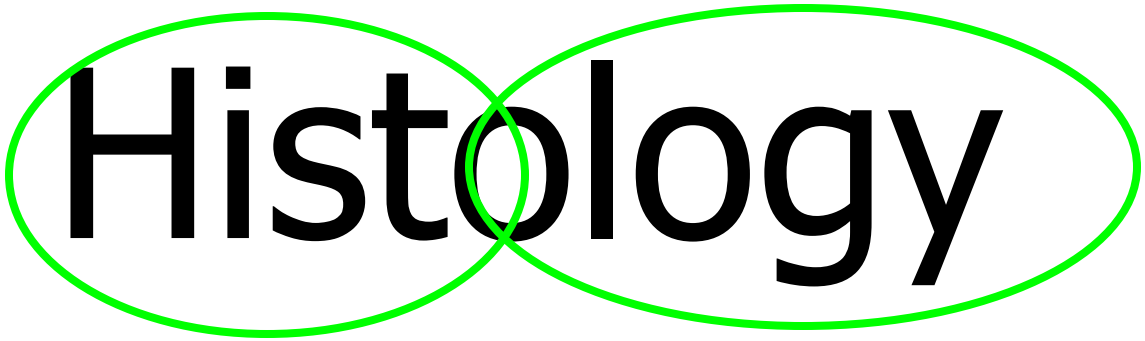



**Tissues** **Science**

**<u>macroscopic anatomy</u>**
**( Gross anatomy) – the study of large, easily observable structures (by naked eye)**
**<u>Microscopic anatomy</u> (cytology=histology) – the study of very small structures, where a magnifying lens or microscope is needed.**

**Histology: study of <u>normal</u> tissues**
**Pathology: study of <u>diseased</u> tissues**

# Introduction to Histology and Cell Structure

- All organisms are made of cells
- The cell is the simplest collection of matter that can live

Two types of cells make up every organism

- Prokaryotic No true nucleus
- Eukaryotic with true nucleus

Eukaryotic cells have internal membranes that compartmentalize their functions

## Prokaryotic and Eukaryotic Cells

| Characteristic | Prokaryote | Eukaryote |
|---|---|---|
| **Typical organisms** | bacteria, archaea | protists, fungi, plants, animals |
| **Nucleus** | Absent (called a nucleoid) | Present |
| **Diameter of a typical cell** | ≈1$\mu$m | 10–100 $\mu$m |
| **Cytoskeleton** | Absent | Present |
| **Cytoplasmic organelles** | Absent | Present examples include lysosomes, Golgi complex, endoplasmic reticulum, mitochondria & chloroplasts |
| **Chromosomes** | Single circular DNA molecule<br>Haploid (1N) | Multible linear DNA molecules<br>Haploid (1N) sex cells or<br>Diploid (2N) |
| **Ribosomes** | Smaller size 70S: 50S+30S | Larger size 80S: 60S+40S |
| **Cell division** | Binary fission or budding | Mitosis /Meiosis |

