Name_____ Grade 9
Date_____ Study Guide

1665 - Robert Hooke identified cells in cork and named them cells
1683 - Anton van Leeuvenhoek 1st to describe living cells
1838 - Matthias Schleiden proposed plants were made of cells
1839 - Theodor Schwann concluded all living things are made of cells
1855 - Rudolf Virchow proposed all cells come from existing cells

These discoveries, confirmed by other biologists, are summarized in the cell theory, a fundamental concept of biology. **The cell theory** states:

- All living things are composed of cells.
- Cells are the basic units of structure and function in living things.
- New cells are produced from existing cells.

Cells are divided into two types, prokaryotic and eukaryotic.

The term "**prokaryote**" is derived from the Greek word "*pro*", (meaning: before) and "*karyon*" (meaning: kernel). It translates to "***before nuclei.***"

The term "**Eukaryotes**" is derived from the Greek word "*eu*", (meaning: good) and "*karyon*" (meaning: kernel), therefore, translating to "***good or true nuclei.***" Eukaryotes are more complex and much larger than prokaryotes.

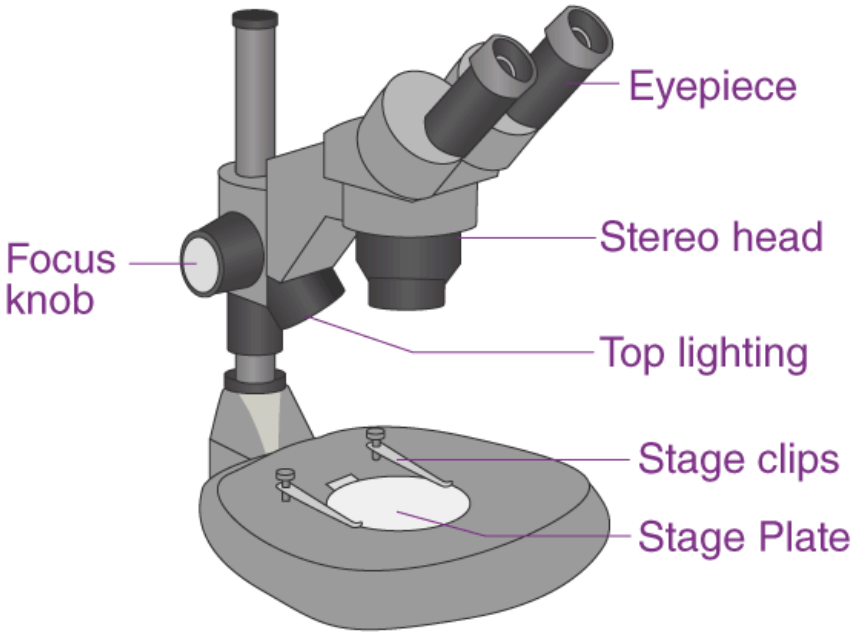
	Prokaryotic	Eukaryotic
Type of Cell	Always unicellular	Unicellular and multi-cellular
Cell size	Ranges in size from 0.2 µm – 2.0 µm in diameter	Size ranges from 10 µm – 100 µm in diameter
Cell wall	Usually present; chemically complex in nature	When present, chemically simple in nature
Nucleus	Absent	Present
Ribosomes	Present. Smaller in size and spherical in shape	Present. Comparatively larger in size and linear in shape
DNA arrangement	Circular	Linear
Mitochondria	Absent	Present
Cytoplasm	Present, but cell organelles absent	Present, cell organelles present
Endoplasmic reticulum	Absent	Present
Ribosome	Small ribosomes	Large ribosomes
Lysosome	Lysosomes and centrosomes are absent	Lysosomes and centrosomes are present
Cell division	Through binary fission	Through mitosis
Reproduction	Asexual	Both asexual and sexual

