

جامعة الانبار

كلية: الصيدلة

قسم : فرع الادوية والسموم

اسم المادة باللغة العربية: فسلجة نظري

اسم المدة باللغة الإنكليزية: . **physiology**

المرحلة: الثانية

التدريسي: مروة شكيب ذنون

عنوان المحاضرة باللغة العربية: مقدمة

عنوان المحاضرة باللغة الإنكليزية: **introduction physiology**

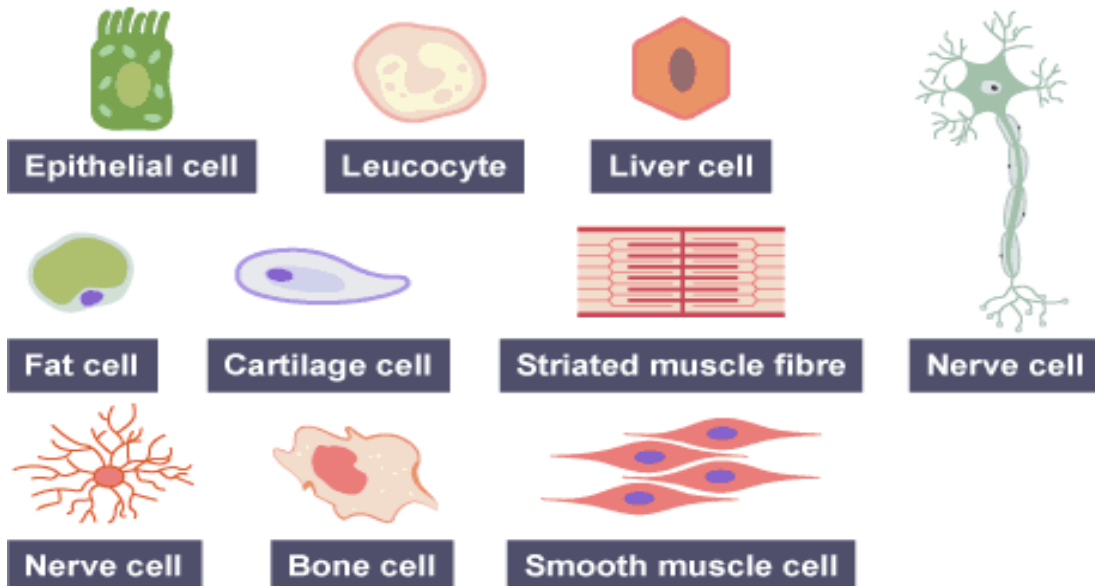
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## introduction physiology محتوى المحاضرة

Physiology : defined as the study of functions of various systems and different organs of the body

### Cell

the basic structural and functional units of the human body.



## Cellular environment

- Water constitutes about 70% of the body wt.
- Body water is distributed between ICF & ECF.
- ICF = 2/3 of body water, contained within cells.
- ECF = 1/3 of body water, outside the cells [**plasma and interstitial fluid**]

## Cell components

- ⊗ Semi-permeable membrane  
(**plasma membrane**)
- ⊗ Set of (**Organelles**) have specific jobs within cell.
- ⊗ These organelles float around Jelly like substance  
(**Cytoplasm**)

## Nucleus

### control center in the cell

- Contains genetic material
- DNA which dictate what the cell is going to do and how to do it
  - Separated from cytoplasm by nuclear membrane:-
- Two layers.
- **Openings** allow material to enter & leave nucleus

## Nucleus structure

### Chromosomes

- Made of DNA
- Contain genetic information

## **Nucleolus**

- Makes **Ribosomes**

## **Ribosomes**

### **Make proteins**

- Wander freely within the cytoplasm or attached to endoplasmic reticulum

### **Golgi Bodies**

- Modify and customize the proteins into forms they can use by the cell

## **Mitochondria**

- **Powerhouses of the cell**
- Its number varies depending on the amount of energy required by the cell
- large quantities of dissolved enzymes that causes oxidation of the

Nutrients → CO<sub>2</sub> + water + ATP.

