

Life Science
Chapter 4
Cell Structure

4A - Membranes

The Unit Membrane

unit membrane: a thin structure composed of proteins and lipids
type of membrane found around all cells and
around many of the structures inside cells
Membranes form the outer boundary of a cell.

The lipid molecules form a flexible (fluid) film. The proteins
perform most of the activities of the membrane.

An important property of a unit membrane is that it is
selectively permeable (certain molecules go through them and
other molecules do not).

Not all membranes are permeable to the same molecules.
However water, oxygen, and carbon dioxide are small and easily
pass through most membranes.

How does a substance pass through a unit membrane?

by **PASSIVE TRANSPORT**(main way): the passage of
substances across a membrane
without the use of energy

two main forms of passive transport:

(1) **diffusion:** the movement of molecules from an area of
higher concentration to an area of lower
concentration

diffusion can be accelerated by such things as heat,
movement, and pressure

diffusion will continue until the relative number of
molecules is equal in the two areas (reaches an
equilibrium)

(2) **osmosis:** the diffusion of water through a membrane

by **ACTIVE TRANSPORT:** the passage of particles
through a membrane; requires the use
of cellular energy (sometimes because
of the size of the molecule being so
large, or going against gradient)

Some substances that are carried into and out of cells in this way include calcium, potassium, and sodium.

----- Quiz 4A -----

4B- Typical Parts of Cells

Comparing Cell Sizes:

A nerve cell in your leg could be a meter long. A human ovum is no bigger than the dot on the letter i. A human red blood cell is about one-tenth the size of a human ovum. A bacterium is even smaller - 8,000 of the smallest bacteria can fit inside one of your red blood cells.

largest: an unfertilized ostrich egg

smallest: The smallest cell is a type of bacteria known as mycoplasma. Its diameter is 0.0001 mm. The smallest cell in the human body is the sperm cell.

Almost 80% of a cell is water.

Most cells are colorless.

Three basic parts of all cells:

- (1) cellular boundaries
- (2) cytoplasm
- (3) genetic material

Cellular Boundaries

All cells have cell membranes. Cell walls and slime capsules are accessory coverings that some cells produce.

Most cells in the human body have only a cell membrane and a thin fluid-filled space separating them from the next cell's membrane.

That fluid does not "drain out" because the cells of the skin form a water-tight barrier. A **dehydrated** person lacks some of this intercellular water. When a person has too much intercellular water, **swelling** occurs.

- (1) **Cell membrane:** All cells are surrounded by a unit membrane called a cell membrane.
Acts as a barrier (protection)
Controls what enters and exits the cell
Also sites of communication with other cells (they sense and respond to changes in their environment).
- (2) **Cell walls:** a rigid structure manufactured by a plant

cell and secreted around the cell membrane
shapes the cell
in plants it contains cellulose
found in plants, bacteria, algae and some
other organisms

Fungal cell walls are chemically different (made of
chitin, not cellulose).

Bacterial cell walls are composed largely of a compound
called peptidoglycan.

- (3) **Capsules:** sometimes called a slime coat
they protect the cells from drying out and
from harmful substances around them
made of cellular secretions
vary in thickness
they give clusters of bacteria and algae
their shiny appearance and slimy feel

Cytoplasm

cytoplasm: all the material, except the nucleus, inside a cell
(constantly moving gel-like mixture inside the
cell membrane)

It is a thick fluid that contains **cytoplasmic
organelles** (parts of a cell that carry on many of
the functions needed to keep the cell alive).

In eukaryotic cells the cellular organelles are anchored by
a "scaffolding" called a cytoskeleton. Cytoskeleton is made up
of thin, hollow tubes of protein and then, solid protein fibers.
It helps the cell maintain or change its shape. It enables some
cells to move (example amoeba).

Cytoplasmic organelles

mitochondria: nicknamed "the powerhouse of the cell"
bean-shaped or rod-shaped structures made of two
layers of unit membranes
the outer membrane is smooth
inner membrane is folded repeatedly into ridges
the folds are called **cristae** (on the inner
membrane are the enzymes that release usable
energy from small food molecules).