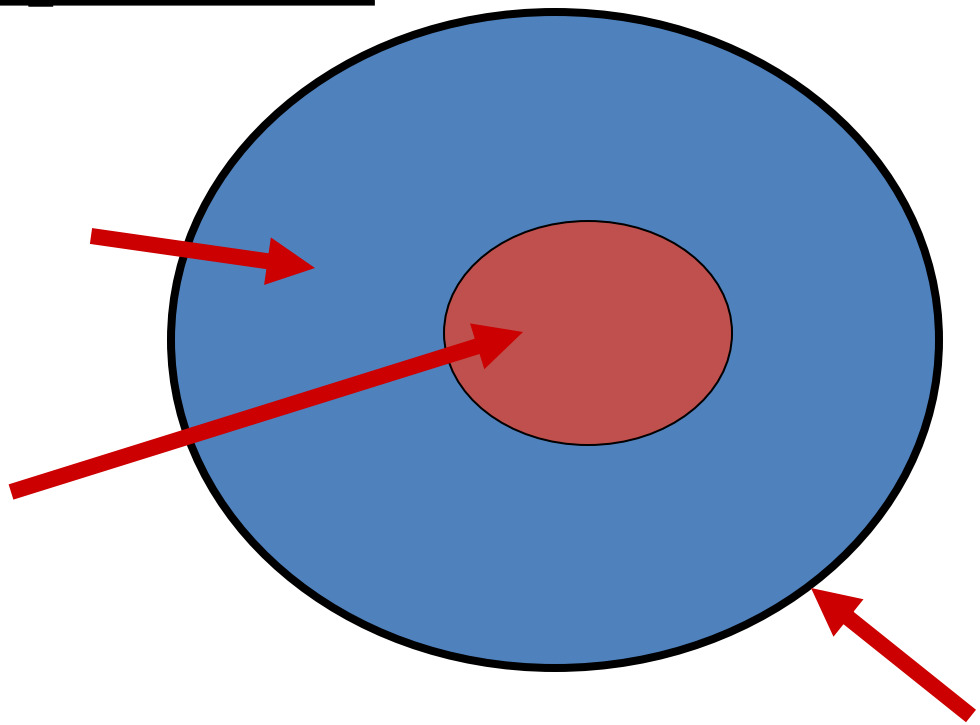
# Cell structure

- Human body has at least 200 different cell types

## 2 major components:

**Cytoplasm**

**Nucleus**



**Each cell is bounded by a cell membrane**

# The cytoplasm

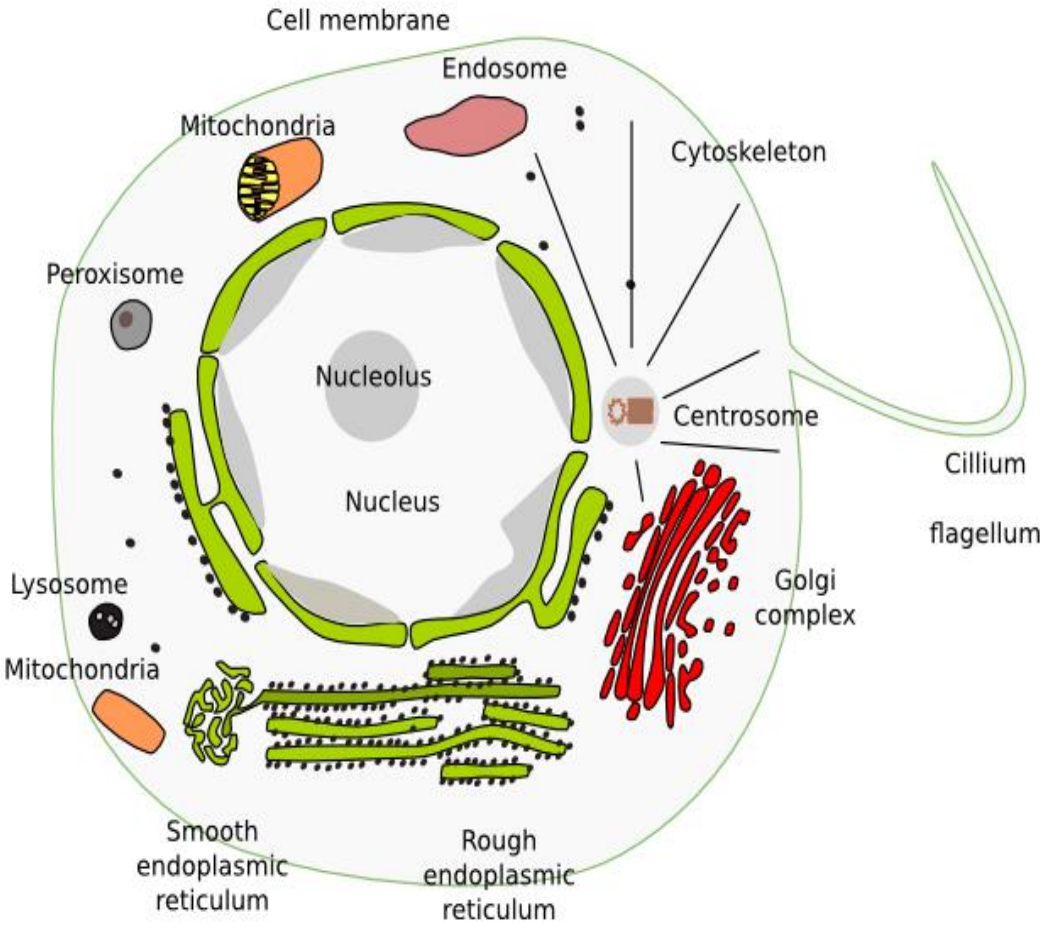
**Composed of:**

**1- <u>Cytosol</u>:**
**jelly like fluid matrix, its primary component is water**

**2- <u>Organelles</u>**

**3- <u>Inclusion</u>**

**4- <u>Cytoskeleton</u>**



# The Cell Membrane

**Plasma membrane = Plasmalemma**

**Definition**

- **It is a vital dynamic , stable , semipermeable structure**

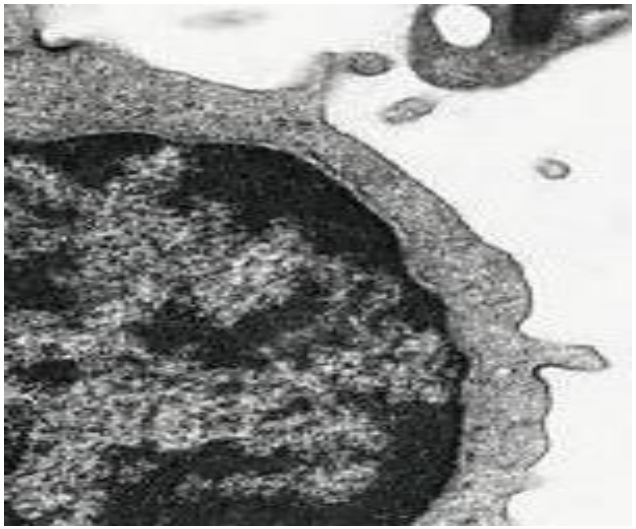
**-Acting as a barrier that surrounds the boundary of the cell and separates its internal contents from the environment**

