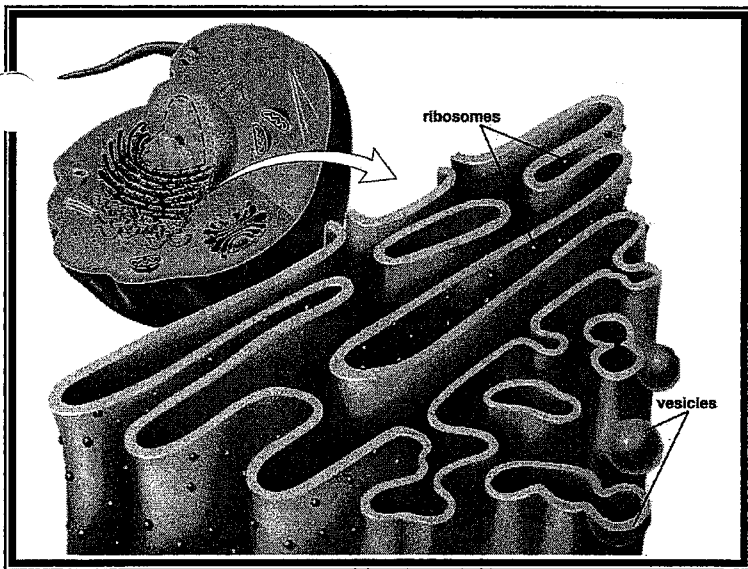
## Ribosomes

- ◆ Ribosomes are the site of **PROTEIN SYNTHESIS**
- ◆ Ribosomes are found either attached to the Endoplasmic Reticulum or free floating in the cytoplasm



Ribosomes

## Endoplasmic Reticulum (ER)



- ◆ “Hallways” of the cell
- ◆ Single continuous membrane
- ◆ Continuous with nuclear Envelope
- ◆ Involved in *transport, storage, and synthesis* of materials within the cell
- ◆ 2 kinds of ER: *Rough ER* and *Smooth ER*

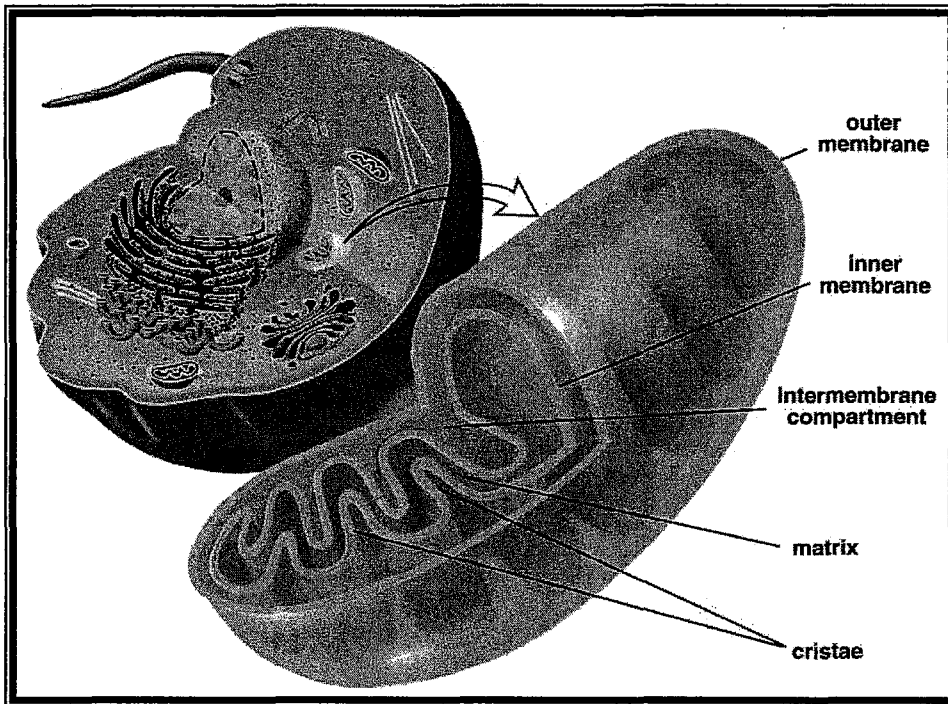
### ***Rough ER:***

- ✓ Covered with ribosomes
- ✓ Major site of protein synthesis and transport within the cell.

