

Introduction to the Cell: Plant and Animal Cells

Tissues, Organs, and Systems of Living Things

Cells, Cell Division, and Cell Specialization

Animal Systems and Human Systems

Plant Systems

All organisms are made up of one or more cells

Cells can be explained by microscopes

Cell cycle occurs in distinct stages

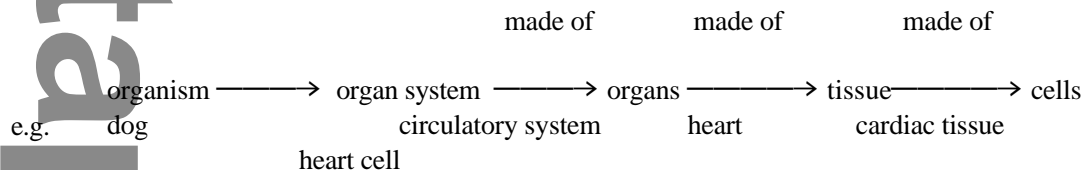
Cell division is important for growth, repair, and reproduction

Organism: several organ systems form an organism

Organ System: organs can work together with other organs to form an organism, e.g. cardiovascular system: heart, lungs, blood vessels, blood

Organ: two or more tissues working together, e.g. brain, kidney, heart, lungs, etc.

Tissue: a group of cells with similar structure and function, e.g. muscle tissue, nervous tissue



What is the Cell ?

The cell is the basic unit for all life.

(FYI: the word 'cell' is derived from the Latin word 'cellula', meaning 'small compartment', an adult human has ~ 10 – 100 trillion cells, i.e. 10^{13} - 10^{14} cells, cell size $\sim 10^{-6}$ m, whereas a molecule size = 10^{-12} m ~ 10^{-9} m)

The cell is the building block of life because all living things are made of cells, which perform all the basic functions of life. An organism can have different types of cells: nerve cells, muscle cells, etc.

Cell Theory

1. All living organisms are made up of one or more cells.
2. The cell is the basic structural and functional unit of living organisms.
3. All cells come from pre-existing cells, they do not come from non-living matter.
4. The activity of an entire organism depends on the total activity of its independent cells.

Single celled life forms, example bacteria, (E. coli), are called **prokaryotes**: these cells do not have a nucleus or other membrane bound organelles.

More complex cells that can exist as single-celled organisms or multicellular organisms, (e.g. amoeba, plants, animals), are known as **eukaryotes**: a cell that contains a nucleus and other membrane bound organelles.

What is an organelle ?

Inside the cell are many smaller parts called organelles that carry out specific functions for the cell.

Organelles are specialized structures that perform specific functions in the cell in order to maintain all the life processes of the cell. Some of these functions include energy production, transportation of materials, and waste packaging and disposal.

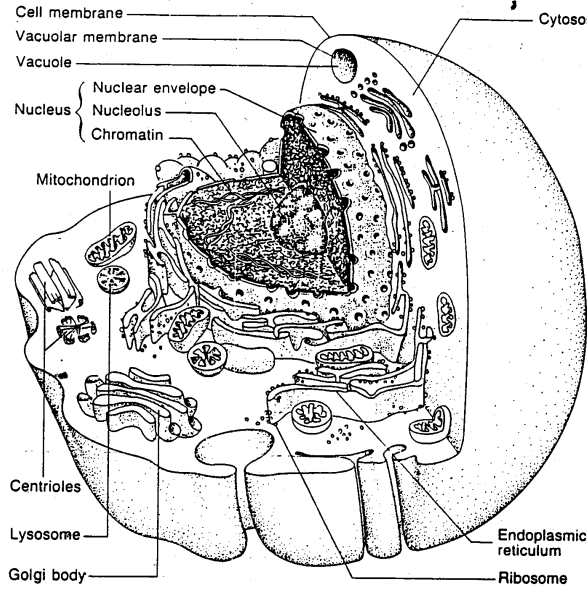
See Table on Page 6 & 7 below:

Description and Function of Cell Organelles

There are two types of cells: plant and animal cells.

Diagram of an animal cell:

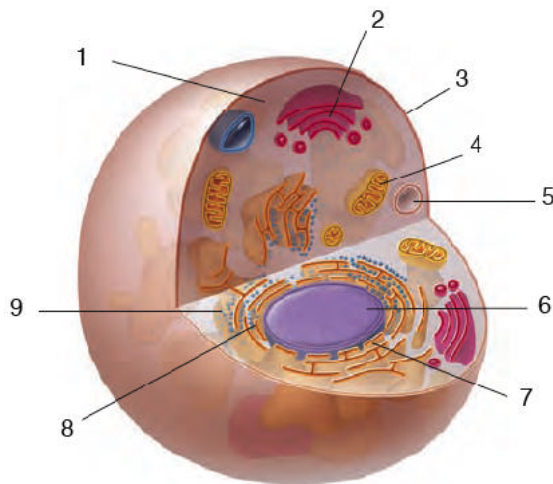
The following is an animal cell because it does not contain a cell wall or chloroplasts, and the vacuole is quite small.