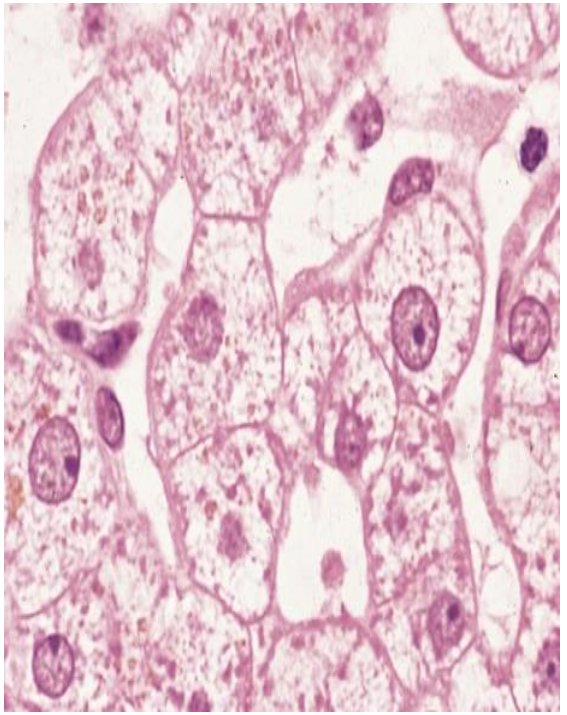
***Structure:***

- **LM : 8.5-10nm not seen**
- **EM**

**Low magnification:**

**Single electron**
***dense line (black)***

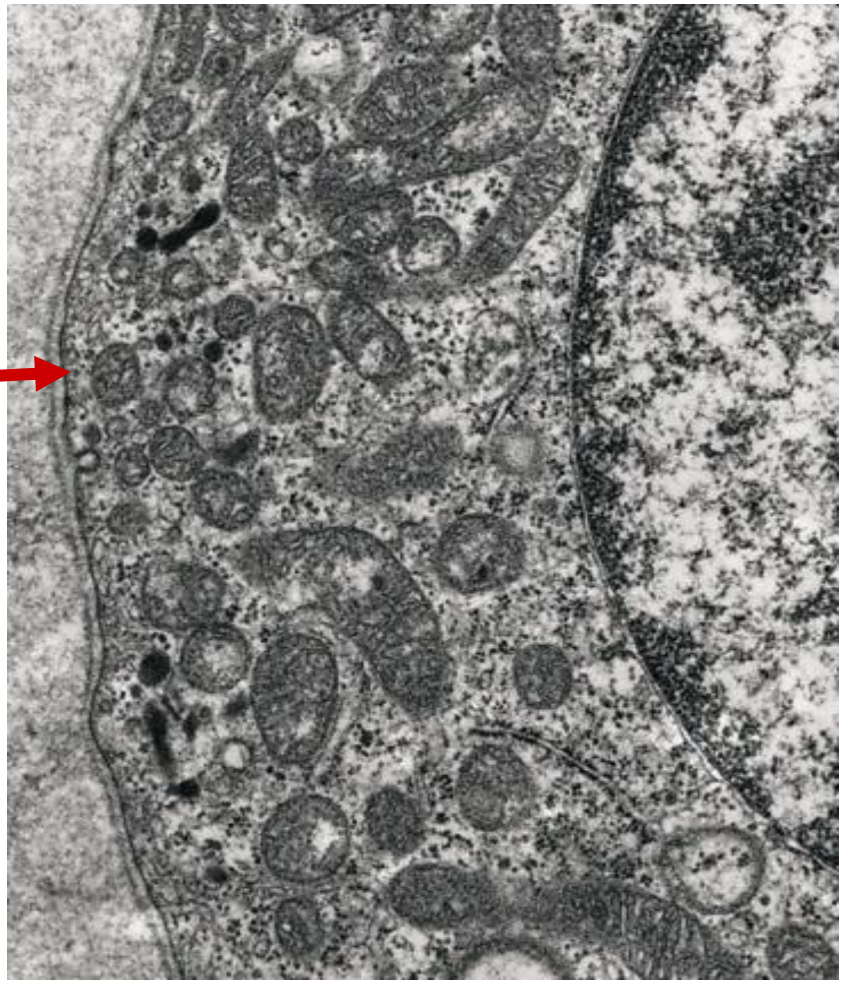




# EM of the cell membrane

Higher magnification:
Trilaminar =
Trilamellar =
3 layers:

- **Outer dense (black)**
- **Middle lucent (white)**
- **Inner dense (black)**



# Molecular structure of the Cell membrane

- **Membranes have been chemically analyzed**
  - **And found to be composed of**

