Biology EOC Review: Tuesday May 30th

1. Characteristics of Life

Biology: is the study of life

Living things:

1) **CELLS**: are made up of BASIC units called cells.
2) **REPRODUCE:** asexually/ sexually/ both
3) **DNA**: are based on a universal genetic code, genetic blueprint
4) **GROW / DEVELOP**: growth is adding mass and development is life's stages.
5) **METABOLISM**: obtain and use materials and energy.
6) **RESPOND TO THE ENVIRONMENT**: an action delivers a response by the organism.
7) **HOMEOSTASIS**: maintain a stable internal environment.
8) **EVOLVE:** as a group, change over time.

1) **The cell**: the smallest units of an organism (a living thing).
- **Unicellular:** organisms made up of only one cell
- **Multicellular:** organisms made up of many cells.

2) **Reproduction:** all living cells come from other living cells (biogenesis).
- Sexual reproduction: the fusing of two different sex cells (sperm and egg) to make the first cell of the new organism.*(Meiosis)*
- Asexual reproduction: does not use sex cells. Usually formed when one organism divides in half to form two new organisms. *(Mitosis)*

3) **Genetic Code:**
- DNA determines the inherited traits of all organisms.

4) **Growth and Development**:
- Growth: an increase in size
- Development: periods of rapid or dramatic change.

5) **Materials and energy**:
- Materials such as water, glucose, or oxygen are examples of the reactants needed for many of the chemical reactions that happen in living things.
- Energy is the product of a chemical reaction that happens in living things.
- Metabolism: the combination of chemical reactions an organism needs to carry out its life processes.

6) **Response to the environment**:
- Organisms respond to stimuli
- Stimuli(us): a signal to which an organism responds.

7) **Maintaining an internal balance**:
- Homeostasis: the process of maintaining a stable internal environment necessary to survive.
- Usually homeostasis is maintained by an internal feedback mechanism.

8) **Evolution:**
- As a group/ population, any kind of organism can change over generations.

2. Identifying Variables

Variable- Something that is changed.

In scientific experiments there are two variables- One that you control and one that is the result.

Independent Variable- "The Cause" The one thing that is ***changed in an experiment*** This variable makes one test "independent" of another test. On a graph it is on the x-axis (along the bottom)

Dependent Variable- "The Effect" The result of the experiment What is measured This "depends" on what you changed On a graph, it is on the y-axis (along the vertical side)

******The independent variable causes the dependent variable to change******

Experimental Group - Those participants exposed to the independent variable

Control Group/ Experimental Control - Those participants treated just like the experimental group EXCEPT they are not exposed to the independent variable; the group with which the experimental group can be compared. These are situations that are kept under **NORMAL** conditions

Control Variables – measurements or things that are kept the ***same*** throughout the experiment. A good experiment is usually only testing one variable at a time.

A biopsychologist is studying the effects of anabolic steroids on the aggressive behavior of female rats. 24 female rats receive daily injections of a placebo (fake drug), while 24 others receive daily injections of the steroid. Round-the-clock videotapes of the communal cages of all rats allow all aggressive encounters to be counted and timed.

Population _____ Sample size _____
Independent variable _____ Control Group _____
Dependent Variable _____
Control Variables _____
_____
_____

3. CELLS

All Organisms are Made of Cells
- The cell is the basic unit of structure & function
- The cell is the smallest unit that can still carry on all life processes
- Both ***unicellular (one celled)*** and ***multicellular (many celled)*** organisms are composed of cells

Before the 17th century, no one knew cells existed
Most cells are too small to be seen with the unaided eye
In the early 17th century microscopes were invented & cells were seen for the 1st time
Microscope was the most innovative machine of the 17th century that propelled the study of Biology forward.