### ***Smooth ER:***

- ✓ Lacks ribosomes
- ✓ Continuous with rough ER
- ✓ Functions:
  1. Transport
  2. Synthesis of lipids
  3. detoxification
  4. storage of calcium ions

## Mitochondria (mitochondrion – singular)



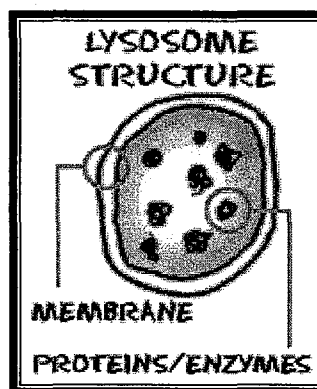
- ◆ Powerhouse of the cell.
- ◆ site of cellular **AEROBIC** respiration
- ◆ Aerobic respiration uses oxygen as part of the chemical process to release energy from food molecules.
- ◆ In the mitochondria, food molecules, such as glucose, are broken apart during aerobic cellular respiration, releasing the energy stored in the bonds.
- ◆ **Cristae** – inner membrane folds that **increase the surface area** so that more energy can

be released by cellular respiration.

- ◆ **Matrix:** fluid inside the mitochondria

## Lysosomes

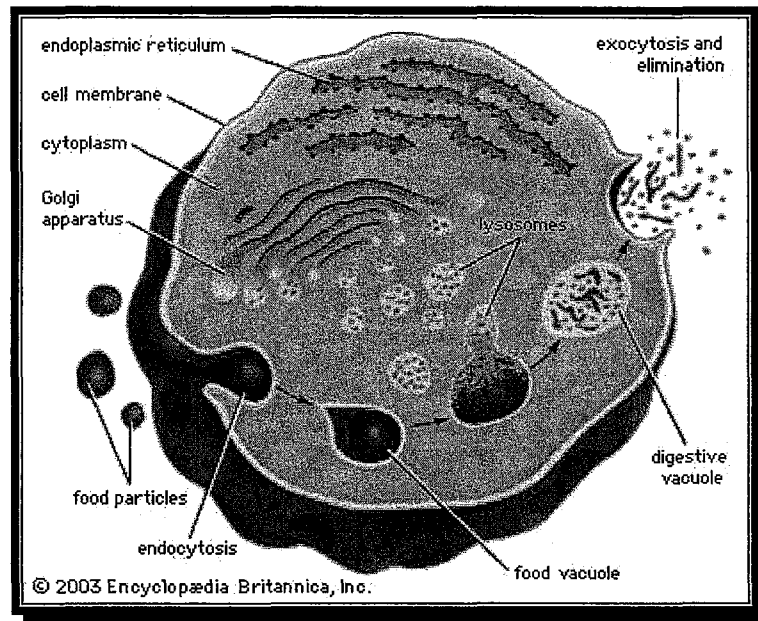
- ◆ Single membrane bound organelle that hold digestive enzymes
- ◆ In single celled organism, lysosomes are involved with food digestion
- ◆ In multicellular organisms, lysosomes are involved in breaking down worn out organelles.