**3 components:**

**1-Lipid molecules:**

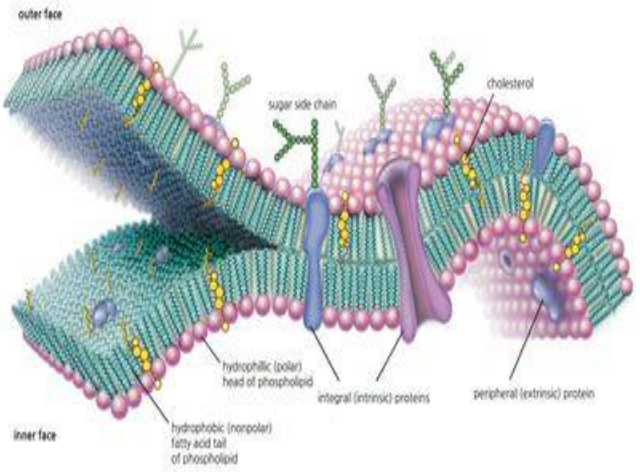
**a- phospholipids**

**b- cholesterol**

phospholipid molecules are arranged in 2 layers (phospholipid **bilayer)**

**2- Protein molecules**

**3- Carbohydrate molecules**



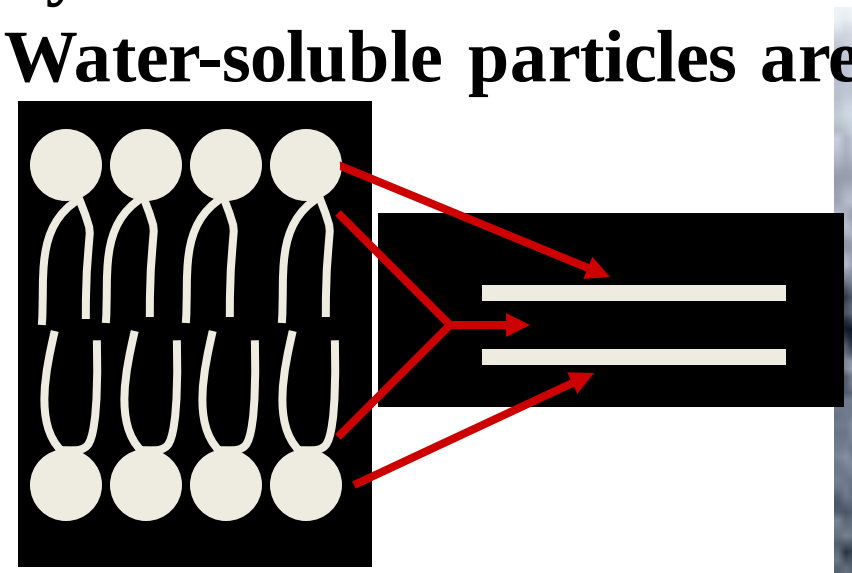
# Trilaminar membrane

## Deposition of osmium in the polar heads

**molecules are responsible for the semipermeability of the cell membrane.**

**It allows lipid-soluble substances to pass passively by diffusion.**

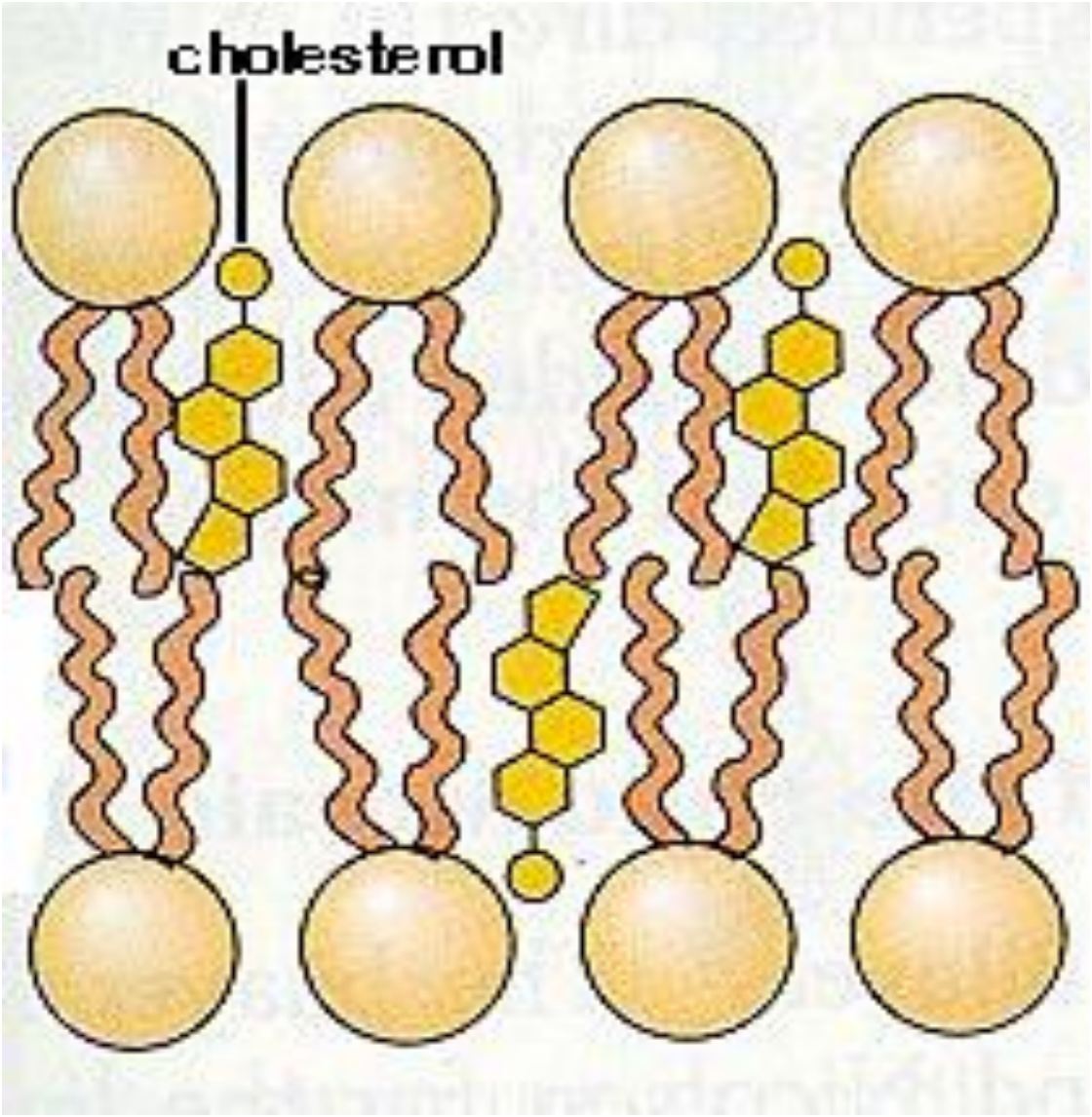
**Water-soluble particles are not allowed to pass.**



# B- Cholesterol

**Control membrane :**

- **fluidity**
- **stability**
- **permeability**



# Protein molecules

## According to membrane proteins' location

**2 Types:**

**1- Integral proteins**

**2-peripheral proteins**

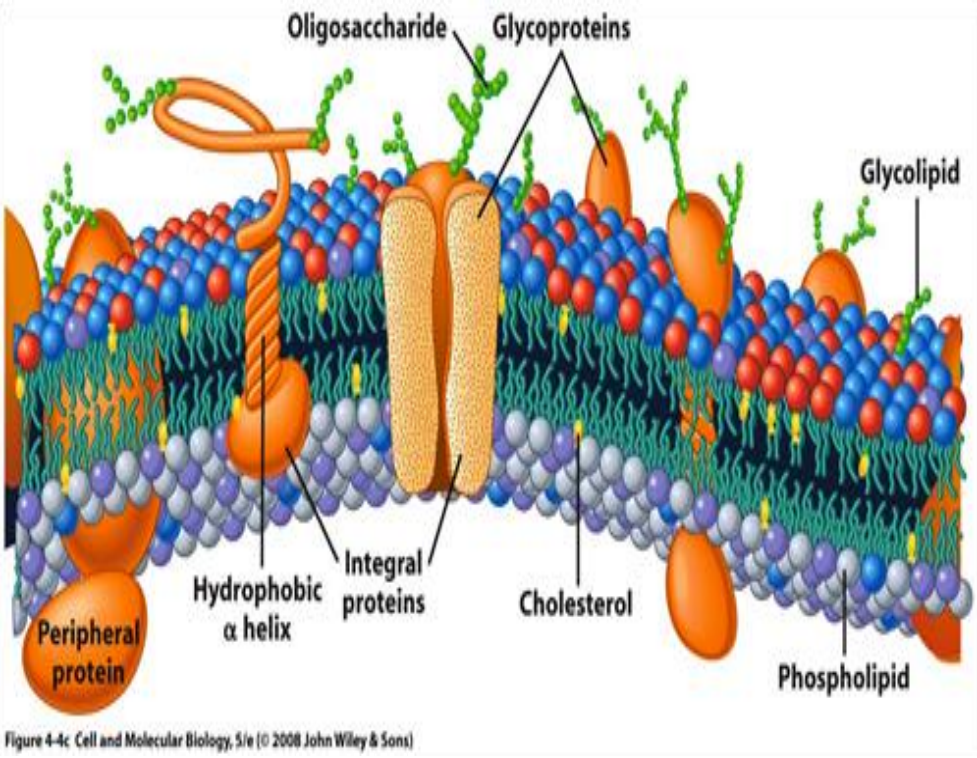


Figure 4-4c Cell and Molecular Biology, 5/e (© 2008 John Wiley & Sons)

# Integral proteins

According to the functions of integral proteins:

