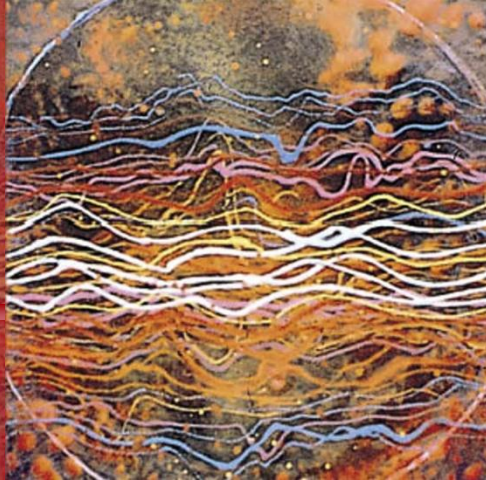


# UNIT I



Textbook of Medical Physiology, 11th Edition

# Homeostasis I

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GUYTON & HALL

# Objectives



➤ **At the end of this session, the students should be able**

**to:**

- Understand the concept and importance of homeostasis.
- Understand how the steady state is monitored.
- Review the compensatory responses to any change in the steady state.
- Review the disturbances of volumes of ECF and ICF.

# Extracellular and Intracellular Fluids



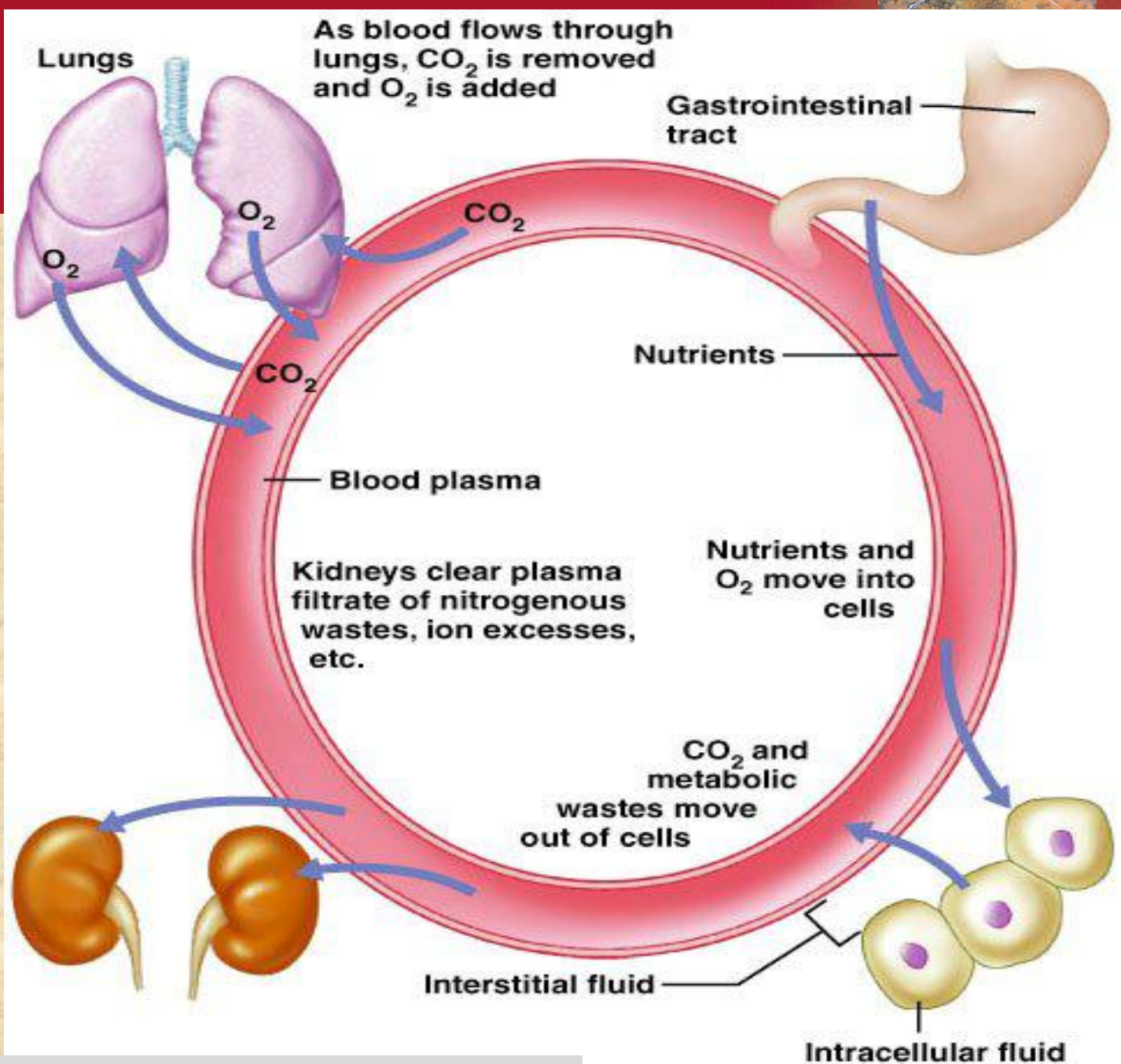
	Plasma (mOsm/L H <sub>2</sub> O)	Interstitial (mOsm/L H <sub>2</sub> O)	Intracellular (mOsm/L H <sub>2</sub> O)
Na <sup>+</sup>	142	139	14
K <sup>+</sup>	4.2	4.0	140
Ca <sup>++</sup>	1.3	1.2	0
Mg <sup>++</sup>	0.8	0.7	20
Cl <sup>-</sup>	108	108	4
HCO <sub>3</sub> <sup>-</sup>	24	28.3	10
HPO <sub>4</sub> <sup>-</sup> , H <sub>2</sub> PO <sub>4</sub> <sup>-</sup>	2	2	11
SO <sub>4</sub> <sup>-</sup>	0.5	0.5	1
Phosphocreatine			45
Carnosine			14
Amino acids	2	2	8
Creatine	0.2	0.2	9
Lactate	1.2	1.2	1.5
Adenosine triphosphate			5
Hexose monophosphate			3.7
Glucose	5.6	5.6	
Protein	1.2	0.2	4
Urea	4	4	4
Others	4.8	3.9	10
Total mOsm/L	301.8	300.8	301.2
Corrected osmolar activity (mOsm/L)	282.0	281.0	281.0
Total osmotic pressure at 37 °C (mm Hg)	5443	5423	5423