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Assignment: Match each organelle with the correct location in the drawing below

- | | |
|---------------------|--------------------------|
| a. nucleus | f. endoplasmic reticulum |
| b. nuclear membrane | g. vacuole |
| c. cytoplasm | h. ribosome |
| d. cell membrane | i. mitochondrion |
| e. Golgi body | |

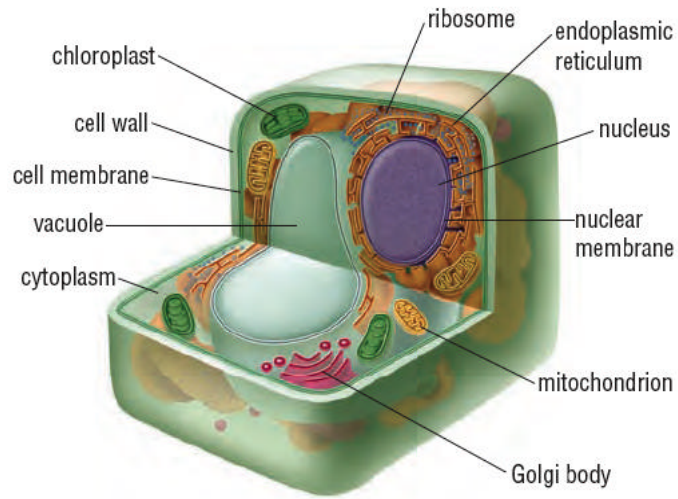


Answer to Cell Organelle Label

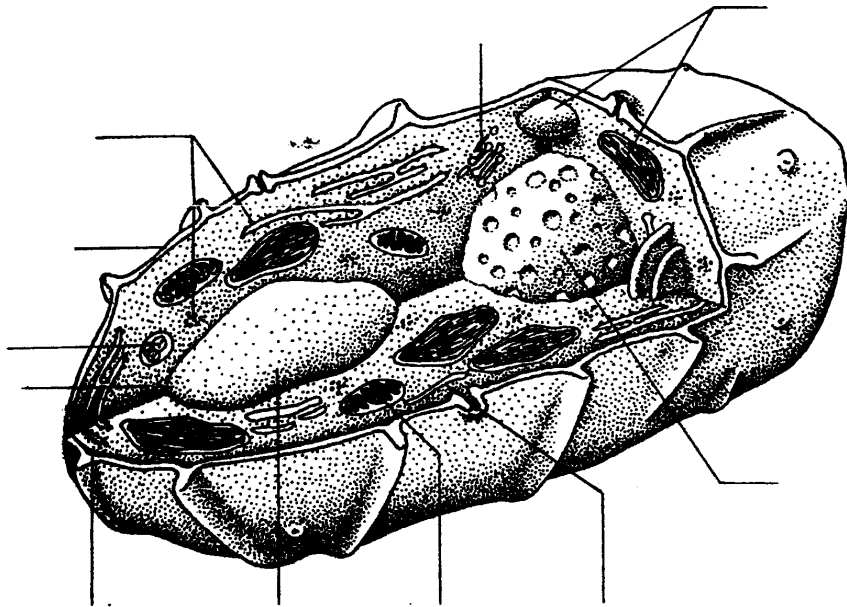
- | | | |
|----------------------|---------------------------|-------------------|
| 1 = cytoplasm | 2 = Golgi body | 3 = cell membrane |
| 4 = mitochondrion | 5 = vacuole | 6 = nucleus |
| 7 = nuclear membrane | 8 = endoplasmic reticulum | 9 = ribosome |

The following is a plant cell: because it contains a cell wall, chloroplasts, and a singular, large vacuole.

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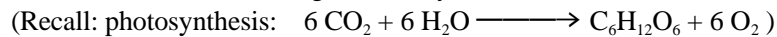
Label the following Plant Cell



What are the major differences between plant cells and animal cells discussed in this chapter?

Plant cells have cell wall– tough rigid structure outside cell membrane providing cellular support.