- Mitochondria are **self-replicative**

## **Lysosomes**

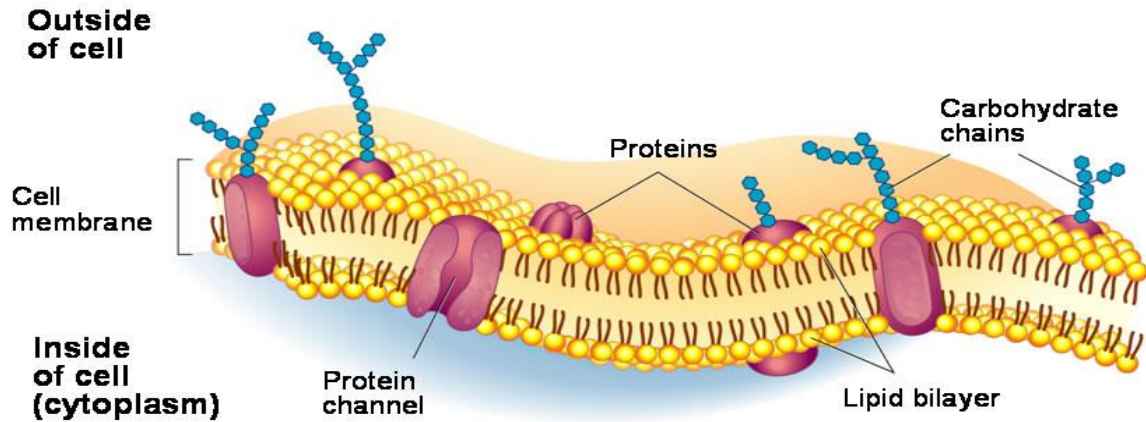
- Filled with enzymes that break down the cellular debris

### **Vacuoles**

- Membrane-bound sacs for storage of different materials (e.g. water in plant cell)

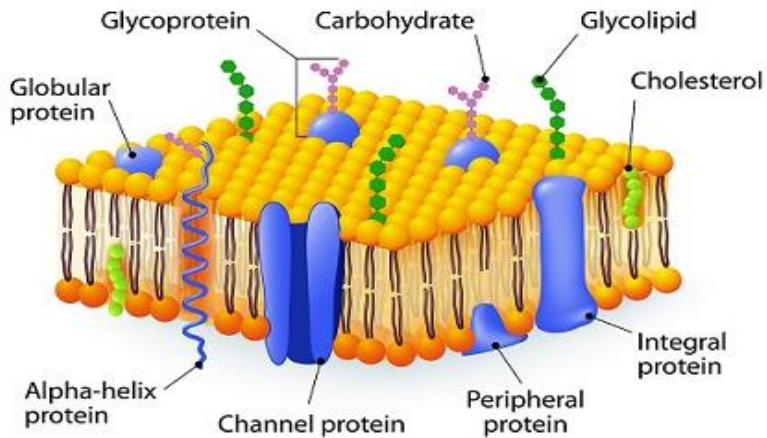
## Cell Membrane

- Regulation of cell contents (**Homeostasis**); determine what enters and leaves the cells
- Provides surface for **enzymes, receptors, recognition**, etc.



## Cell Membrane

- 👉 **Lipids** (bilayer) 47%
- 👉 **Proteins** 50%
- 👉 **Carbohydrates** 3%.



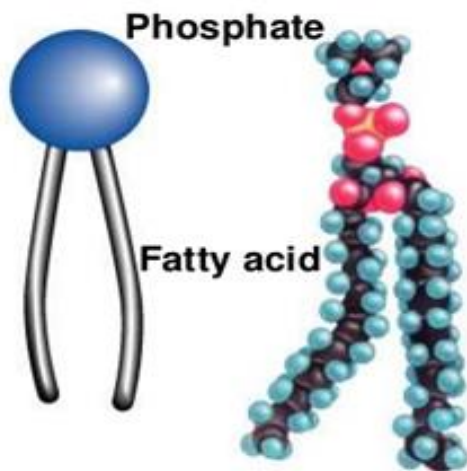
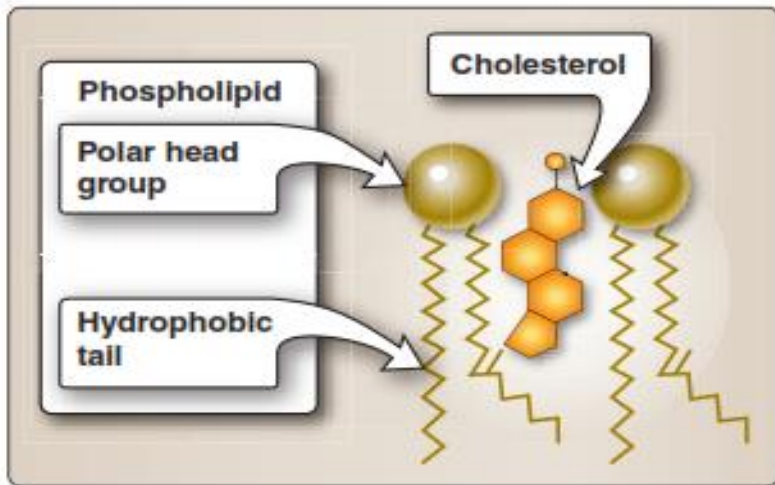
## Lipid