Depending upon the energy demands of the cell, the
mitochondria may be large and numerous with many cristae (as in
muscle cells) or they may be small and relatively few with only a

few cristae. A liver cells has hundreds of mitochondria, which makes up about 25% of the cell's volume.

Endoplasmic reticulum (ER): a cellular organelle consisting of a network of membranes (a maze of passageways)
function - enables substances to be transported throughout the cell (it connects the nucleus to the cell membrane)
types: **rough ER** - ER dotted with ribosomes
smooth ER - ER lacking ribosomes

Ribosomes: a cellular organelle that directs the assembling of proteins
nickname "protein factories"
function - protein synthesis (direct the assembling of proteins)
found on ER and scattered throughout the cytoplasm
get coded instructions from nucleus for making proteins
protein: major building materials of cells and chemical regulators of cells

Golgi body: a cellular organelle that (1) collects chemicals from the cytoplasm, (2) processes them, and (3) secretes them
(sort proteins and other cellular substances and package them into membrane-bound structures called vesicles)
(receive proteins and other newly formed materials from the ER, package them, and distribute them to other parts of the cell or outside the cell)
first seen in 1898 by Camillo Golgi.

The Golgi apparatus and the endoplasmic reticulum are interconnected and function together.

Vacuoles: a membrane-bound sac that contains food, water, wastes, or other materials within a cell
nickname "containers of the cell"
small vacuoles are sometimes called vesicles
Contractile vacuoles (paramecium; stentor) regulates water inside cell (without it the organism would take in water by osmosis and burst).
Central vacuoles store water in plant cells.

Endocytosis: the process of taking substances into a cell by surrounding it with the cell membrane
Exocytosis: process by which vesicles release their contents outside the cell

Lysosomes: an organelle that contains digestive enzymes
digest invading substances or large food substances
occasionally its enzymes destroy old or no longer
needed cellular structures (demolition crew)

At one time lysosomes were called "suicide sacs" because certain stimuli seemed to cause the cell to commit suicide by releasing the enzymes which digested the cell.

Actually, as the cell dies, the membrane which holds the enzymes falls apart (disintegrates), causing protoplasm destruction.

Chloroplasts: a cellular organelle that contains chlorophyll and other pigments
(the organelle in which photosynthesis occurs)

Cilia: short hairlike extensions from a cell's cell membrane aids in movement (*Cilium* means "eyelid" or "eyelash")

Flagella: long, hairlike extensions from a cell's cell membrane aids in movement (*flagellum* means "whip")

How do ribosomes, Golgi bodies, and the endoplasmic reticulum work together? (Ribosomes make proteins that are released through the endoplasmic reticulum and moved to the Golgi bodies.)

How do chloroplasts, mitochondria, lysosomes, and vacuoles work together in a plant cell? (Chloroplasts capture the sun's energy and use it to make food for the cell. Mitochondria convert energy in the food to energy the cell can use (chemical energy). Lysosomes break down materials, including food particles. Vacuoles store food and other materials the cell needs.)

Genetic Material

nucleus: sometimes called "the control center of the cell"
the cellular region that contains the chromosomes
usually the largest organelle in a cell

The nucleus has a double unit membrane around it called the **nuclear membrane** or **nuclear envelope**.

The nuclear envelope has large pores - permitting the passage of material between the cytoplasm and **nuclear sap** (protein rich fluid inside the nuclear membrane).

Inside the nucleus are **chromosomes** - contains the coded information for making various parts of the cell and controlling the activities of the cell. **Chromatin** is the complex of DNA and protein that makes up chromosomes.

Chromosomes are made up of a chemical called deoxyribonucleic acid (DNA).

DNA: the nucleic acid that carries genetic information

nucleolus: looks like a nucleus inside the nucleus (structure where ribosomes are assembled)

eukaryotes: organisms with cells that have a nucleus

prokaryotes: organisms with cells lacking a nuclear membrane

----- **Quiz 4B** -----