Microscopes

Light Microscopes

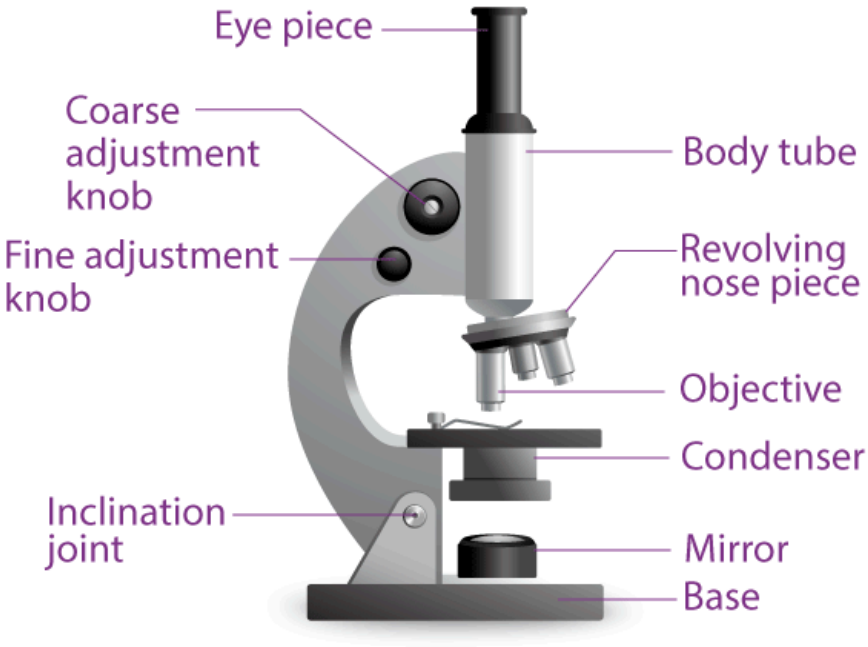
These are basic microscopes that use light to magnify objects. The lenses in these microscopes refract the light for the objects beneath them to appear closer. The different types of light or optical microscopes are:

- Compound microscope
- Simple microscope
- Dissection or stereo microscope (image below)



Stereo microscope

Compound light microscopes use lenses and light to magnify objects max magnification = 1000x ocular (eyepiece) x lens = total magnification often uses stains to see cells better. (image below)



Electron Microscopes

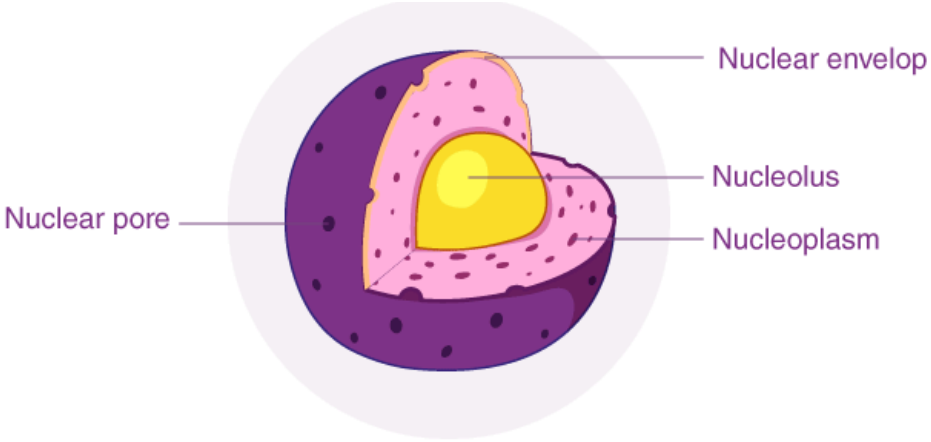
Instead of light, these microscopes use beams of electrons to generate images. The two well-known electron microscopes are:

- TEM (Transmission Electron Microscope) – the electrons transmit or pass through a very thin specimen.
- SEM (Scanning Electron Microscope) – It scans through the surface of the specimen by focusing the electron beam.

As a result of technical advancements, one can also find more efficient microscopes like scanning probe microscopes and scanning acoustic microscopes.