6 forms

1-Structural proteins

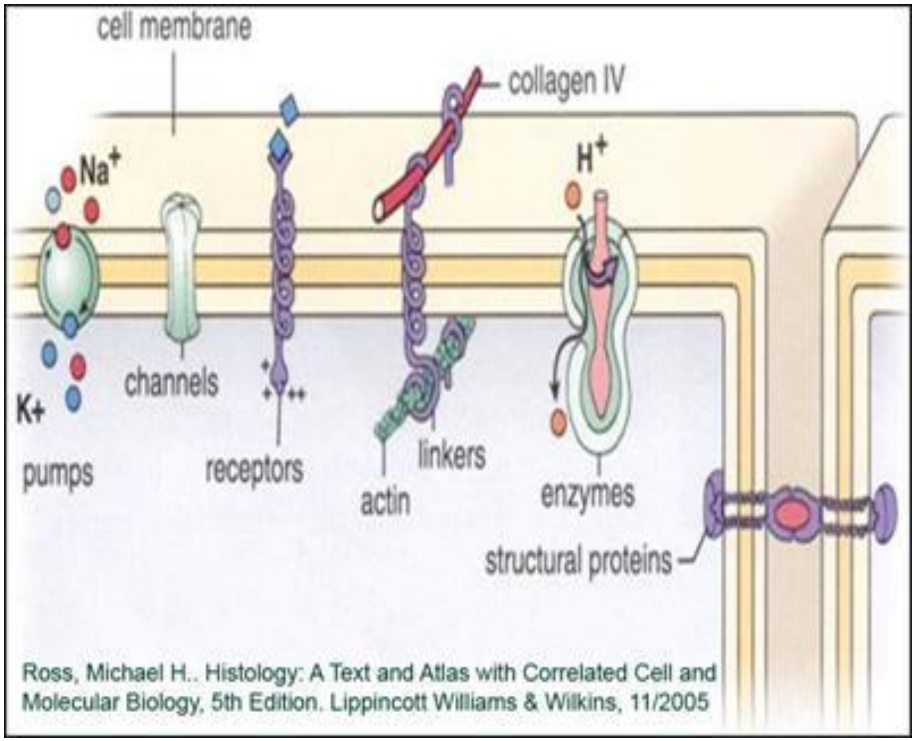
2-Pumps

3-Enzymes

4-Linkers

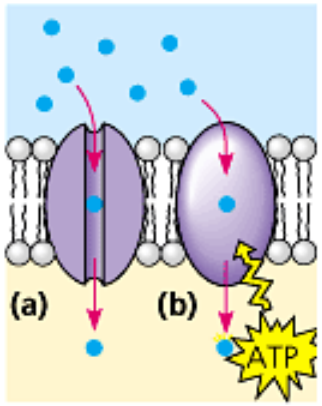
5-Channels

6-Receptors




**Transmembrane proteins**

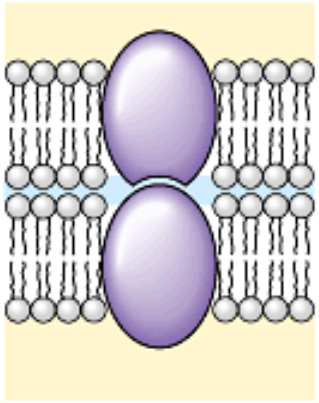
# Protein Functions




## Transport

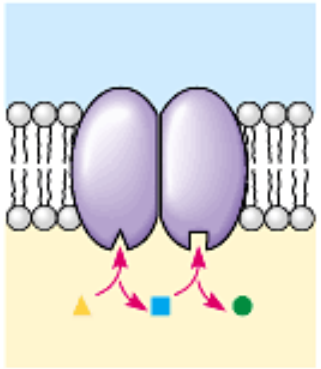
-Passive // Channel Proteins

-Active // Protein Pumps



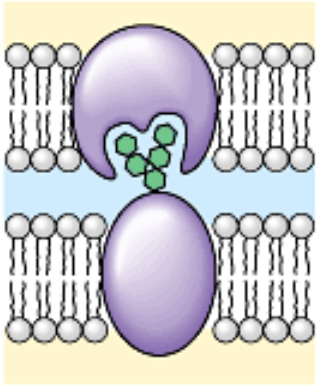
## Intercellular joining

Intercellular junctions



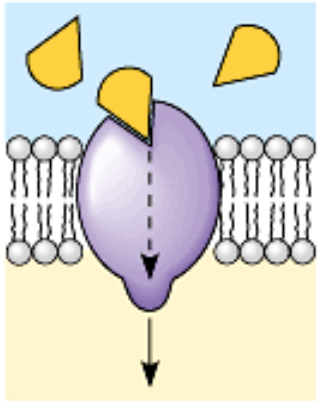
## Enzymatic activity

Membrane enzymes produce a variety of substances essential for cell function



## Cell-cell recognition (Cell surface identity Marker)

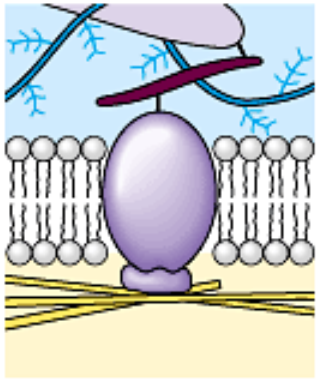
Some glycoproteins serve as identification tags that are specifically recognized by other cells



## Signal transduction (Cell surface Receptor)

Extracellular signaling molecule activates a membrane receptor

creating intracellular response



## Attachment to the cytoskeleton and extracellular matrix

Microfilaments or other elements bonded to membrane proteins, maintain cell shape and stabilizes the location of certain membrane proteins

# Peripheral proteins

- They are not embedded

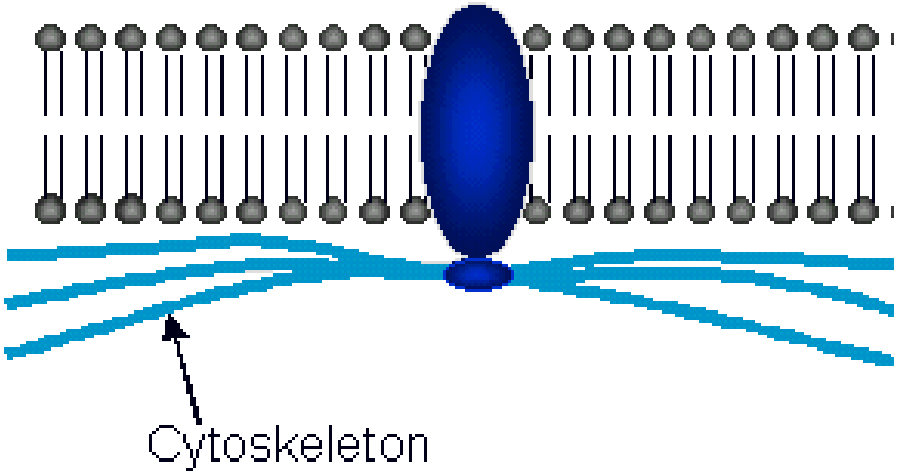
into lipid bilayer

- loose association with

membrane surface through

ionic interaction mainly

with integral protein

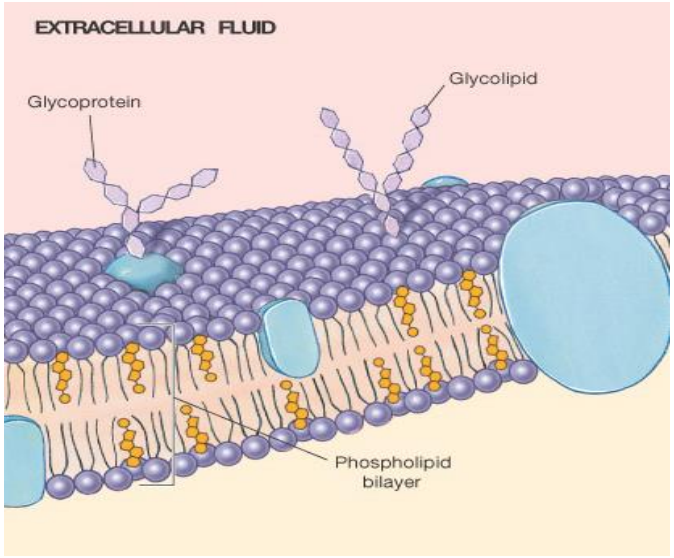



- They are usually located on the cytoplasmic surface and occasionally on the extracellular surface of the membrane.