### Phospholipids

- bilayer of **phosphate gp (hydrophilic)** & **fatty acid tail (hydrophobic)**
- **core repels water**

### Cholesterol

- **hydroxyl gp (nestles between adjacent phospholipids)** + **steroid nucleus**
- **make cell relatively inflexible.**



## protein

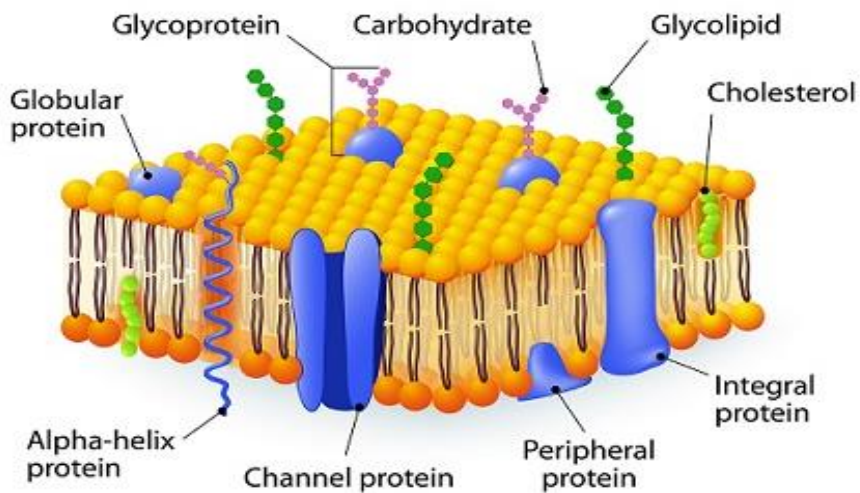
⌘ **Peripheral** : on the membrane surface

1- **Intracellular**: **anchoring** cytoskeleton to the membrane ; **triggering intracellular signaling** (e.g. **G-Protein** )

2- **Extracellular**: **cell-cell signaling or interactions**

⌘ **Integral**: Penetrate the lipid core

**ion channels, transporters, receptors and link**



## Carbohydrate

- **Glycolipids** and glycoproteins both contribute to structural stability of cell membranes.
- **Glycoprotein** : important for cell recognition and immune response.

## Cell Membrane c.c

### Fluidity of cell membrane

⇒ **Exocytosis**: remove of hormones , waste product outside.

⇒ **Endocytosis**: engulfment of sub. (bacteria) inside

## Cell Membrane

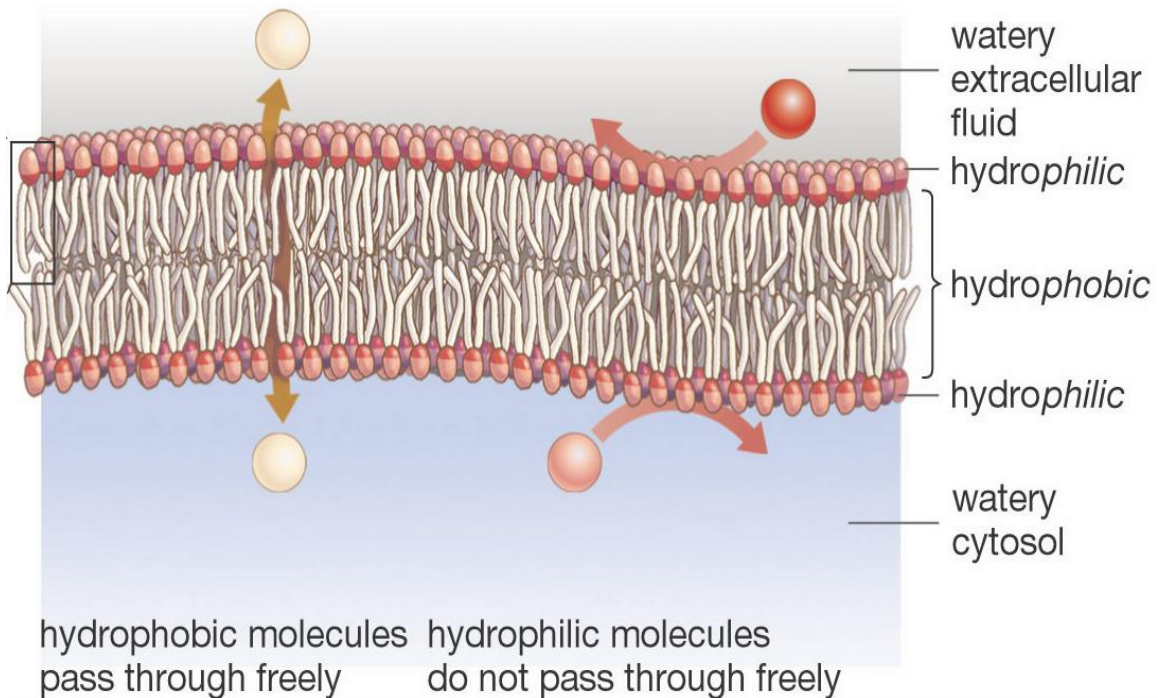
Polar heads are **hydrophilic** “water loving”