Cell Organelles	Structure	Functions
Cell membrane	A double membrane composed of lipids and proteins. Present both in plant and animal cells.	Provides shape, protects the inner organelles of the cell and acts as a selectively permeable membrane.
Centrosomes	Composed of centrioles and found only in the animal cells.	It plays a major role in organizing the microtubule and cell division.
Chloroplasts	Present only in plant cells and contains a green-coloured pigment known as chlorophyll.	Sites of photosynthesis.
Cytoplasm	A jelly-like substance, which consists of water, dissolved nutrients and waste products of the cell.	Responsible for the cell's metabolic activities.
Endoplasmic Reticulum	A network of membranous tubules, present within the cytoplasm of a cell.	Forms the skeletal framework of the cell, involved in the detoxification, production of lipids and proteins.
Golgi apparatus	Membrane-bound, sac-like organelles, present within the cytoplasm of the eukaryotic cells.	It is mainly involved in secretion and intracellular transport.

Lysosomes	A tiny, circular-shaped, single membrane-bound organelles, filled with digestive enzymes.	Helps in the digestion and removes wastes and digests dead and damaged cells. Therefore, it is also called as the “suicidal bags”.
Mitochondria	An oval-shaped, membrane-bound organelle, also called the “Powerhouse of The Cell”.	The main site of cellular respiration and also involved in storing energy in the form of ATP molecules.
Nucleus	The largest, double membrane-bound organelles, which contains all the cell’s genetic information.	Controls the activity of the cell, helps in cell division and controls the hereditary characters.
Ribosomes	Non-membrane organelles, found floating freely in the cell’s cytoplasm or embedded within the endoplasmic reticulum.	Involved in the synthesis of proteins.
Vacuoles	A membrane-bound, fluid-filled organelle found within the cytoplasm.	Provide shape and rigidity to the plant cell and help in digestion, excretion, and storage of substances.