# Extracellular and Intracellular Fluids



- **Ion fluxes** are restricted and move selectively by active transport.
- Nutrients, respiratory gases, and wastes move unidirectionally.
- Plasma is the only fluid that circulates throughout the body and links external and internal environments
- Osmolalities of all body fluids are equal; changes in solute concentrations are quickly followed by osmotic changes





**Continuous exchange of Body Fluids**

# Concept of Homeostasis



## Homeostasis:

**The maintenance of nearly constant conditions in the internal environment**

Claude Bernard (1813 - 1878)

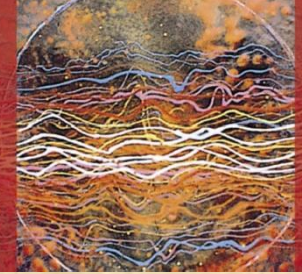
# Concept of Homeostasis



- The internal environment of the body (ECF) is in a dynamic state of equilibrium
- All different body systems operate in harmony to provide homeostasis
- Extreme dysfunction leads to death; moderate dysfunction leads to sickness.



# Homeostatic control mechanism



- The variable produces a change in the body
- The three interdependent components of **control mechanisms** are:
  - **Receptor** – monitors the environments and responds to changes (stimuli)
  - **Control center** – determines the set point at which the variable is maintained
  - **Effector** – provides the means to respond to the stimulus



# Regulation of body functions



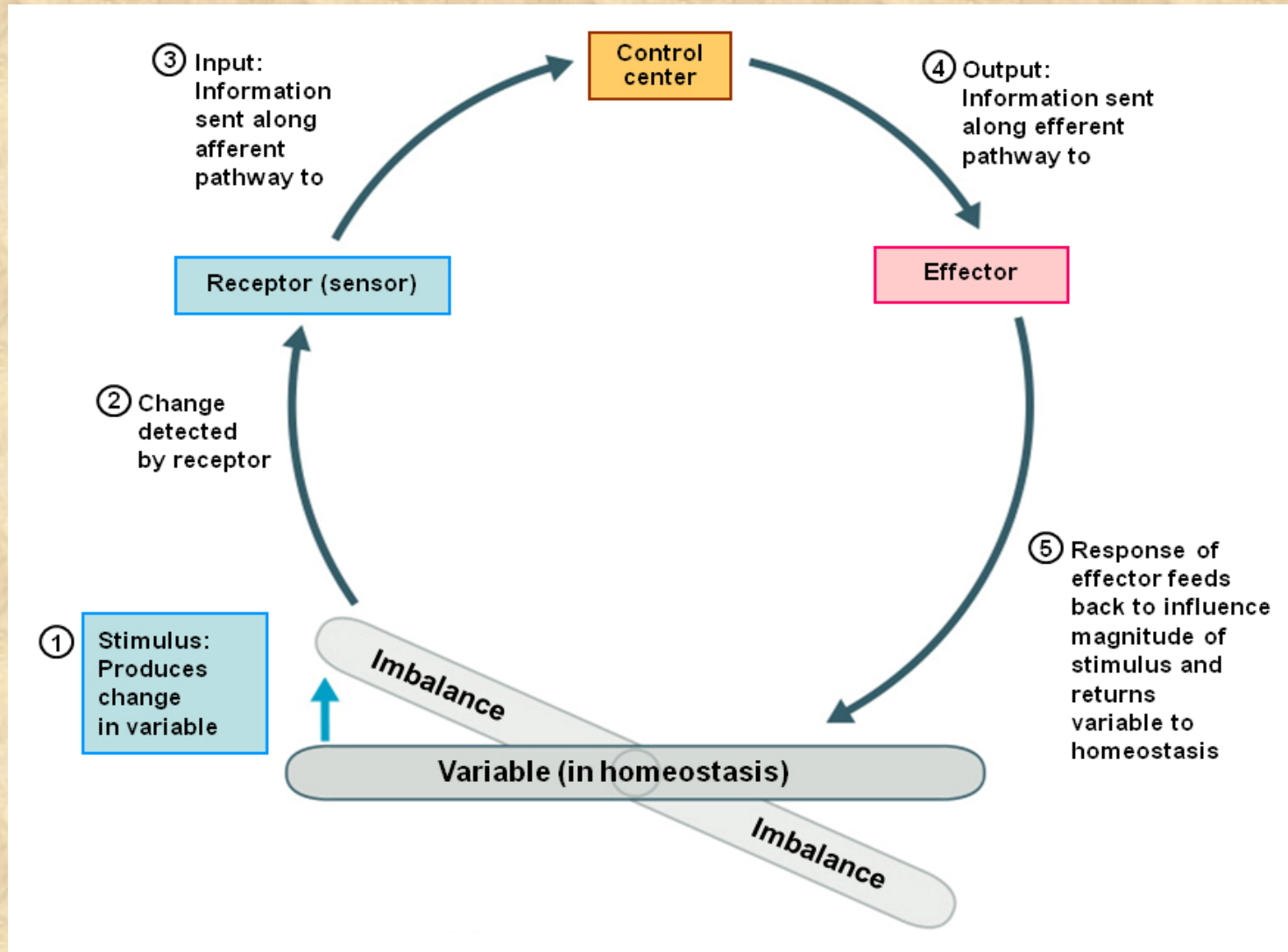
## 1. Nervous system

- - sensory input.
- - central nervous system.
- - motor output.