Anton Von Leeuwenhoek, a Dutchman, made the 1st hand-held microscope & viewed microscopic organisms in water & bacteria from his teeth

In 1665, an **English scientist** named **Robert Hooke** made an improved microscope and viewed thin slices of cork viewing plant cell walls
- *Hooke named what he saw "cells*"

3. CELLS- continued

In the **1830's, Matthias Schleiden (botanist studying plants) & Theodore Schwann (zoologist studying animals)** stated that all living things were made of cells

In **1855, Rudolf Virchow** stated that cells only arise from pre-existing cells
Virchow's idea contradicted the idea of spontaneous generation (idea that nonliving things could give rise to organisms)

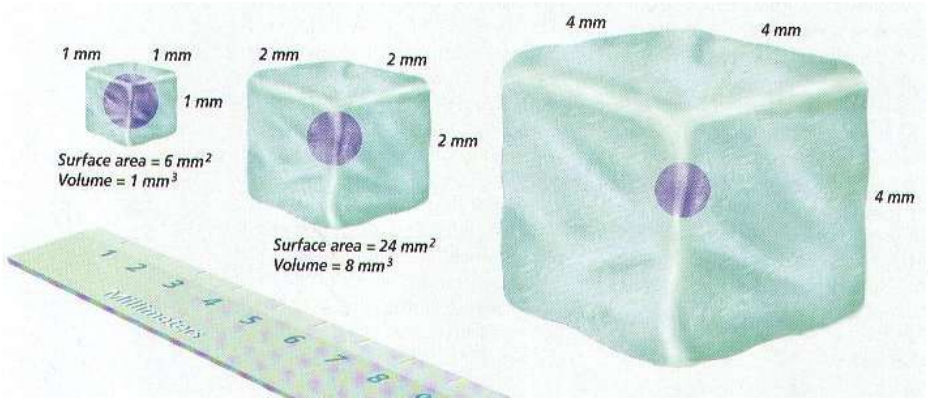
The combined work of **Schleiden, Schwann, & Virchow is known as the Cell Theory:**

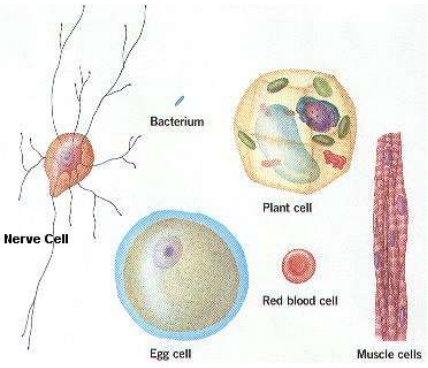
Principles of the Cell Theory

1. **All living things are made of one or more cells**
2. **Cells are the basic unit of structure & function in organisms**
3. **Cells come only from the reproduction of existing cells**

Not all cells are alike- Shape determines function
Cells **differ in size, shape, and function**
The female **egg cell is the largest** cell in the body & can be seen without a microscope
Bacteria cells are very small and need a powerful microscope to be seen.

Cells **need surface area** of their cell membrane large enough to adequately exchange materials with the environment (wastes, gases such as O2 & CO2, and nutrients)
Cells are **limited in size by the ratio between their outer surface area & their volume**
Small cells have more surface area for their volume of cytoplasm than large cells and are more efficient at transferring food and waste.
As cells grow, the amount of surface area becomes too small to allow materials to enter & leave the cell quickly, and the volume becomes too large.





Cell **size is also limited** by the amount of cytoplasmic activity that the cell's nucleus can control

Cells come in a **variety of shapes,** & the **shape helps determine the function** of the cell (e.g. **Nerve cells** are long to transmit messages in the body, while **red blood cells** are disk shaped to move through blood vessels)

<u>Prokaryotes:</u> Prokaryotic cells are **less complex**

Unicellular
Do not have a nucleus & no membrane-bound organelles
Most have a **cell wall** surrounding the **cell membrane** & a single, looped **chromosome** (genetic material) in the **cytoplasm**
*Include **bacteria** & blue-green bacteria*

Eukaryotes
More complex cells
Includes **both unicellular & multicellular** organisms
Have a true nucleus & membrane-bound organelles
Organelles are internal structures in cell's that perform specific functions