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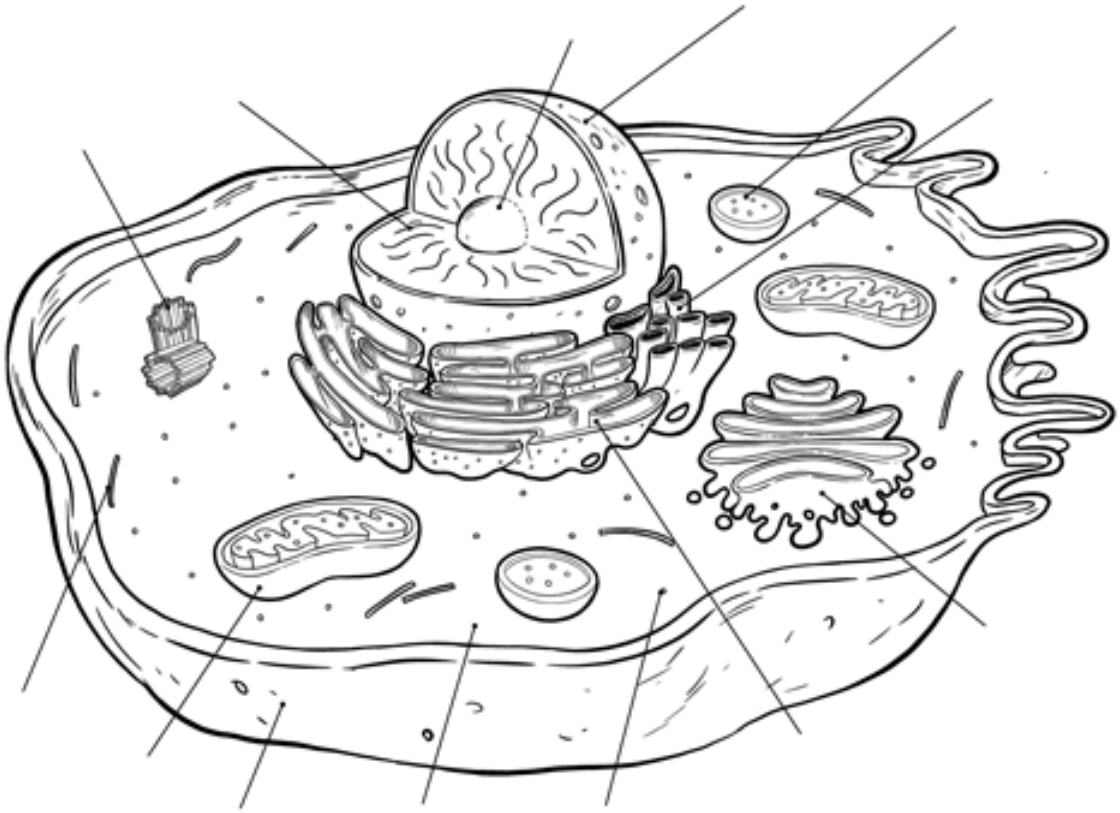
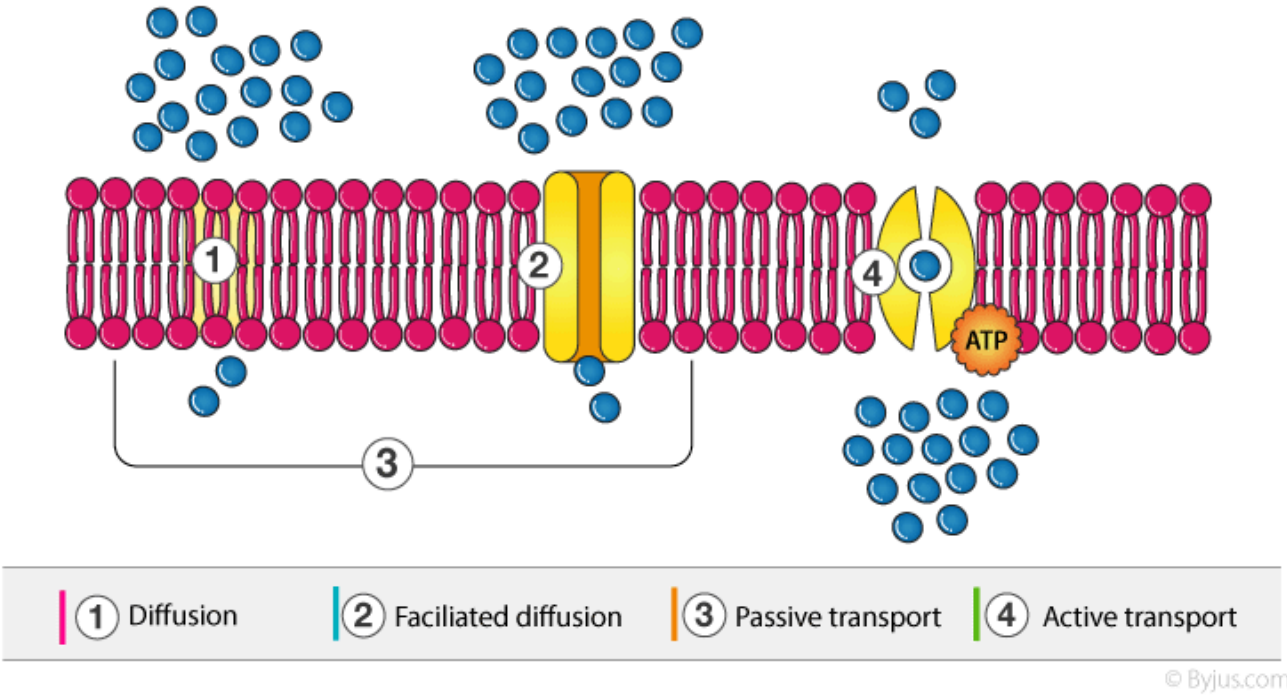


Diffusion

Diffusion is a spontaneous process in which a substance moves from a region of high concentration to a region of low concentration, eventually eliminating the concentration difference between the two regions.