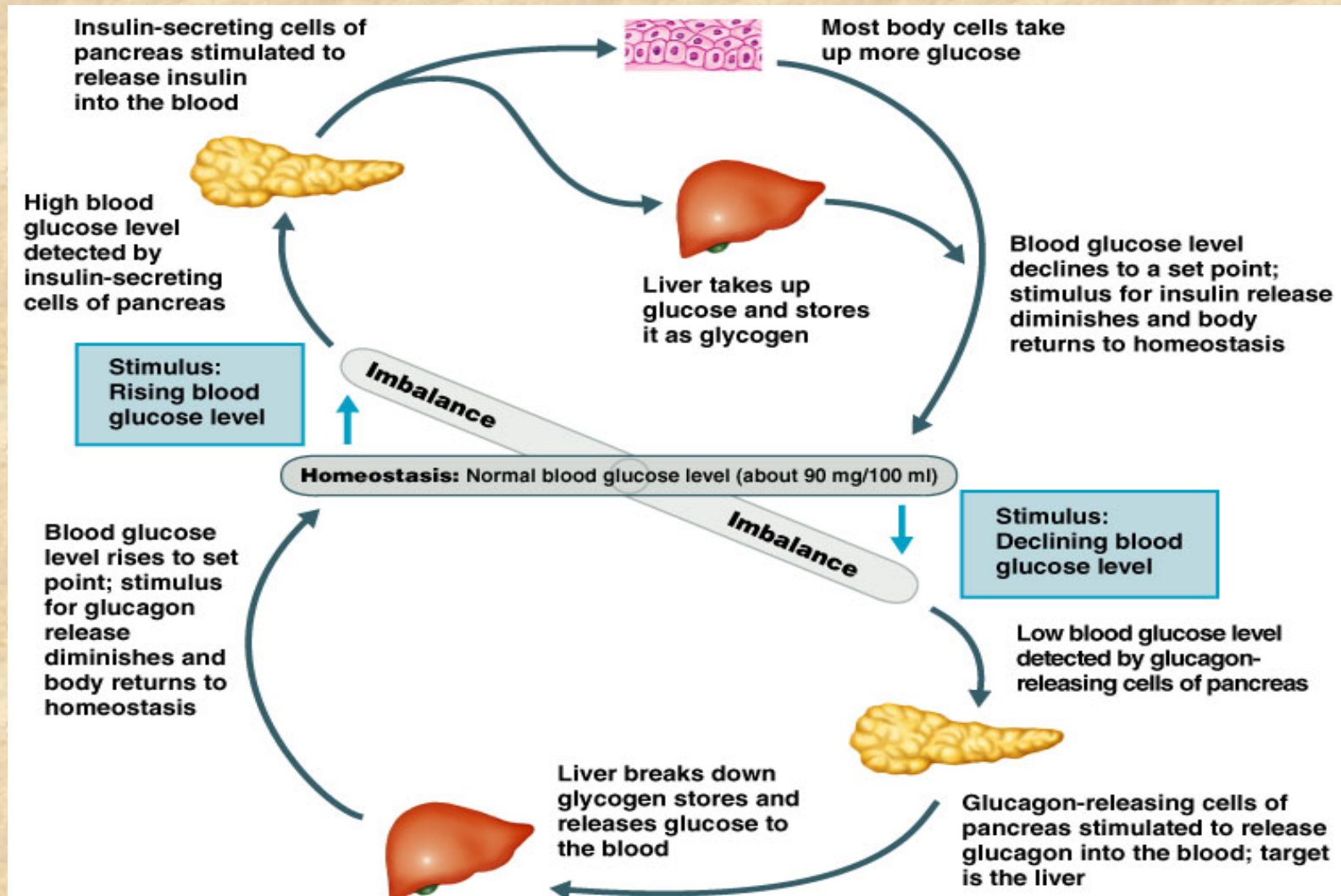
## 2. Hormonal system

- - Endocrine glands.
- - Pancreas, thyroid
- e.g. : insulin control glucose level.