Plant cells have chloroplasts containing chlorophyll, to trap solar energy to manufacture glucose, whereas animal cells do not. The sugar (carbohydrate) is converted into usable energy.



Plant cells typically contain a single, large vacuole, whereas animal cells contain several small vacuoles. The large vacuole in plants allows the plant cell to store water and maintain internal fluid pressure (turgor).

In animals, mitochondria release energy stored in glucose that animals digested, however in plants mitochondria release energy stored in glucose that the plant produced itself.

Animal cells have centrioles that are involved in cell division while plant cells do not.

Assignment: Complete the following Table: **Differences between Plant and Animal cells**

Plant Cells	Animal Cells

What would make plant cells easier to see than animal cells?

The size, and plant cells have a cell wall, and chloroplasts which makes it easier to identify individual cells.

Why do some plant cells contain more chloroplasts than others?

The number of chloroplasts will depend on the position of the cell within the plant.

Photosynthesis occurs mainly in the leaves. Therefore, the cells in the leaves will contain more chloroplasts.

What happens when the leaves of a plant appear wilted?

If the plant does not absorb enough water, the vacuoles of the cells shrink and can no longer provide support for the plant.

Why would the cells of a desert plant, such as a cactus, to have thickened cell walls?

The cells of a desert plant would have thick cell walls in order to reduce the amount of water the plant loses, in order to conserve water.

Assignment I: Development of the Cell Theory

Research the following scientists to determine their contribution to the development of the cell theory:

Robert Hooke (1663), Henri Dutrochet (1824), Robert Brown (1831), Felix Dujardin (1835), Mathais Schleiden (1838), Theodor Schwann (1839), Rudolf Virchow (1858)

Plant Cell

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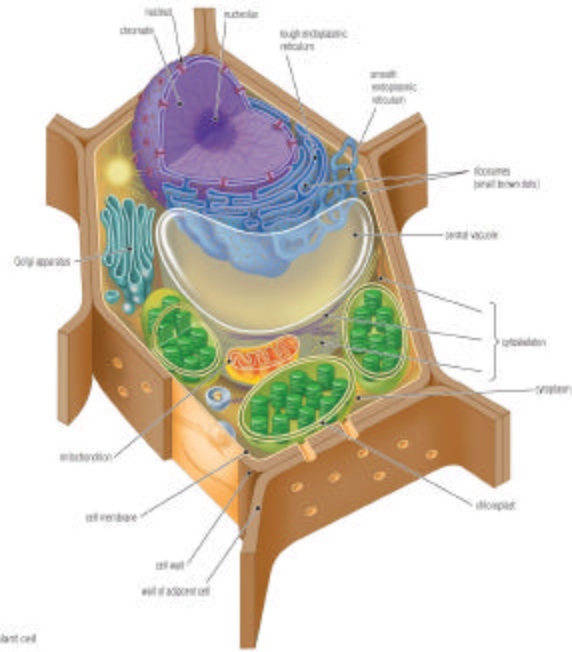


Figure 1.5 A plant cell

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An Animal Cell

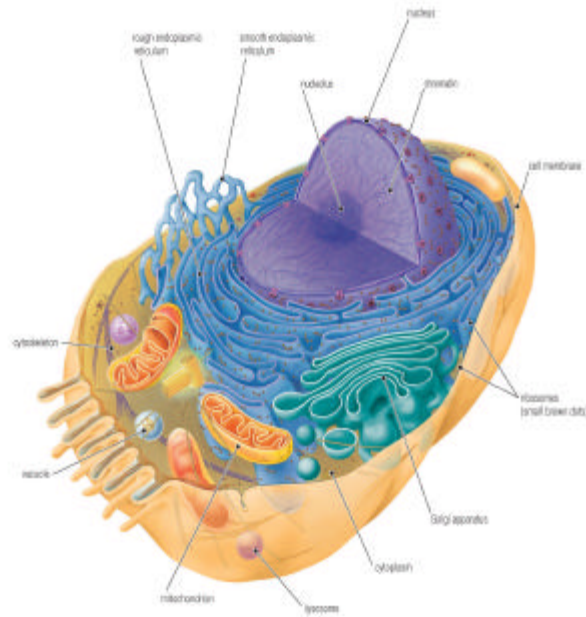


Figure 1.6 An animal cell

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Description and Function of Cell Organelles