Simple Diffusion

Transport across the plasma membrane occurs unaided in simple diffusion, i.e., molecules of gases such as carbon dioxide and oxygen, as well as small molecules like ethanol, enter the cell by crossing the cell membrane without the assistance of any permease.



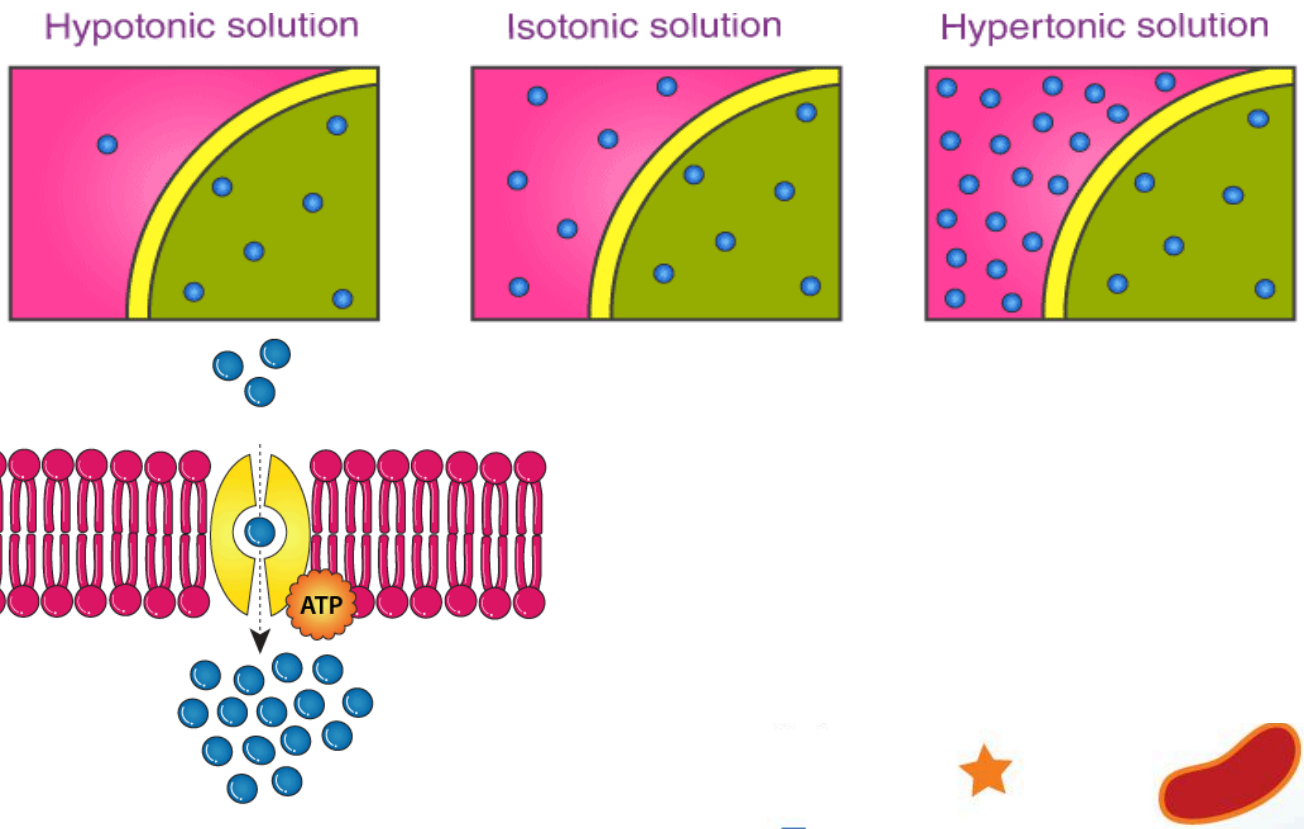
Facilitated Diffusion

This is a type of passive transport in which molecules that cross the cell membrane move quickly due to the presence of specific permeases in the membrane. Facilitated diffusion occurs only in the direction of a concentration gradient and does not require metabolic energy.