- - Functionally, They are associated with the cytoskeletal apparatus.

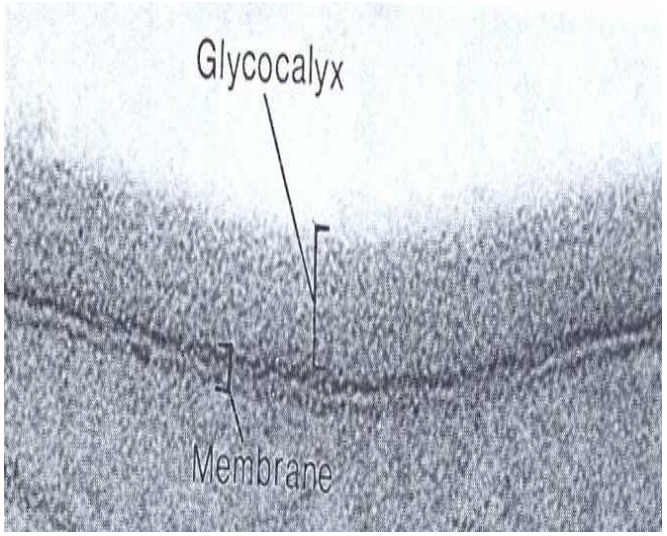
# Carbohydrate molecules
# The cell coat = Glycocalyx

- Only at the outer surface of the membrane.
- Attached to lipid molecules to form glycolipids
- Attached to integral proteins to form glycoproteins



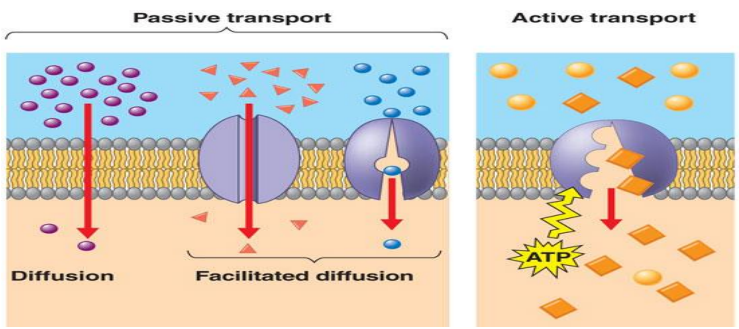

## Function:

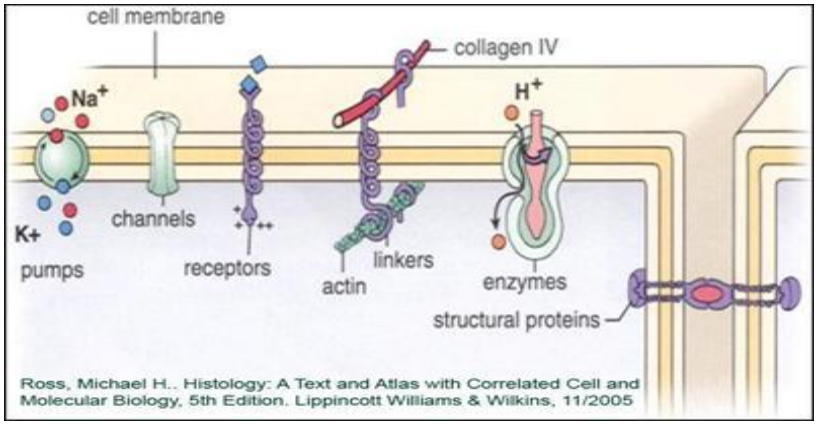
1- Protection
2- Identification markers (Recognition)
3- Adhesion
4- Receptors



# Functions of cell membrane

- Maintaining the structural integrity of the cell
- Acting as an interface between the cytoplasm and the external environment.
- Controlling movements of substances in and out of the cell
- transport systems for specific molecules
- Regulating cell-cell interactions
- Recognizing antigens, foreign cells and altered cells