Organelle	Description	Function
Nucleus	Spherical or oval body usually near the center of the cell (largest organelle) Appears as a large dark staining structure	Control center of all cell processes Contains the information to regulate the growth and reproduction of the cell
Nucleus membrane	Double membrane that surrounds the nucleus	Regulates the movement of materials in and out of the nucleus
DNA	Molecule called deoxyribonucleic acid Found in the nucleus Model has the shape of a double helix	Hereditary material that carries the genetic code for all cell activity. Genetic code controls cell processes such as protein synthesis
Chromatin	Long strands of DNA scattered throughout the nucleus When cell divides strands form chromosomes	Contains genetic information to control cell processes
Nucleolus	Located in nucleus this dense body is made up of nucleic acids (RNA & DNA and proteins)	Manufacturers ribosome parts, which in turn help produce protein
Ribosomes	Tiny grainy organelles located on the surface of the ER or floating freely in cytoplasm Composed mainly of RNA	Site of protein synthesis (Amino acids join together to form proteins), i.e.. make hormones
Cell membrane	Selectively permeable barrier 'plasma membrane' (double membrane made up of lipids and proteins)	Holds the contents of the cell together Controls passage of materials in and out of the cell, (diffusion process)
cytoplasm	Jelly-like clear material enclosed by the cell membrane, fills the cell and surrounds the organelles. Often moving	Suspends the organelles. Provides the environment for movement of materials 'cytoplasmic streaming'
Endoplasmic reticulum	Folded membrane that forms a series of canals	Transports materials within the cell
Mitochondria	Sausage shaped structure surrounded by two membranes. Active cells, e.g. muscle cells have more mitochondria.	Centers of respiration of the cell Release energy that powers all cell activities, powerhouse of cell

Golgi bodies, (Golgi apparatus, Golgi complex)	Several flattened membrane tubes – ends have tiny sacs Scattered throughout the cytoplasm	Store and transport cell products Package proteins and transport them outside the cell
Vacuoles	Fluid filled spaces surrounded by a single membrane Contain food, water, waste and other materials	Storage area for materials: water, food, minerals, and waste, in plants, when large vacuole is full it can add support to the cell structure
Lysosomes	Fluid filled spaces surrounded by a single membrane Contain food, water, waste and other materials	Contain digestive enzymes to breakdown cell materials: carbohydrates, fats proteins, foreign materials such as bacteria, worn out cell parts If released from lysosome enzymes could digest entire cell “suicide bags”
Cell wall (Organelle in plants)	Composed largely of cellulose Located outside the cell membrane of plant cells, rigid frame around the cell (fungi and bacteria have a cell wall)	Provides strength, support and protection for cell parts Gives shape to individual plant cells
Chloroplast (Organelle in plants)	‘plastids’ oval shaped organelle found in plant cells contain chlorophyll needed for photosynthesis	to produce carbohydrates ‘food’
Centriole	Occur in pairs in a structure called centrosome, located near the nucleus	Involved in cell division

Assignment II

1. What is an organelle ?
2. (a) Are your cells prokaryotic or eukaryotic ? Explain.
(b) What is the difference between prokaryotic and eukaryotic cells ?
3. What is the function of the: vacuoles, endoplasmic reticulum, and Golgi apparatus.
4. What are three differences between plant and animal cells ?
5. Match each organelle with the life function it is associated with in the cell from the following word bank:
cell membrane, nucleus, mitochondria, endoplasmic reticulum, vacuole, Golgi bodies
 - a. _____ collect and process materials to be removed from the cell
 - b. _____ “power plants” of the cell
 - c. _____ functions to support the cell
 - d. _____ fluid-filled tubes that transport materials, such as proteins, through the cell
 - e. _____ a single layer of membrane enclosing fluid in a sac
 - f. _____ contains genetic information that controls all cell activities
 - g. _____ functions to allow some substances to enter while keeping others out
6. What are the major differences between plant cells and animal cells.
7. Where does cellular respiration occur? Explain what it is.
(Answer: Mitochondria; it is the organelle in the cell that converts the stored energy into an easily usable form.)
8. Explain how diffusion works. How does a cell utilize diffusion?
(Answer: Diffusion is the movement of particles from an area of higher concentration to an area of lower concentration. A cell uses diffusion to bring chemicals and water that it needs into the cell and move stuff out of the cell that it does not need. Example: a tea bag steeping in hot water is an example of diffusion. The tea particles from the bag are diffusing throughout the entire cup of water.)
9. When viewing the cells taken from the leg muscle of an athlete and cells taken from the skin of an elderly individual . What differences in the number of mitochondria would you see in the two samples?
(When answering, consider the function of the mitochondria: it is the powerhouse of the cell, i.e. to supply energy—this organelle converts the chemical energy in sugars into energy that the cell can use; hence which person would need a greater number of mitochondria organelle !!)
10. How does the nucleus coordinate cell activities?