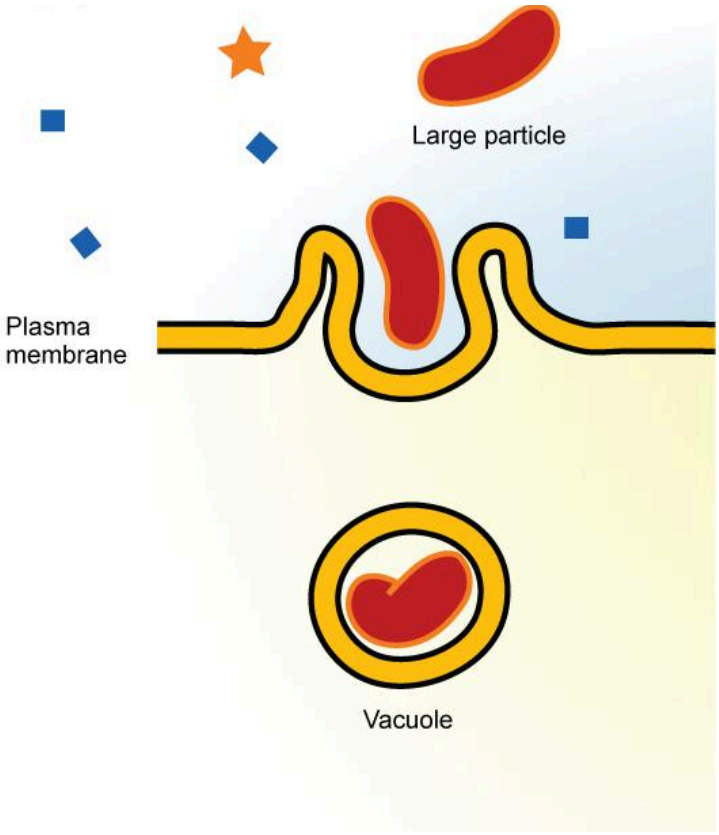
Osmosis

Water molecules can transport through the cell membrane. The movement of water molecules through the cell membrane is caused by differences in the concentration of the solute on its two sides. Osmosis is the process by which water molecules pass through a membrane from a region of higher water concentration to a region of lower water concentration.

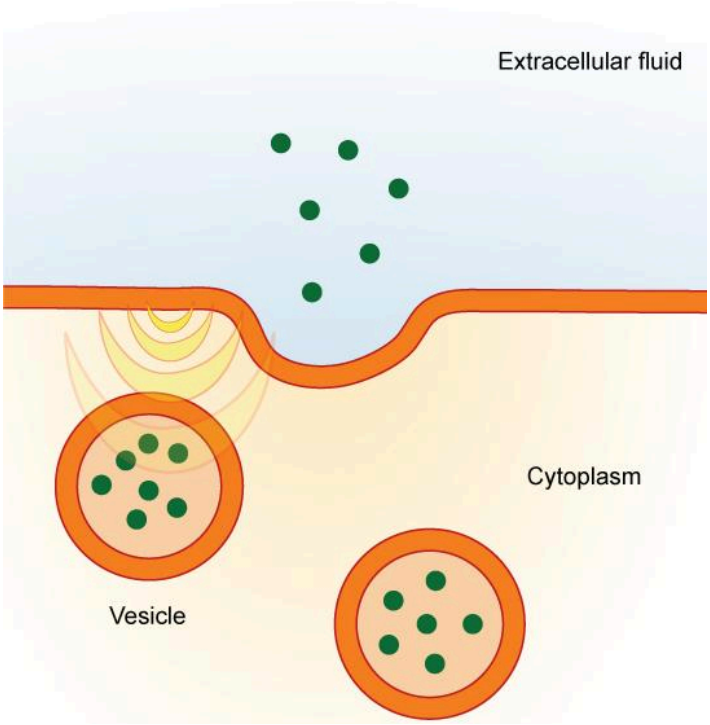
- When two compartments of different solute concentrations are separated by a semipermeable membrane, the compartment with higher solute concentration is called **hypertonic** relative to the compartment of lower solute concentration, which is described as **hypotonic**.
- If a cell is placed in a hypotonic solution, it rapidly gains water by osmosis and swells. Conversely, a cell placed into a hypertonic solution rapidly loses water by osmosis and shrinks.
- When the internal solute concentration equals the external solute concentration, it is said to be **isotonic**. Here, no net movement of water in or out of the cells occurs.
- The amount of water contained within the cell creates a pressure termed hydrostatic pressure (osmotic pressure). The cell membrane regulates the osmotic pressures of intracellular and intercellular fluids.