Organelles are surrounded by a single or double membrane
Entire eukaryotic cell surrounded by a thin **cell membrane** that controls what enters & leaves the cell
Nucleus is located in the center of the cell
The nucleus contains the genetic material (DNA) & controls the cell's activities
Eukaryotes include **plant cells, animal cells, fungi, algae, & protists**
Prokaryotes or bacteria lack a nucleus

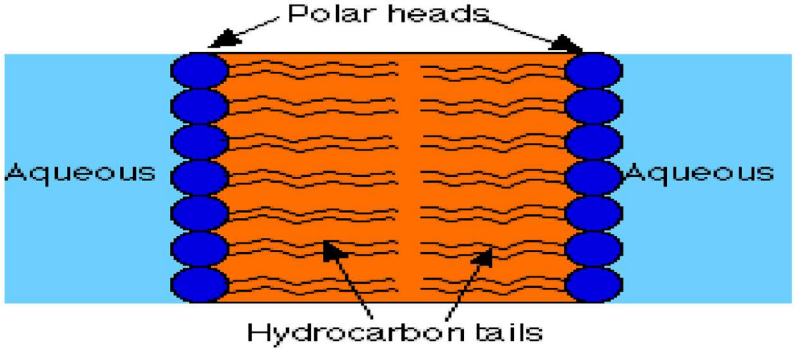
TABLE 4-2 *Organelles*

Organelle	Function
Mitochondrion	transfers energy from organic compounds to ATP
Ribosome	organizes the synthesis of proteins
Endoplasmic reticulum (ER)	prepares proteins for export (rough ER); synthesizes steroids, regulates calcium levels, breaks down toxic substances (smooth ER)
Golgi apparatus	processes and packages substances produced by the cell
Lysosome	digests molecules, old organelles, and foreign substances
Microfilaments and microtubules	contribute to the support, movement, and division of cells
Cilia and flagella	propel cells through the environment; move materials over the cell surface
Nucleus	stores hereditary information in DNA; synthesizes RNA and ribosomes
Cell wall*	supports and protects the cell
Vacuole*	stores enzymes and waste products
Plastid*	stores food or pigments; one type (chloroplast) transfers energy from light to organic compounds

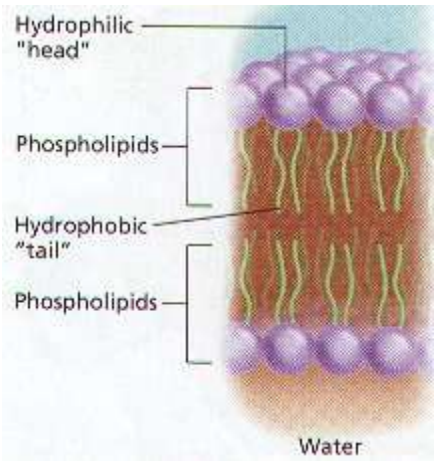
*Cell walls, large vacuoles, and plastids are found in the cells of plants and some other eukaryotes, but not in the cells of animals.

4. CELL TRANSPORT

Cell Membrane
Separates the cytoplasm of the cell from its environment
Protects the cell & **controls what enters and leaves**
Cell membranes are **selectively permeable** only allowing certain materials to enter or leave
Composed of a lipid **bilayer** made of **phospholipid molecules**

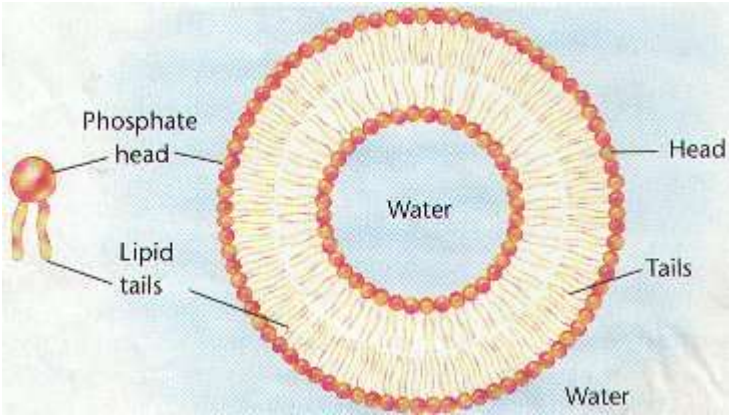


The **hydrophilic head** of a phospholipid is **polar** & composed of a **glycerol & phosphate group** and points to the **aqueous** cytoplasm and external environment.
The two **hydrophobic tails** are **nonpolar** point toward each other in the center of the membrane & are composed of **two fatty acids**