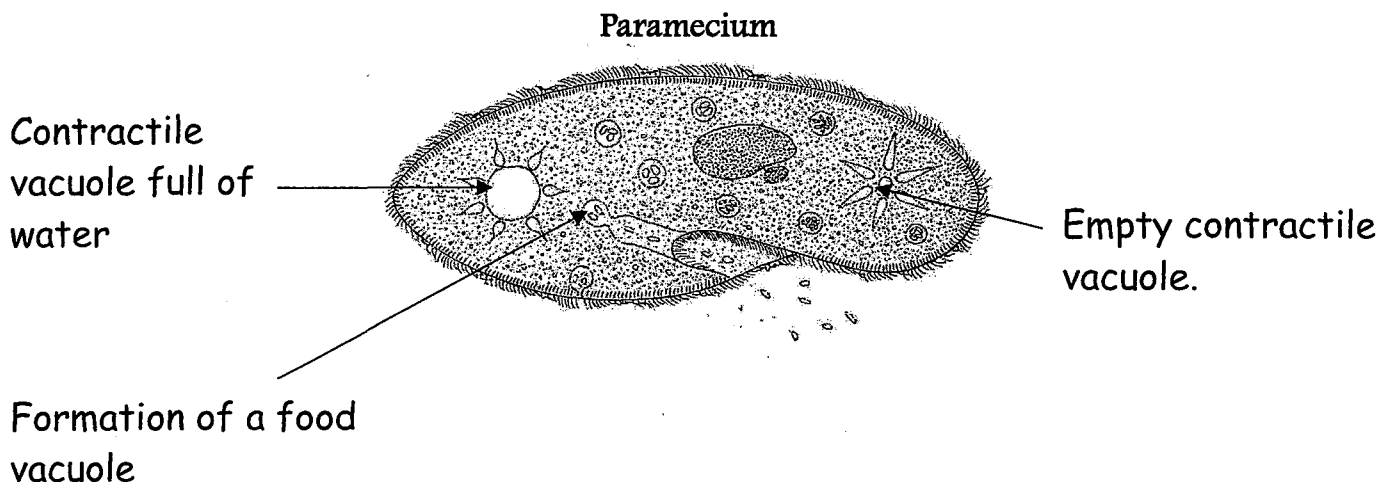
## Vacuoles

- ◆ “Warehouse” of the cell
- ◆ Membrane bound sac that is involved in storage of materials
- ◆ Vacuoles can be involved in food digestion, storage of cellular wastes, or even the elimination of excess water

- ◆ In animal cells, vacuoles tend to be small.
- ◆ In plant cells, there tends to be one or two large vacuoles that collect water, helping to make the plant cells rigid.
- ◆ **Examples of vacuoles:**
  - a. **food vacuole:** in single celled organisms like the paramecium and ameba, food particles are held in food vacuoles. These vacuoles join up with lysosomes that empty digestive enzymes into the food vacuoles. The food particles are digested and the nutrients absorb across the vacuole membrane and enter the cell. The digestive enzymes and wastes from digestion remain in the food vacuole until they can be eliminated from the cell. In this way, the cell is protected from the digestive enzymes that could end of digesting the entire cell.



- b. **Contractile Vacuole:** In a single celled organisms, like the paramecium and the ameba, water from the outside environment continually enters the cell. Without a way to eliminate the continual flow of water inward, these cells would eventually pop, causing the death of these single celled organisms. Contractile vacuoles collect the excess water that comes into the cell and periodically eliminates the water back into the organism's environment.



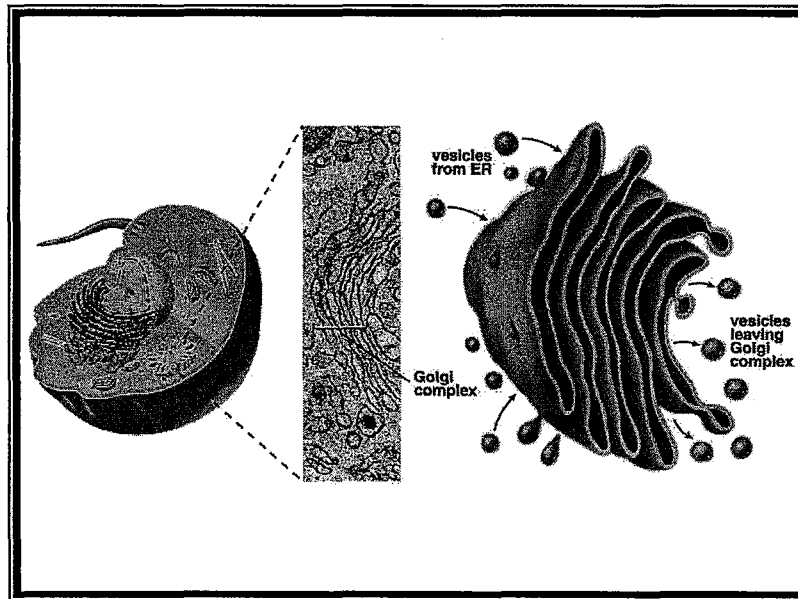
## Golgi Complex

- ◆ Also known as the **golgi body** or **golgi apparatus**
- ◆ Single membrane bound stack of flattened pancake looking sacs located near the cell membrane.
- ◆ These sacs are surrounded by smaller membrane bound **vesicles**.
- ◆ Known as the **UPS of the cell** because it processes, modifies, packages macro-molecules that are either secreted by the cell or used within the cell for various functions.