Non-polar tails are **hydrophobic** “water fearing”

Makes membrane “**Selective**” in what crosses

# Cell Membrane

## (b) Phospholipid bilayer



## Semi permeable Membrane

**Small molecules  
and larger hydrophobic molecules  
move through the membrane easily.  
e.g.  $O_2$ ,  $CO_2$  ....  $H_2O$  (channel)**



**Ions,  
hydrophilic molecules larger than water,  
and large molecules such as proteins**

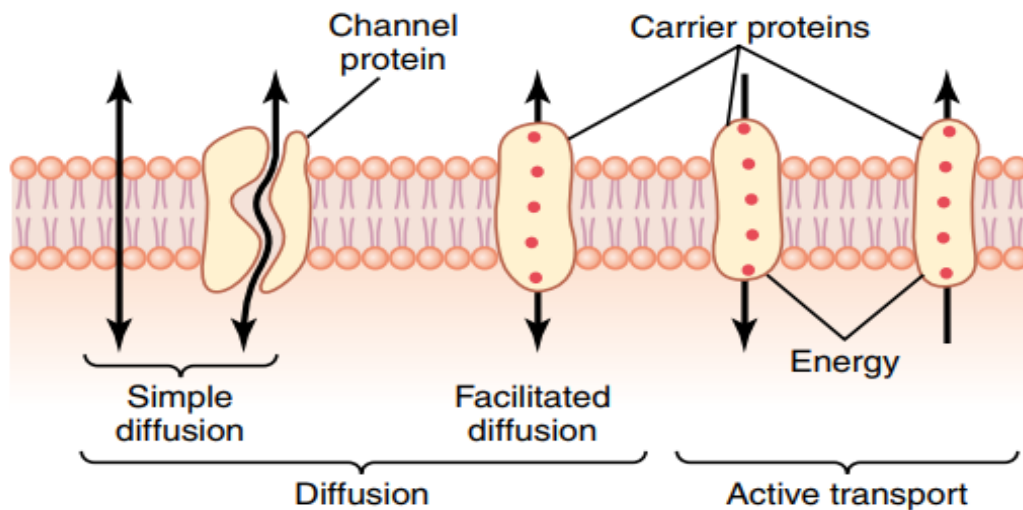
**do not move through the membrane on their own.**

## Transport of Substances Through Cell Membranes

- Two main mechanisms

### 1- Diffusion

### 2- Active transport



## Diffusion

- movement of molecules from a region of high concentration to low concentration & does not require external energy.
- \* **Simple diffusion**
- \* **Carrier-mediated diffusion (facilitated Diffusion)**

### Simple Diffusion

movement of molecules or ions through **opening (H<sub>2</sub>O, urea)** or through **intermolecular spaces (O<sub>2</sub>, CO<sub>2</sub>, N<sub>2</sub>)** without any interaction with carrier proteins in membrane.