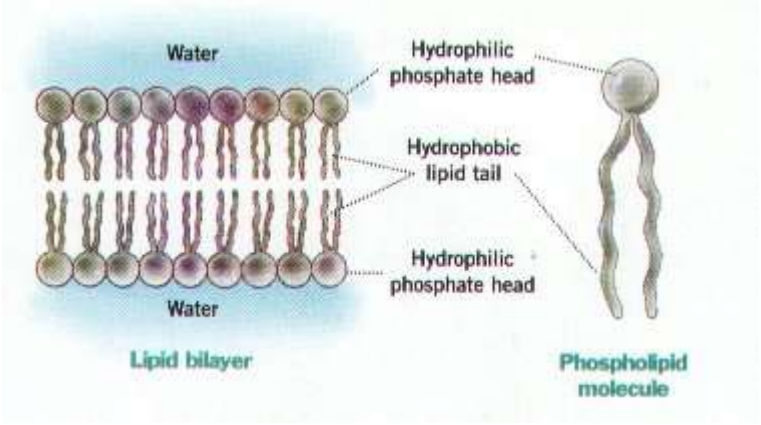


When phospholipids are placed in water, they line up on the water's surface with **their heads sticking into the water** & their **tails pointing upward** from the surface.

The inside of the cell or **cytoplasm is an aqueous** or watery environment & so is the **outside of the cell**. **Phospholipid "heads" point toward the water**.