Endocytosis is a type of active transport that moves particles, such as large molecules, parts of cells, and even whole cells, into a cell. There are different variations of endocytosis, but all share a common characteristic: The plasma membrane of the cell invaginates, forming a pocket around the target particle. The pocket pinches off, resulting in the particle being contained in a newly created intracellular vesicle formed from the plasma membrane.



Exocytosis



The reverse process of moving material into a cell is the process of **exocytosis**. Exocytosis is the opposite of the processes discussed above in that its purpose is to expel material from the cell into the extracellular fluid. Waste material is enveloped in a membrane and fuses with the interior of the plasma membrane. This fusion opens the membranous envelope on the exterior of the cell, and the waste material is expelled into the extracellular spaces.

REVIEW QUESTIONS

Which of the following cell organelles is absent in animal cells and present in a plant cell?

A. Cytoplasm
B. Cell wall
C. Vacuoles
D. None of the above

Which of the following cell organelles does not contain DNA?

A. Chloroplast
B. Lysosomes
C. Mitochondria
D. None of the above

Which of the following statements is true about the cell wall?

A. The cell wall is mainly composed of cellulose
B. The cell wall is mainly composed of protein
C. The cell wall is mainly composed of lipid
D. None of the above

Which of the following statements is true about cell theory?

A. The Cell theory does not apply to algae
B. The Cell theory does not apply to virus
C. The Cell theory does not apply to fungi
D. None of the above

_____ is a jellylike substance found floating inside the plasma membrane.

A. Karyoplasm
B. Cytoplasm
C. Mitochondria
D. None of the above

The Cell as an Organism

Unicellular organisms dominate life on Earth. Unicellular organisms include both prokaryotes and eukaryotes. Prokaryotes, especially bacteria, live almost everywhere. Many eukaryotes also spend their lives as single cells.

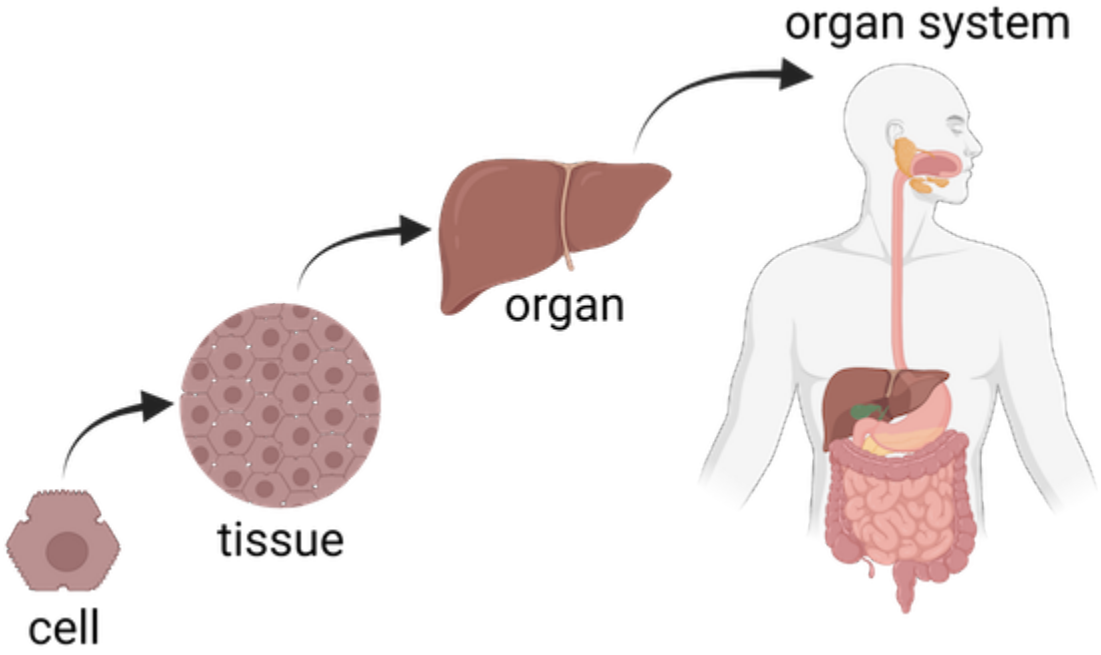
- Some types of algae are unicellular.
- Yeasts, or unicellular fungi, are also widespread.