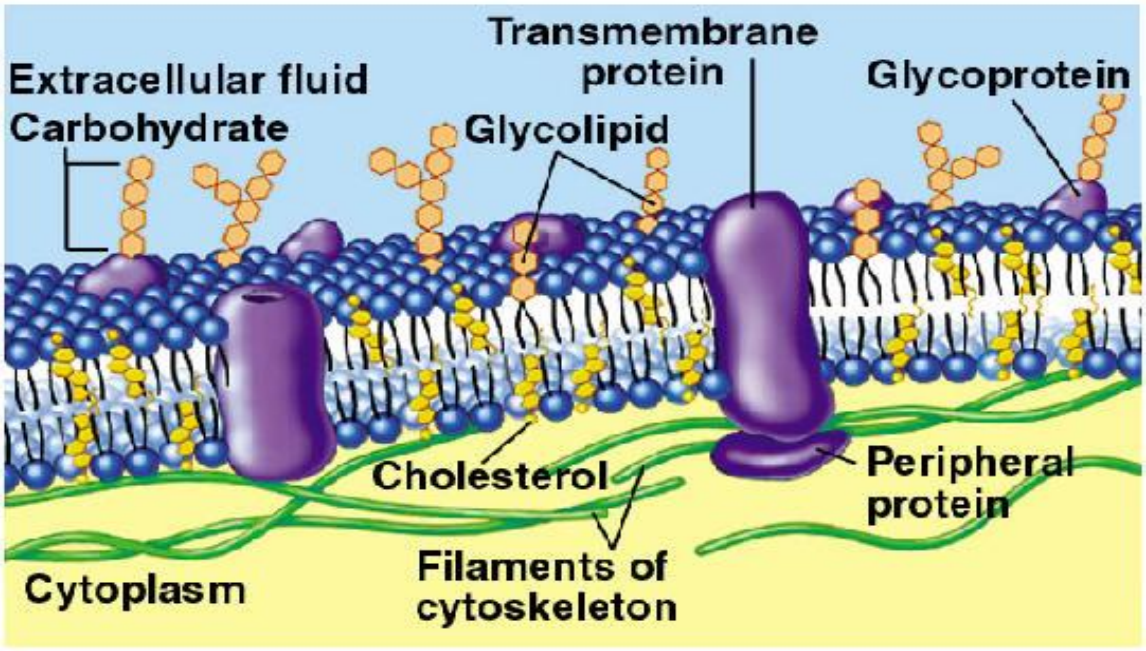


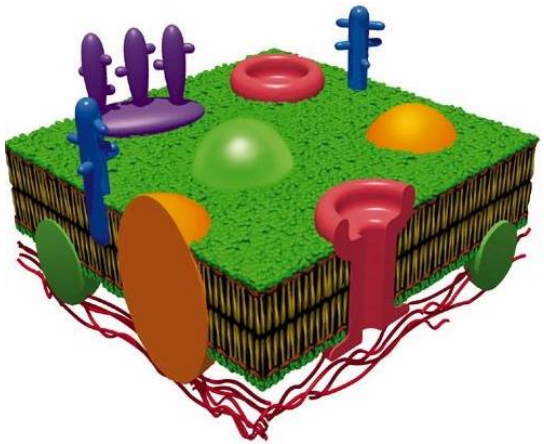



# Fluid mosaic model of the cell membrane

**The membrane is composed of a sea of lipids (fluid) in which proteins (mosiac) are moving and floating like icebergs.**





# Functions of the cell membrane

## Control exchange of materials (semipermeable)

**Small molecules (micromolecules)**

- 1-Simple diffusion
- 2-Active transport

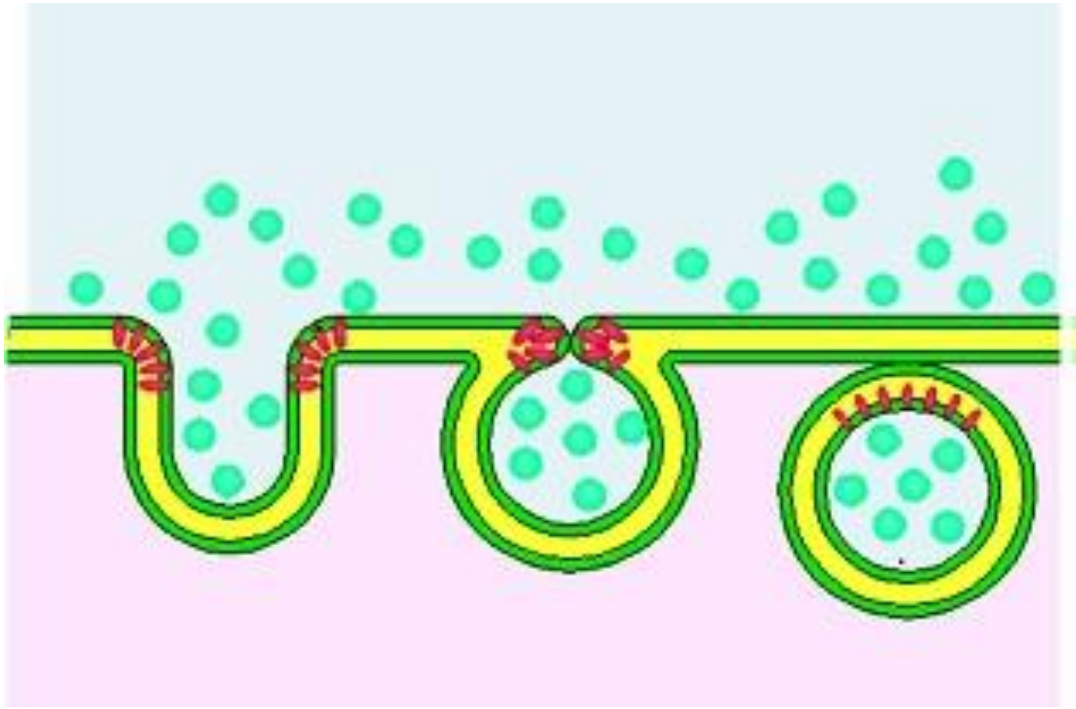
**Large molecules (macromolecules)**

- 1-Endocytosis
- 2- Exocytosis

# 1-Endocytosis

**Inside = internal**

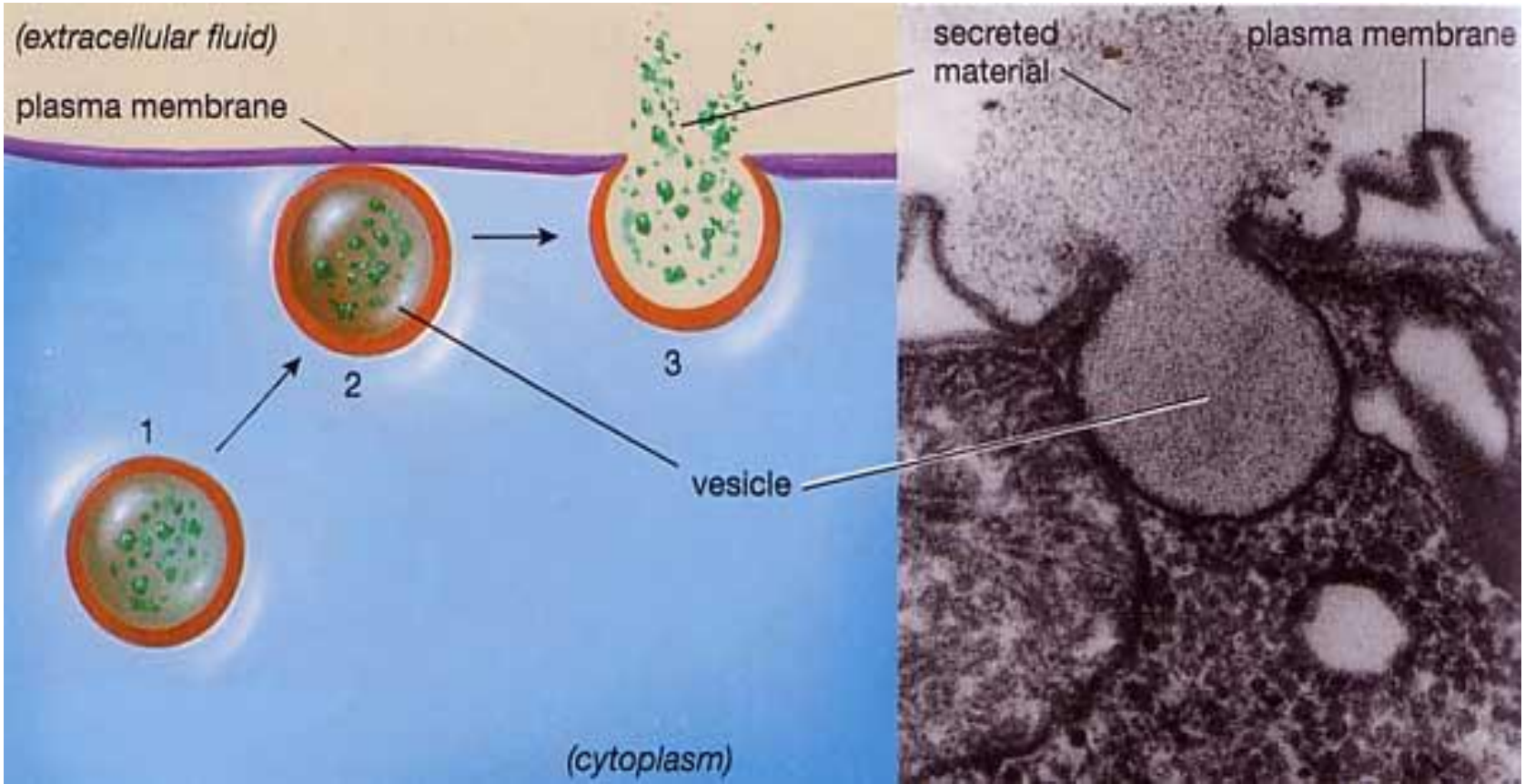
**Intake of molecules to the inside of cell.**