I. **Phospholipid "tails" are sandwiched inside the lipid bilayer**.

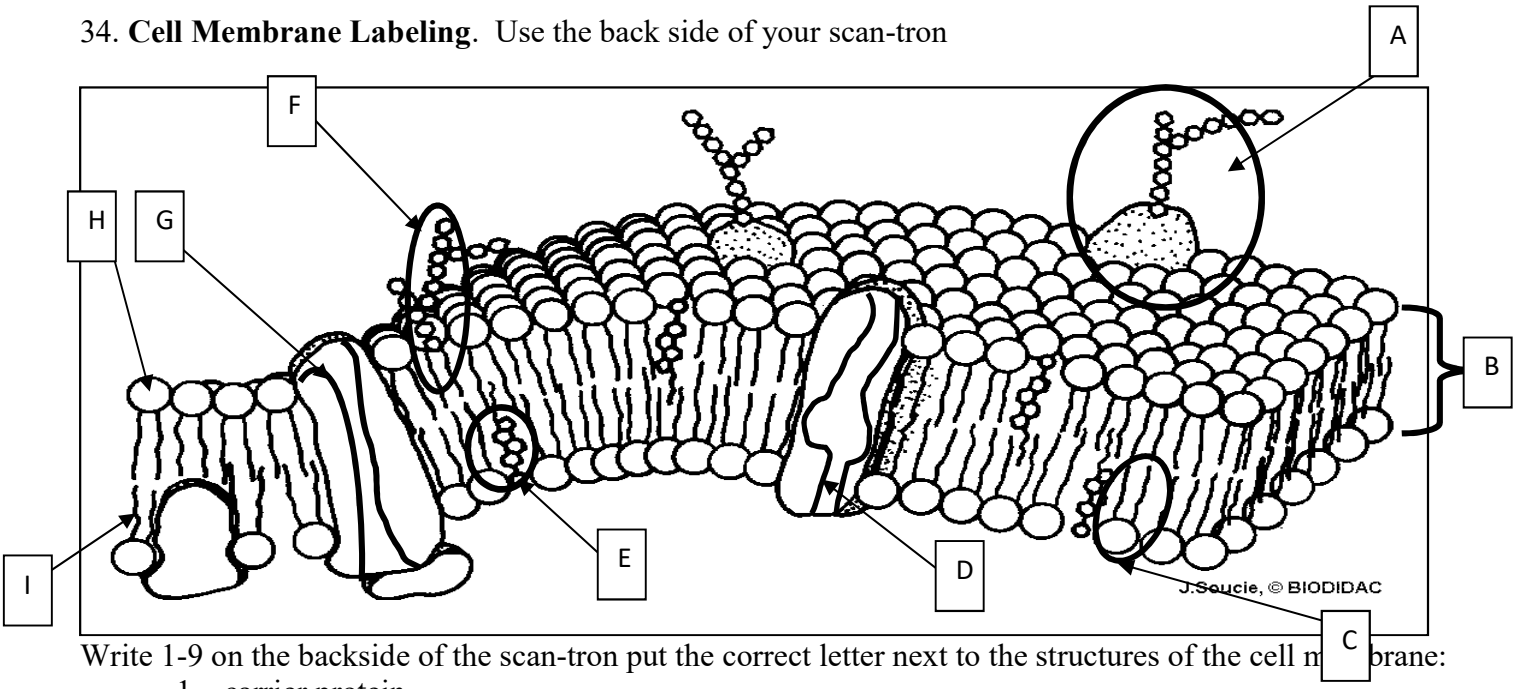


The cell membrane is **constantly breaking down & being reformed** inside living cells. Certain small molecules such as **CO2, H2O, & O2 can easily pass** through the phospholipids

Membrane Proteins

A variety of **protein molecules are embedded** in the cell's lipid bilayer.

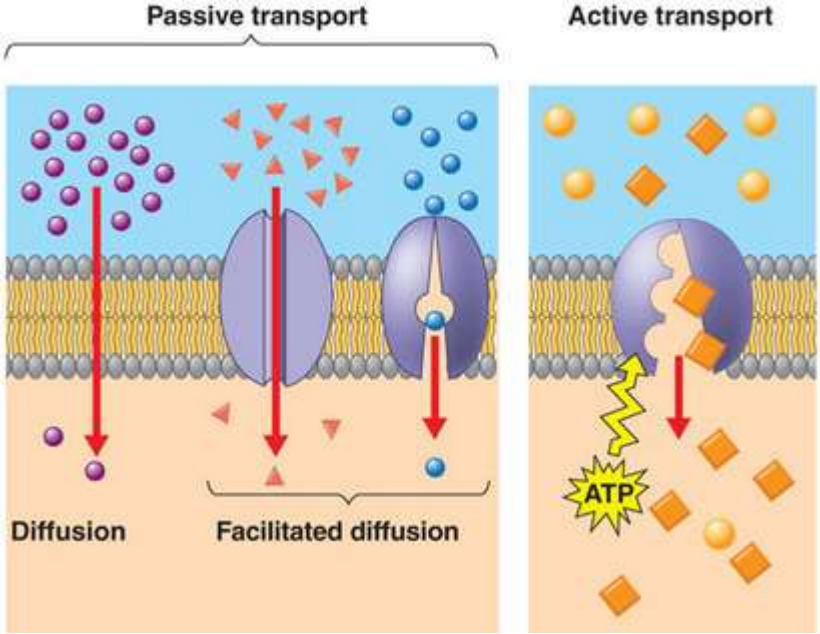
34. **Cell Membrane Labeling**. Use the back side of your scan-tron



Write 1-9 on the backside of the scan-tron put the correct letter next to the structures of the cell membrane:

1. carrier protein ___
2. channel protein ___
3. glycoprotein _____
4. hydrophobic ___
5. cholesterol ___
6. hydrophilic ___
7. phospholipid bilayer ___
8. glycolipid ____
9. phospholipid ____

ACTIVE and PASSIVE TRANSPORT



ACTIVE TRANSPORT VERSUS PASSIVE TRANSPORT

Passive Transport

PASSIVE TRANSPORT requires NO energy. Like rolling a ball down a hill.