Unicellular organisms must maintain **homeostasis** - relatively constant internal physical and chemical conditions. To maintain homeostasis, unicellular organisms grow, respond to the environment, transform energy, and reproduce.

Multicellular Life
The cells of multicellular organisms become specialized for particular tasks and communicate with one another to maintain homeostasis.

Levels of Organization
The specialized cells of multicellular organisms are organized into tissues, then into organs, and finally into organ systems.

- A **tissue** is a group of similar cells that performs a particular function.
- To perform complicated tasks, many groups of tissues work together as an **organ**.
- A group of organs that work together to perform a specific function is called an **organ system**.



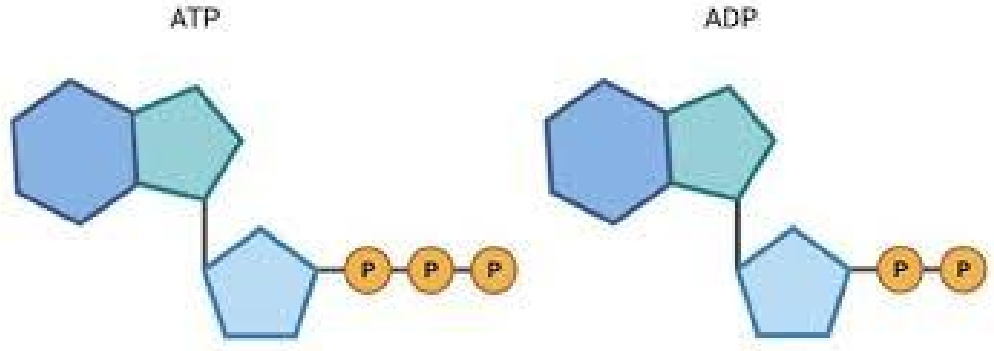
Cells in a large organism communicate by means of chemical signals that are passed from one cell to another.

Some cells form connections, or cellular junctions, to neighboring cells.

Some junctions hold cells firmly together. Some junctions speed communication between the joined cells. - receptor = molecule that binds to specific chemical messengers

Chemical Energy and ATP

Energy is the ability to do work. Organisms need energy to stay alive.
Adenosine triphosphate (ATP) is a chemical compound cells use to store and release energy.
An ATP molecule consists of adenine, the sugar ribose, and three phosphate groups.



Cells store energy by adding a phosphate group to **adenosine diphosphate (ADP)** molecules.

Cells release energy from ATP molecules by subtracting a phosphate group.
Energy provided by ATP is used in active transport, to contract muscles, to make proteins, and in many other ways.
Cells contain only a small amount of ATP at any one time. They regenerate it from ADP as they need it, using energy stored in food.

Heterotrophs and Autotrophs The energy to make ATP from ADP comes from food. Organisms get food in one of two ways.

Heterotrophs get food by consuming (eating) other organisms.
Autotrophs use the energy in sunlight to make their own food.

Photosynthesis is the process that uses light energy to produce food molecules.