# Homeostatic control mechanism



# Examples of Homeostasis





# Homeostatic Imbalance

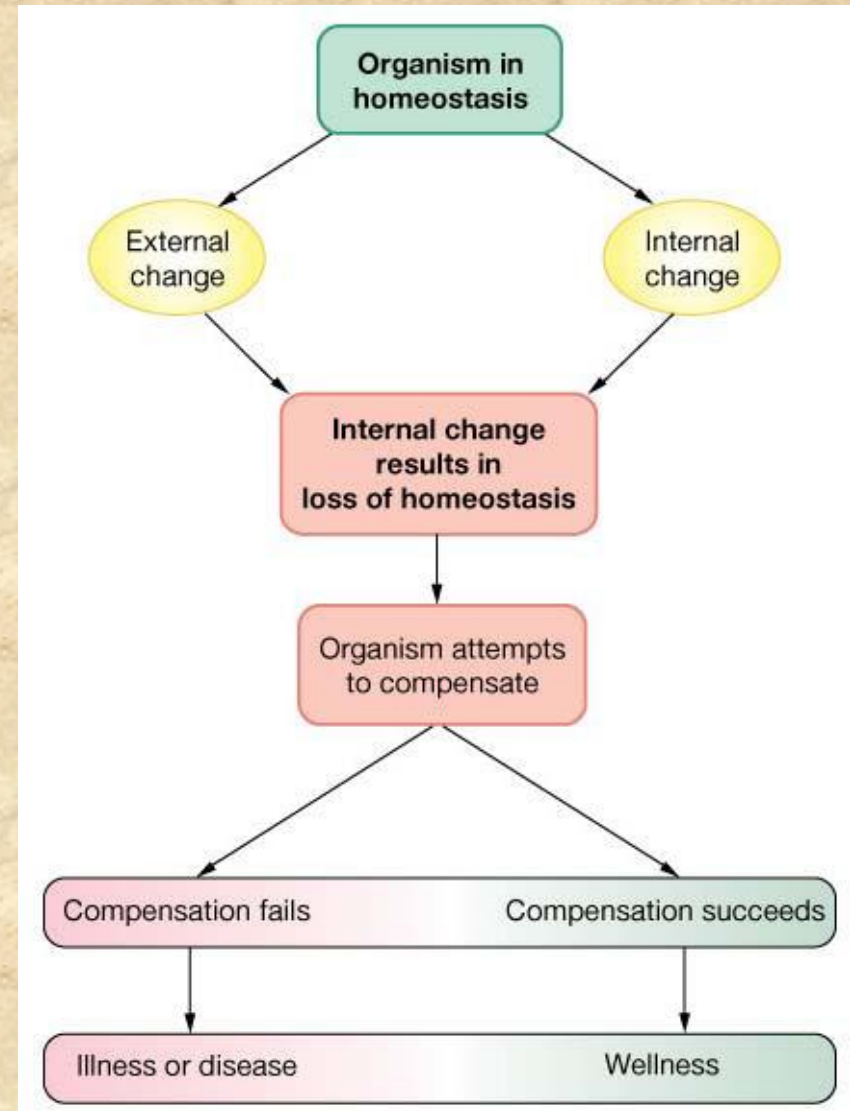


- **Disturbance** of homeostasis or the body's normal equilibrium.

# Control of Homeostasis



- **Successful compensation:**
  - homeostasis re-established
- **Failure to compensate:**
  - pathophysiology
  - illness
  - death



# Regulation of fluid exchange



- **Osmotic equilibrium is maintained between intracellular and extracellular fluids**
- **Small** changes in concentration of solutes in the extracellular fluid can cause tremendous change in cell volume.
- Intracellular **osmolarity** = extracellular **osmolarity** .
- $\approx 300 \text{ mosm/L}$