Simple Diffusion
Some particles can pass through the plasma membrane by simple diffusion. The cell uses NO energy to move these particles.

- Diffusion is classified as passive transport.

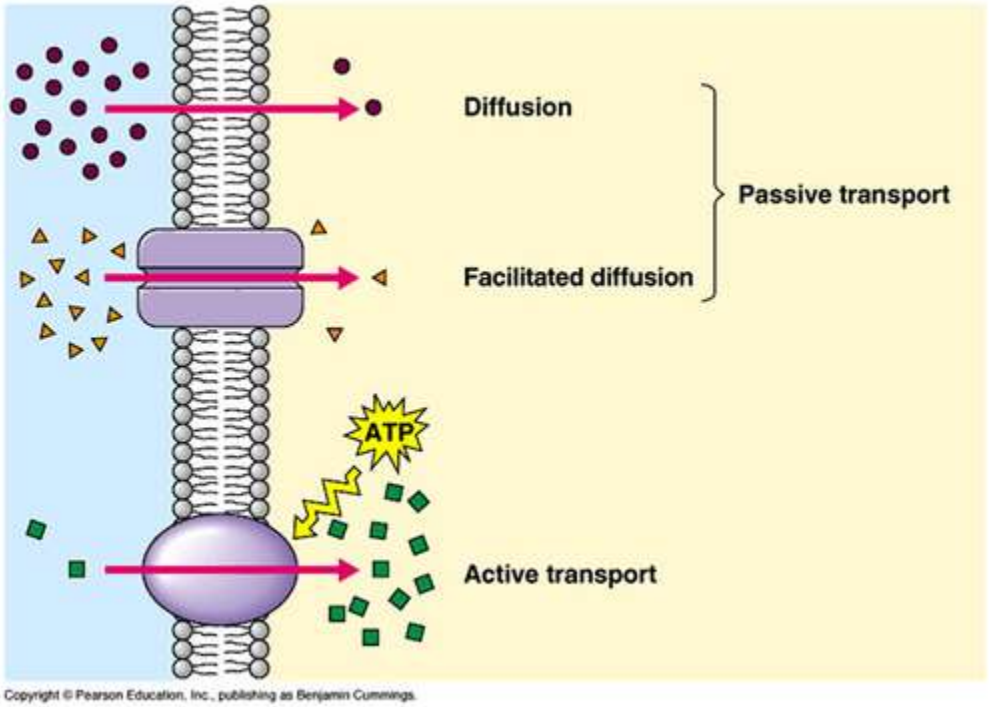
Facilitated Diffusion
Transport proteins (located within the plasma membrane) help substances to move through the plama membrane.

- Passive transport of materials across the plasma membrane using the transport proteins is called facilitated diffusion.
- Some transport proteins called channel proteins form channels that allow specific molecules to flow through. The movement is with the concentration gradient, and requires NO energy input from the cell

Carrier proteins are another type of transport protein.

- Carrier proteins change shape to allow substances to pass through the plasma membrane.
- In facilitated diffusion by carrier proteins, the movement is with the concentration gradient and require NO energy input from the cell.

Active Transport
Active Transport



ACTIVE TRANSPORT - requires the USE of ENERGY. Like rolling a ball up hill.

In many cases, cells must move materials up their concentrated gradient, from and area of lower concentration to an area of higher concentration. Such movement of materials is known as **ACTIVE TRANSPORT.**

Unlike Passive Transport, Active Transport **REQUIRES A CELL TO EXPEND ENERGY (ATP).**

Cells often move molecules across the membrane AGAINST a Concentration Gradient.

Cell membrane pumps from an area of LOW Concentration to areas of HIGH Concentration.

The cell membrane can pump and move molecules AGAINST the Concentration Gradient this **REQUIRES ENERGY**.

Carrier Proteins - Role in Active Transport
WHEN ENERGY IS USED TO TRANSPORT MOLECULES ACROSS THE MEMBRANE, THE PROCESS IS CALLED **Active Transport often involves CARRIER PROTEINS**.