# 2-Exocytosis

**External = outside**

**Release of cell products into the extracellular environment.**



# Transport of macromolecule (vesicular transport)

## 1-Endocytosis

**Inside = internal**

**Intake of molecules inside the cell.**

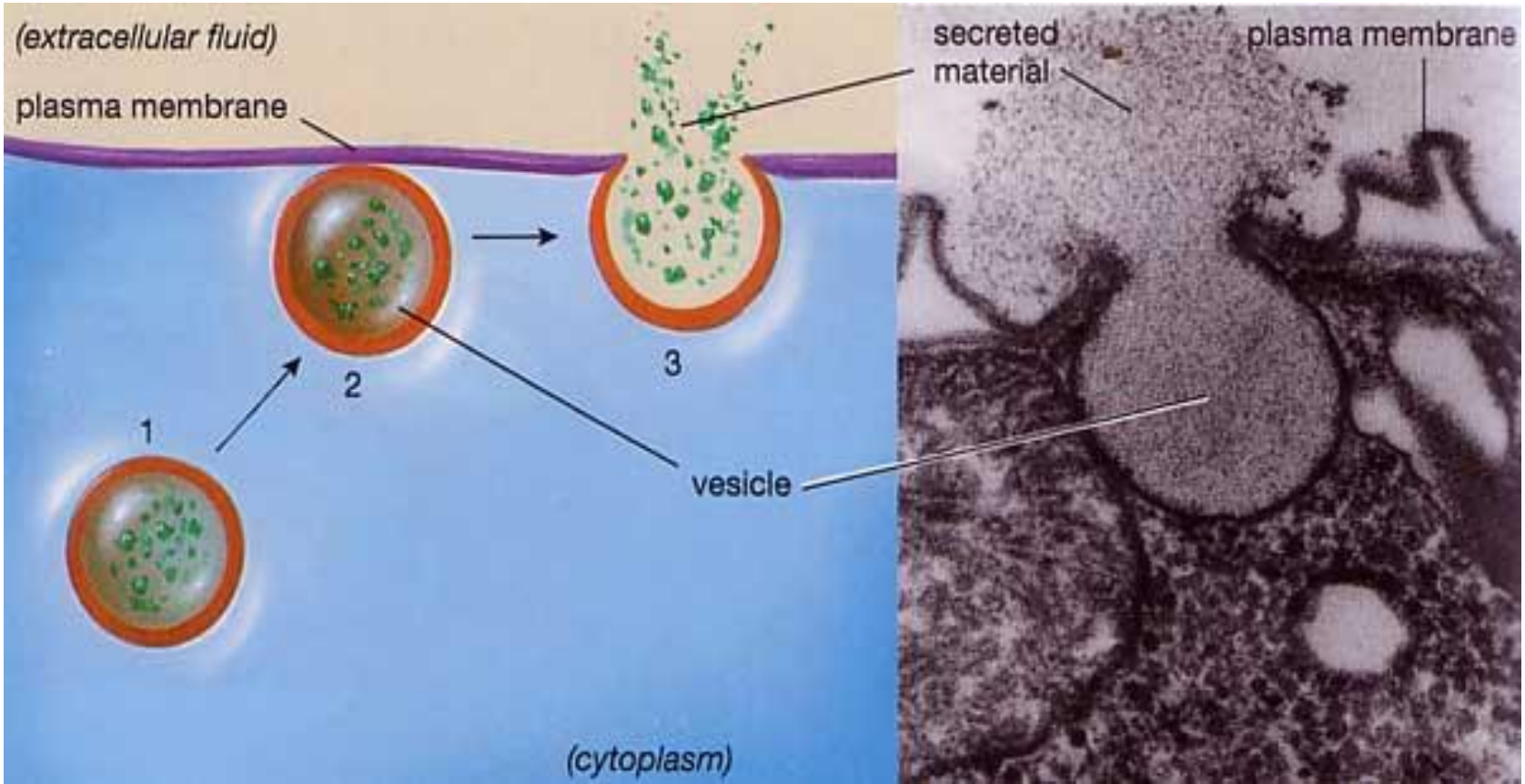
**3 mechanisms:**

- **Pinocytosis (cell drinking)**
- **Receptor–mediated endocytosis**
- **Phagocytosis (cell eating)**

# Exocytosis

***External = outside***

**Release of cell products into the <u>extracellular</u> environment.**



# Types of exocytosis

***1- Regulated secretion:***

***- stimulus-dependent***

***- secretory granules***

**2- Constitutive secretion:**

**- continuous**

**- without a stimulus**

**- transport vesicles**