### Facilitated Diffusion

movement of **large** molecules requires interaction with a carrier protein (**glucose**)

### Factors Affect Net Rate of Diffusion

**A-** Rate of Diffusion Proportion to **Concentration Difference** Across a Membrane

**B-** Effect of Membrane **Electrical Potential** on Diffusion of Ions

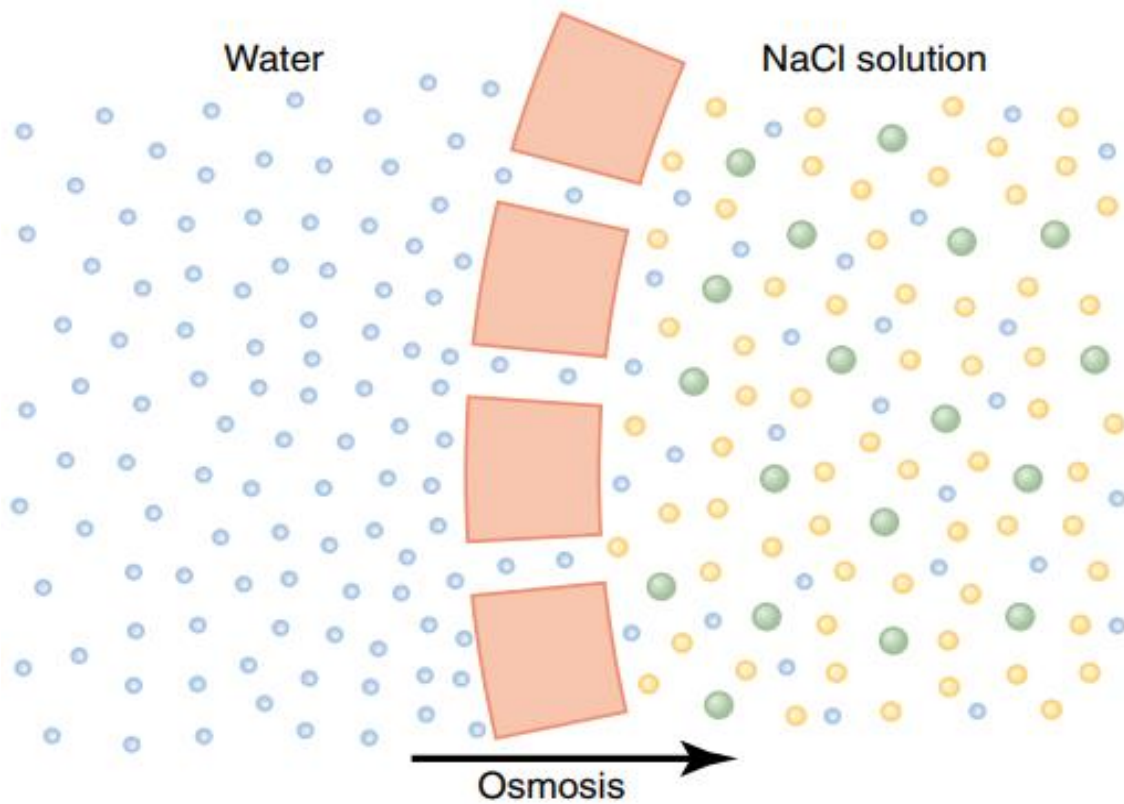
(electrical charges of the ions cause them to move through the membrane even though no concentration difference exists to cause movement )

**C-** Effect of a **Pressure Difference** Across the Membrane

(e.g. at the blood capillary membrane in all tissues of the body.  
The pressure is about 20 mm Hg greater inside the capillary than outside)