# Mechanisms of movement



## 3 general mechanisms:

1. Simple diffusion (passive)
2. Facilitated transport (passive)
3. Active transport

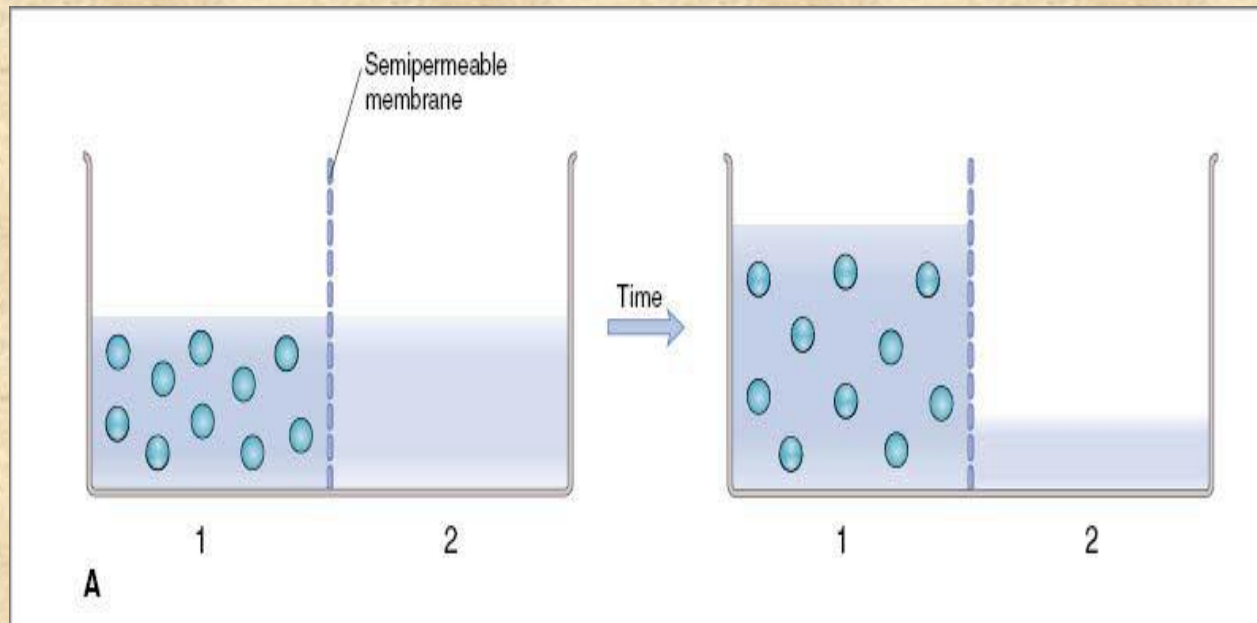
### ➤ **Osmosis**

- Is the flow of water across a semipermeable membrane because of differences in *solute concentration*.

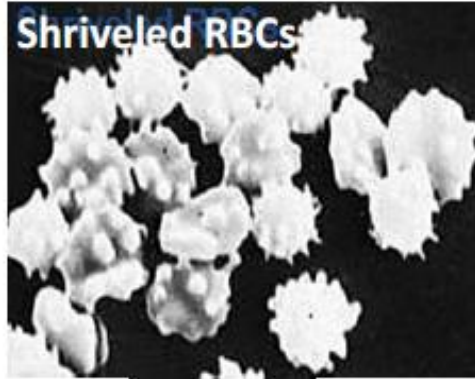
# Osmosis of Water



- ❖ Concentration differences of **impermeable solutes** establish **osmotic pressure differences**
- ❖ Osmosis of water is **not** diffusion of water



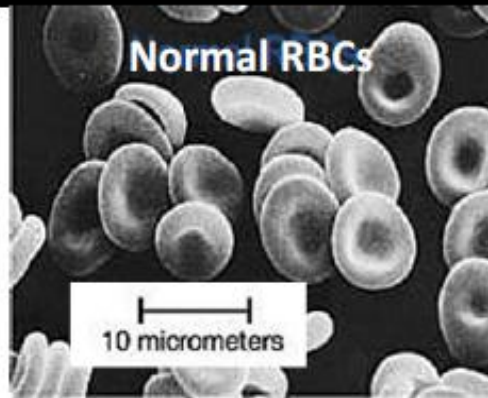
# Isotonic, Hypertonic, and Hypotonic Fluids