- The **CARRIER PROTEINS** act as **PUMPS** that **USE ENERGY** to move IONS and Molecules across the membrane.
- The Carrier Proteins that serve in Active Transport are often called **CELL MEMBRANE PUMPS.**
- **ACTIVE TRANSPORT** is especially **IMPORTANT** in **MAINTAINING ION CONCENTRATION IN CELLS AND BETWEEN CELLS.**
- Carrier proteins first binds with a particle of the substance to be transported.
- Carrier protein must be a similar shape that fits the molecule or ion that it is binding to.
- When the molecule binds with the carrier protein, chemical energy allows the cell to change the shape of the carrier protein so that the particle to be moved is released on the other side of the membrane (like an open door). Once particle is released the carrier protein returns to its original shape.

Active transport allows particle movement into and out of the cell against the concentration gradient

- **ATP** supplies the energy

Transport of substances across the cell membrane is required for cells to maintain homeostatsis

Active Transport - Example in Plants
In Plants, ACTIVE TRANSPORT enables roots to absorb nutrients from the soil.

- Plant Nutrients are more concentrated inside the roots than in the surrounding soil.
- WITHOUT ACTIVE TRANSPORT, NUTRIENTS would DIFFUSE OUT OF THE ROOTS.
- Active Transport in the root cell membrane enables the plant to absorb the nutrients against the Concentration Gradient

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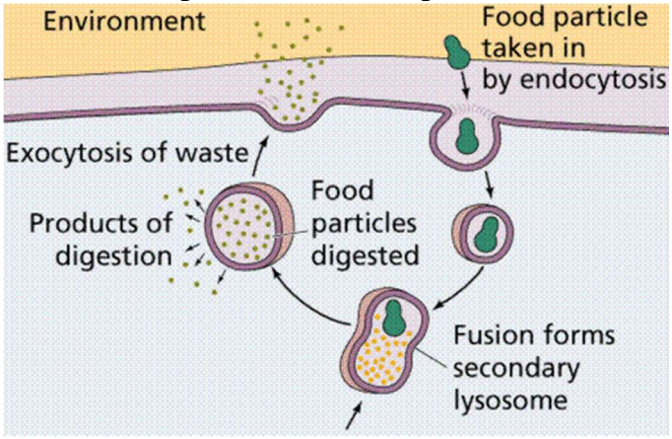
Active Transport - Bulk Transport



BULK TRANSPORT

Take in or release large molecules from the cell. These molecules or particle are too large to pass directly through the plasma membrane.

Two process are involved in taking in or releasing large molecule from the cell - ENDOCYTOSIS AND EXOCYTOSIS

Some Molecules, such as COMPLEX PROTEINS, are too LARGE to cross the Cell Membrane.

These Substances cross the Membrane by BULK TRANSPORT.

Endocytosis

LARGE MOLECULES, FOOD, AND OTHER SUBSTANCES ARE engulfed and enclosed by a portion of the cell plasma membrane (PACKAGED IN MEMBRANE-BOUND SACS CALLED A VACUOLE) AND MOVED ACROSS THE MEMBRANE.

- During **ENDOCYTOSIS** the Cell Membrane folds into a POUCH that Encloses the Particles.
- The Pouch pinches off INSIDE the Cell to form a **VACUOLE** (membrane-wrapped bubbles).
- The VACUOLE can then fuse with other Organelles (LYSOSOMES) or Release its contents into the Cytoplasm.

Exocytosis

EXOCYTOSIS IS THE OPPOSITE OR REVERSE OF ENDOCYTOSIS.

- DURING **EXOCYTOSIS**, WASTE AND CELL PRODUCTS LEAVE THE CELL.
- MUCUS, AND WASTE PRODUCTS ARE MATERIALS SECRETED BY EXOCYTOSIS

Endocytosis and Exocytosis

- Both move masses of material
- Both require energy
- Endo - means within “moves material into the cell”
- Exo - means out “moves material out of the cell”