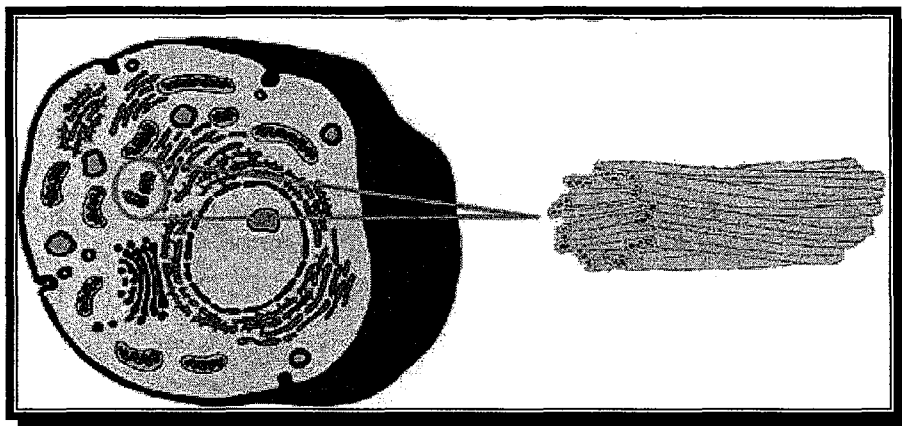
## Vesicles

- ◆ Single membrane bound organelles used for short term transport and storage.
- ◆ Used to transport material from ER to Golgi Apparatus.
- ◆ Used to transport packaged molecules from Golgi to cell membrane for export out of cell.

## Golgi Apparatus and Vesicles



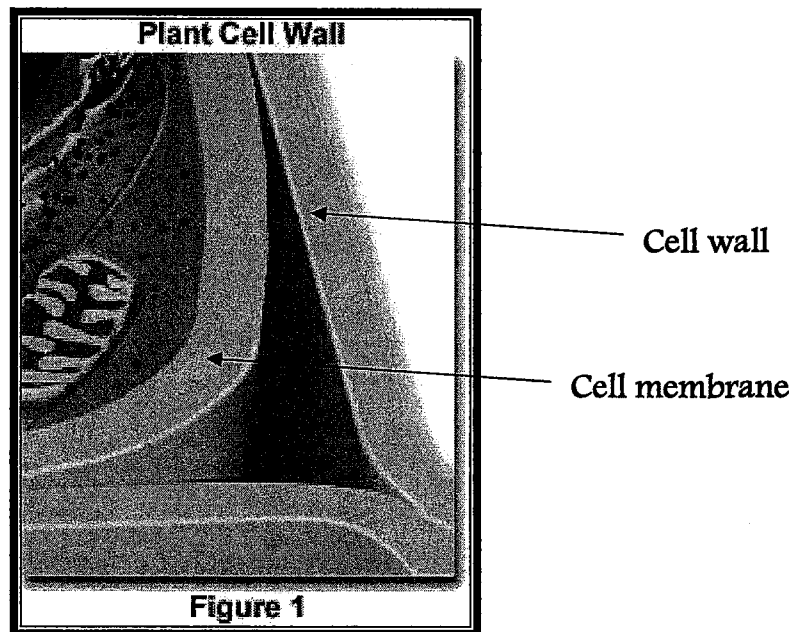
## Centrioles



- ◆ A pair of barrel shaped organelles found near the nucleus that are made up of microtubules.
- ◆ **Found only in animal cells.**
- ◆ Involved in *reproduction* of animal cells.

### Cell Wall

- ◆ Surrounds the outside of plant cells
- ◆ Composed of nonliving material called *cellulose*, a type of starch (complex carbohydrate)
- ◆ Completely permeable
- ◆ Provides protection from injury and support for the plant cells