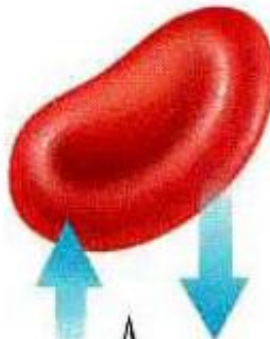
Hypertonic solution



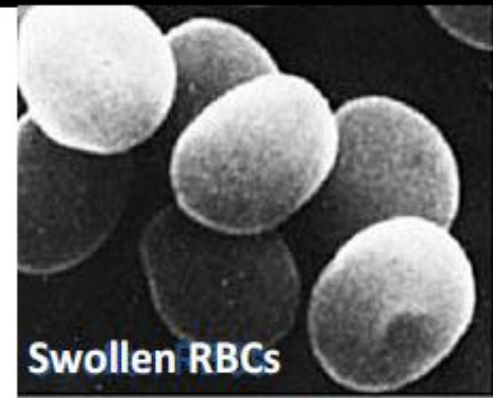
Net movement of water out of cells



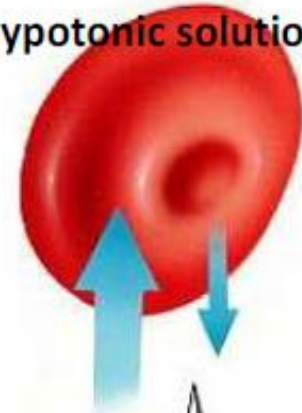
Isotonic solution



Equal movement of water into and out of cells



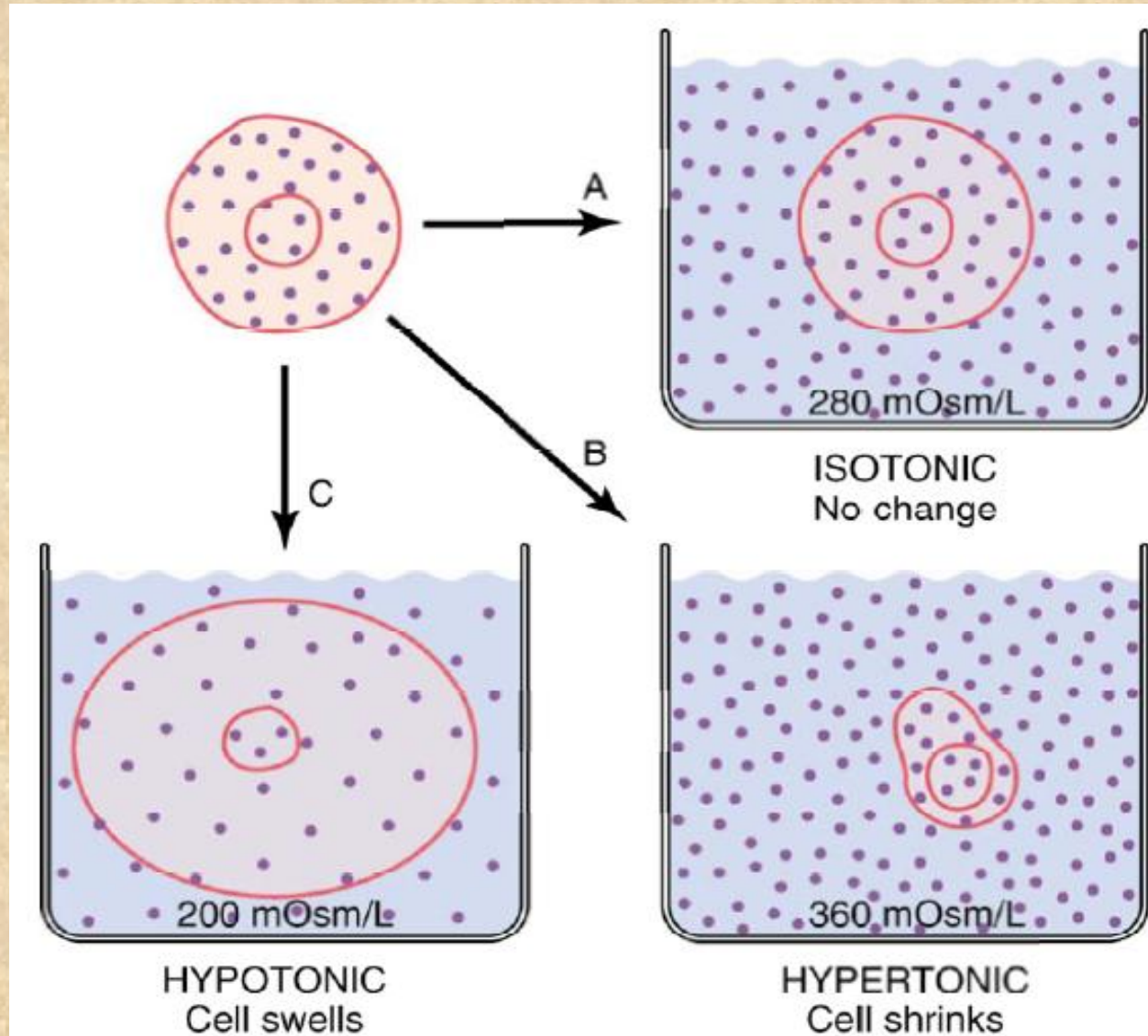
Hypotonic solution



Net movement of water into cells



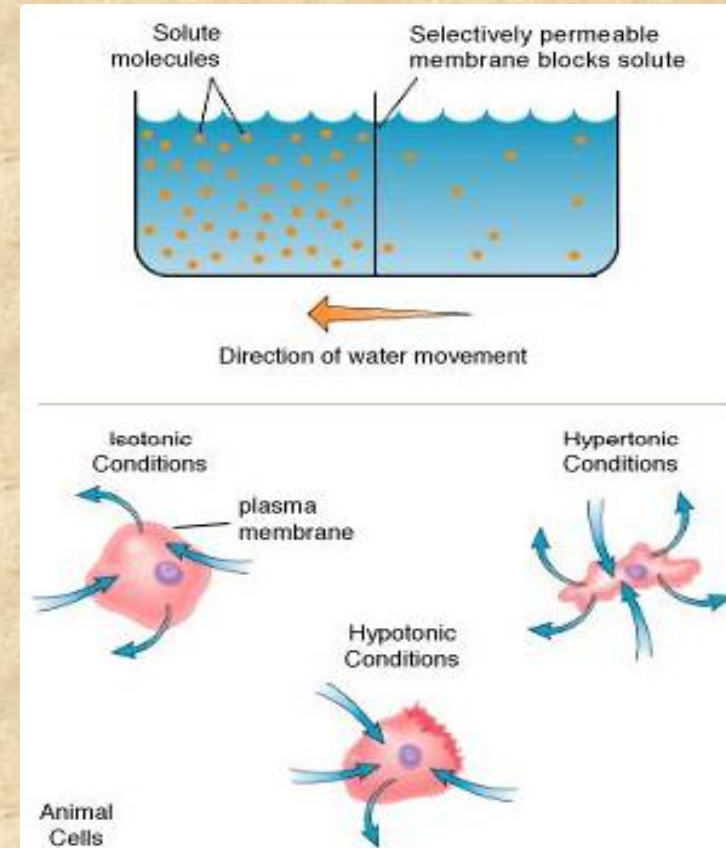
# Isotonic, Hypertonic, and Hypotonic Fluids



# Isotonic, Hypertonic, and Hypotonic Fluids



- If environment is:
- **Isotonic:**
- same
- No change in cell volume
- **Hypertonic:**
- MORE SOLUTES outside cell
- MORE WATER IN CELL
- over time, cell loses water
- **Hypotonic:**
- LESS SOLUTES outside cell
- LESS WATER IN CELL, more solutes in cell.
- over time, cell gains water



# Isotonic, Hypertonic, and Hypotonic Fluids



- **Isotonic solution :**
- (no swells or shrink )
- 0.9% solution of sodium chloride or 5% glucose .
- same **in** and **out** .
- **Hypertonic solution :**
- (shrink)  $\uparrow$  0.9%
- - **out** is higher than **in**
- **Hypotonic solution :**
- (swelling)  $\downarrow$  0.9%
- **in** is higher than **out**

## Glucose and other solutions administered for nutritive purposes

- People who cannot take adequate amount of nutrition.
- Slowly.
- Prepared in isotonic solution.





**The End**

**Thank You**