## Osmosis

Net movement of water caused by a concentration difference of water



## Osmotic pressure

Amount of pressure required to **stop** osmosis

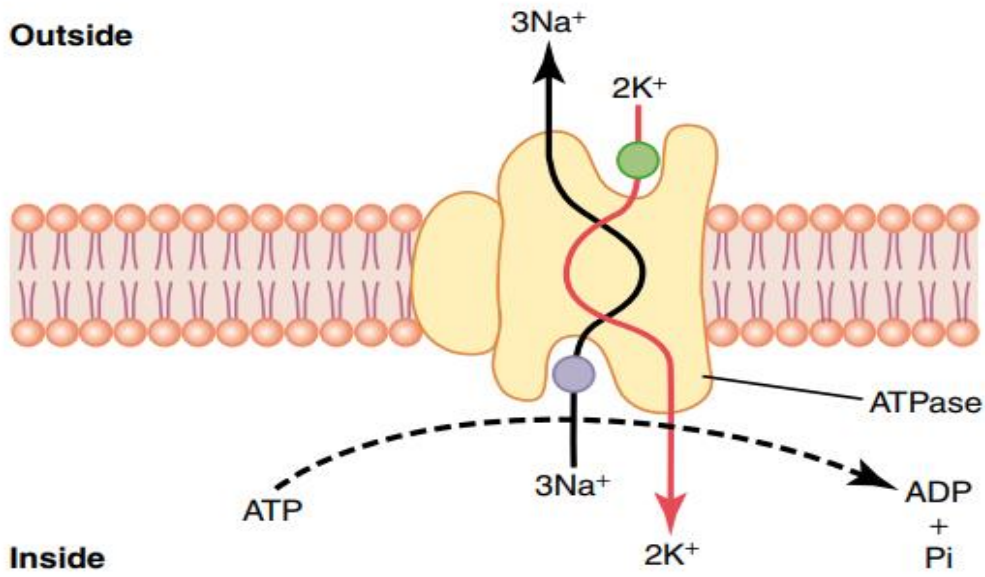
## Active Transport

- movement of molecules from a region of low concentration to High concentration & require **external energy and carrier.**
- \* **Primary active transport**
- \* **Secondary active transport**

## Primary active transport

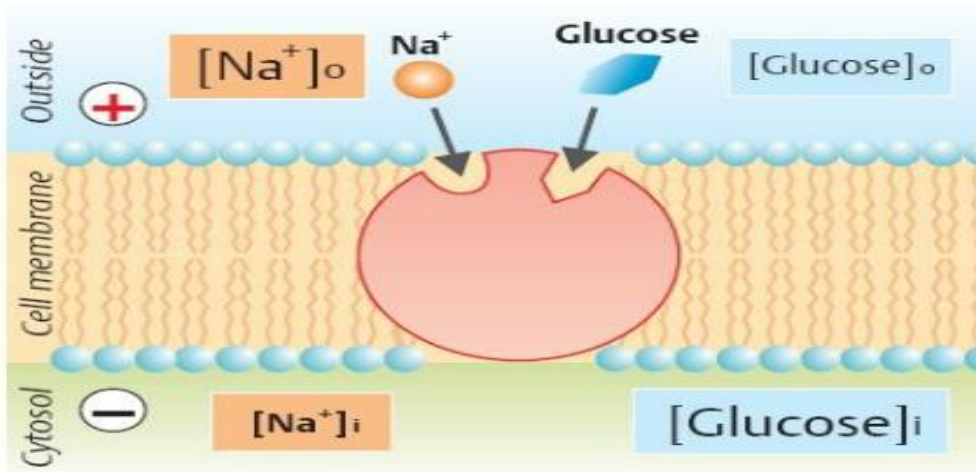
The energy is derived directly from breakdown of adenosine triphosphate (ATP)

e.g. Na<sup>+</sup>-K<sup>+</sup> ATPase pump



## Secondary active transport

energy is derived 2ndly from energy that has been stored in the form of ionic concentration differences of ionic substances b\w the two sides of a cell membrane.



## Secondary active transport :

a carrier-mediated transport mechanism 2 types :

- **Symporters** carry the substrate and co-substrate in the same direction.

Example: Na –glucose co-transport in the small intestine and kidney, Na transported into cells brings glucose with it.

- **Antiporters** carry the substrate and co-substrate in opposite directions.

Example: HCO<sub>3</sub>–Cl counter transport at red blood cell membranes

## INTERCELLULAR COMMUNICATION

- ⚙ **Gap junctions** : pores that allow for exchanging chemical and electrical information **e.g. cardiac excitation and contraction.**
- ⚙ **Hormones** : chemicals produced by endocrine glands that are carried to distant targets by the vasculature . **e.g. insulin.**
- ⚙ **Paracrines** : are released from cells in proximity to their target . e.g. **the endothelial cells that line blood vessels release nitric oxide affect muscle.**
- ⚙ **Autocrine** : messengers bind to receptors on the same cell creating a negative feedback pathway that modulates autocrine release
- ⚙ **Neural communication:** in which neurotransmitters are released at synaptic junctions from nerve cells and act across a narrow synaptic cleft on a postsynaptic cell

	GAP JUNCTIONS	SYNAPTIC	PARACRINE AND AUTOCRINE	ENDOCRINE
Message transmission	Directly from cell to cell	Across synaptic cleft	By diffusion in interstitial fluid	By circulating body fluids
Local or general	Local	Local	Locally diffuse	General
Specificity depends on	Anatomic location	Anatomic location and receptors	Receptors	Receptors

## INTRACELLULAR SIGNALING

**Receptors:** Integral or intracellular proteins interact with chemical messenger (**Ligand.** e.g. hormones, neurotransmitter) and then transduced into a form can modify cell function.

These proteins are not static components of the cell **But** they increase (**up-regulation**) or decrease (**down-regulation**) in response to various stimuli