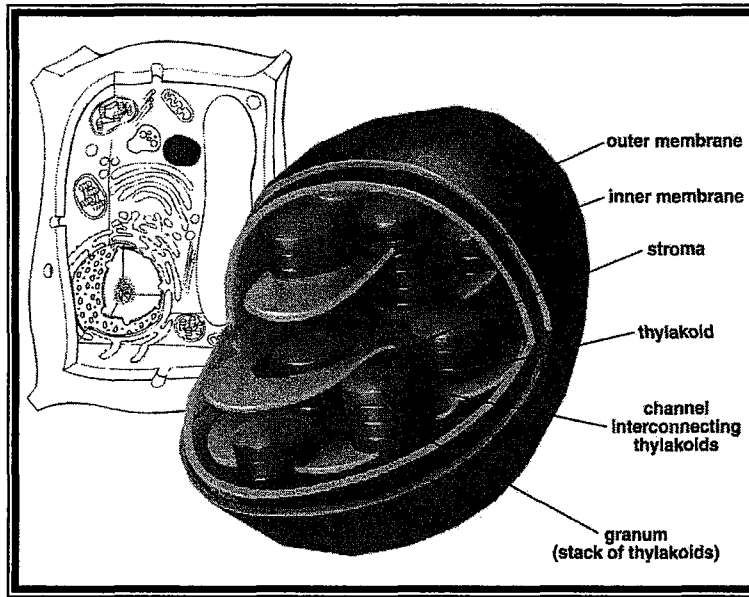
### Plastids

- ◆ Double membrane bound organelles found in plant cells
- ◆ There are three main classes of plastids:
  - a. *chloroplasts* (see notes below)
  - b. *leucoplasts* – colorless organelles that store starch
  - c. *chromoplasts* – contain pigments that color flowers, fruits, and leaves

### Chloroplasts

- ◆ Membrane bound organelle found in the leaves of plants
- ◆ Contains the green pigment, **CHLOROPHYLL**
- ◆ Chlorophyll not only gives plant cells their green color, but also is involved in capturing light rays from the sun
- ◆ *Site of photosynthesis*, the process by which green plants manufacture their own food, converting the energy of light to chemical bond energy (needed to hold the elements that make up food molecules like glucose together).

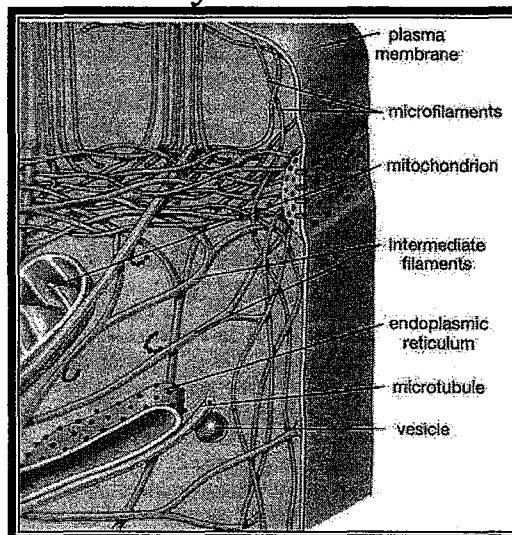
## Diagram of a Chloroplast



## How do Plant and Animal Cells Differ?

Characteristic/Organelle	Plant Cell	Animal Cell
shape	rectangular	irregular
Cell wall	yes	no
centrioles	no	yes
chloroplasts	yes	no
vacuoles	One or two large vacuoles, filled with fluid	If present, they are small

## Cytoskeleton



- ◆ Until recently, the cytoskeleton was thought to be a characteristic unique to eukaryotic cells.
- ◆ It is a dynamic three-dimensional structure that fills the cytoplasm.



- ◆ This structure gives the cell its shape, enables movement, and provides stability.
- ◆ The primary types of fibers comprising the cytoskeleton are microfilaments, microtubules, and intermediate filaments

### ***Microfilaments:***

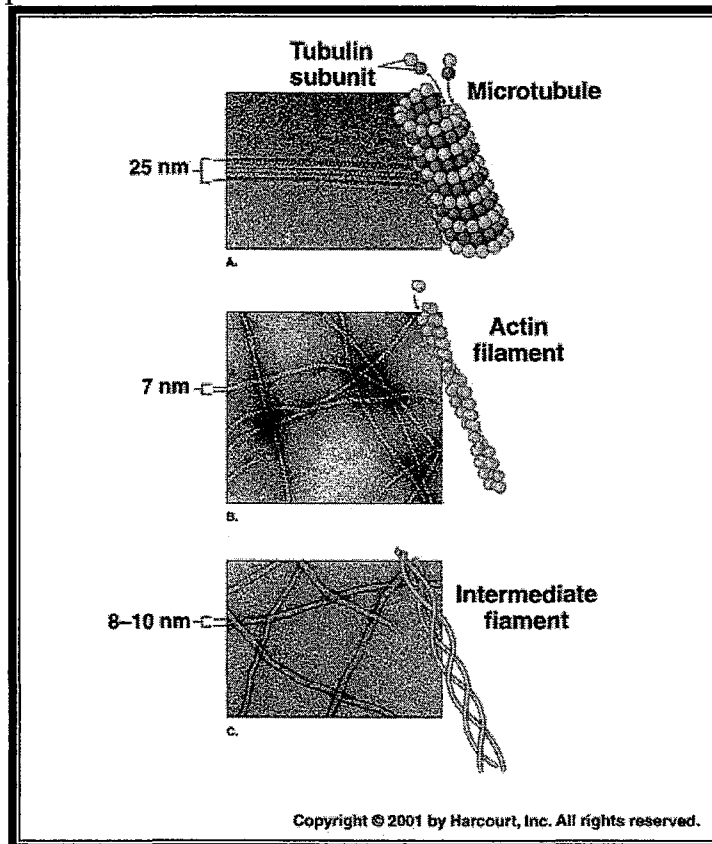
- ◆ fine thread-like solid protein fibers that are composed mostly of a contractile protein, actin.
- ◆ Involved in muscle contraction and particularly abundant are found in muscle cells, but are found in all other eukaryotic cells as well.
- ◆ Enable the cell to carry on cellular movements such as gliding, contraction, **cyclosis** and **cytokinesis** (division of the cytoplasm during asexual reproduction).

### ***Microtubules:***

- ◆ Hollow cylindrical tubes that are composed of subunits of protein called tubulin.
- ◆ Act as a scaffold to provide cell shape
- ◆ Provide a set of “tracks” for cell organelles and vesicles to move on.
- ◆ Form spindle fibers for separating chromosomes during mitosis.
- ◆ Join with other proteins to form cilia and flagella – structures that provide locomotion for certain cells

### ***Intermediate Filaments:***

- ◆ Provide tensile support for microfilaments and microtubules



**Questions:** Please answer the following questions in full sentences on separate paper.

1. **Explain WHY** mitochondria and chloroplasts are exceptions to the cell theory.
2. Describe the structure of the cell membrane.
3. Define the term semi-permeable as it **RELATES** to the cell membrane.
4. What is function of the cytoplasm?
5. The cytoplasm is most made up of water. **Is water an inorganic or organic compound? Explain!**
5. Differentiate between **cytosol and cytoplasm**.
6. Define the term **cyclosis**.
7. The nucleus is often called the “**brain of the cell**”. **What is meant by this phrase?**
8. What is the function of the **nuclear pores** that are found in the nuclear membrane?
9. Where is the **nucleolus found and what is its function?**
10. What is **chromatin** and where is it found?
11. Differentiate between the terms **intracellular and intercellular**.
12. Where are **ribosomes** are found within the cell?
13. Describe the function of ribosomes.
14. Why is the **endoplasmic reticulum** often called “the hallways of the cell”?
15. Differentiate between **rough and smooth endoplasmic reticulum AND discuss the functions of each**.
16. Discuss the function of the **mitochondria**.
17. Does the mitochondria release energy from the bonds of food molecules such as glucose or does it produce (create) energy? **Explain your answer**.
18. Describe **the structure of the cristae** found in the mitochondria and **indicate its function**.
19. How does the role of the lysosomes differ in single and multicellular organisms?
20. In your own words, describe the how the lysosome and food vacuole interact during the process of intracellular digestion. **Be specific in your answer**.
21. Describe the function of a **contractile vacuole**.
22. What do you think would happen to a paramecium if it did **NOT** have a contractile vacuole?
23. Describe the **structure and function** of the **golgi complex**.
24. Why is the **golgi complex** sometimes referred to as the “**U.P.S. of the cell**”?
25. How do vesicles help the golgi complex with its function?
26. Describe the **structure, location, and function** of **centrioles in animal cells**.
27. A plant’s cell wall is made up of cellulose which is a type of starch (complex carbohydrate).
  - a. What are the basic building blocks of cellulose?
  - b. By what biological process is cellulose made from its building blocks (think life functions)
  - c. By what biological process is cellulose broken down into its building blocks?
28. Describe the function(s) of the **cell wall**.
29. Differentiate among **chloroplasts, leucoplasts, and chromoplasts**.
30. Why are chloroplasts “green”?
31. Discuss the function of chloroplasts within plant cells.
32. Describe the function of the **cytoskeleton** of a cell.
33. Differentiate among **microfilaments, microtubules, and intermediate filaments** found within the cytoskeleton of a cell.