Foundation Block

Physiology team 441

4,5-

Homeostasis (1)

+

Homeostasis (2)

Team Leaders

★ Alanoud albawardi

★ Nawaf alshehri

Editing File

Color index

- Main Text
- Important
- Dr's notes
- Female
- Male
- Extra

Objectives

- Understand the concept and importance of homeostasis.
- Understand how the steady state is monitored.
- Discuss the physiologic control mechanisms that enable maintenance of the normal steady state of the body.
- Identify and describe the compensatory responses to any change in the steady state.
- Define a feedback mechanism and describe its components.
- Differentiate between positive and negative feedback mechanisms and give examples for each in the body.
- Apply the knowledge gained in feedback mechanisms to disturbances in the disturbances in ECF volume and osmolarity.
- Define the concept of the “internal environment” and state its physiological importance and differentiate between the external and internal environment.

★ Mechanisms for movement

Continues exchange of body fluids.
All the body system try to keep the inter environment table.

<u>3 general mechanisms for Movement :</u>

1. Simple diffusion (passive)

Non-carrier mediated transport down an electrochemical gradient.

2. Facilitated transport (passive)

Carrier mediated transport down an electrochemical gradient.

3. Active transport against electrochemical gradient and it Required energy.

★ Osmosis

- Osmosis (passive):means Net diffusion of water H_2O (across a selectively permeable membrane.) from a region of high water concentration to region of low water concentration. (in the osmosis remember that what moves is the water).

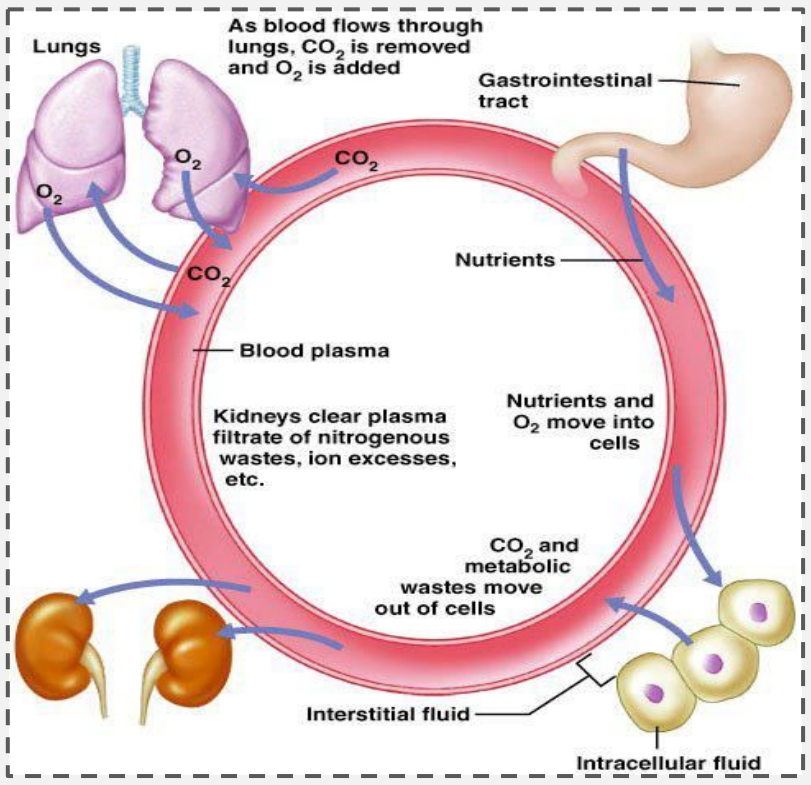
- **<u>Osmotic equilibrium; is maintained between intracellular and extracellular fluids:</u>**

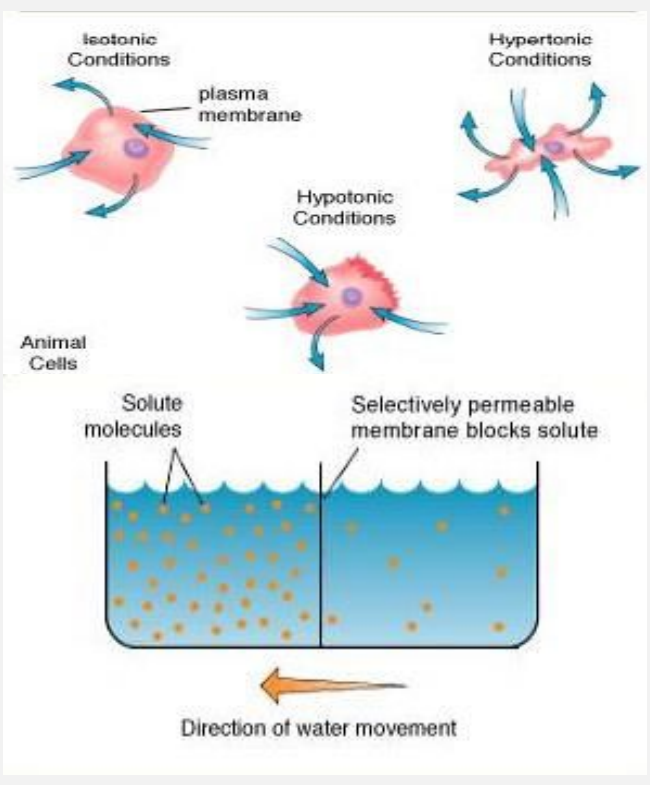
1. Small changes in concentration of solutes(like Na and K) in the extracellular fluid can cause tremendous(huge) change in cell volume.
2. Intracellular osmolarity = extracellular osmolarity (≈ 300 mosm/L).

(The molecules number determines the osmolarity not the size of molecules)

- 2 requirements for osmosis:
  - Must be difference in [solute] on the 2 sides of the membrane
  - Membrane must be impermeable to the solute.

- Osmotically active solutes:
  - Solutes that cannot pass freely through the membrane.



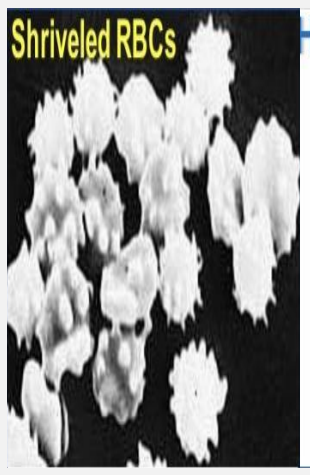


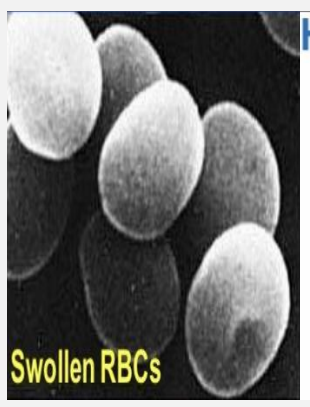
number of molecules هو الي يحدد ال osmosis

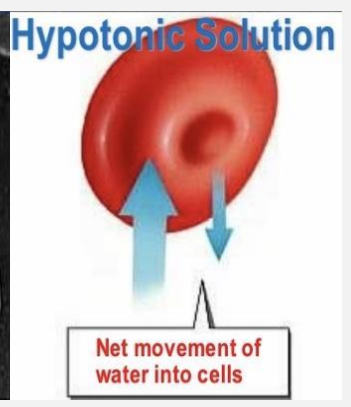
- What is the difference between osmolarity and tonicity?

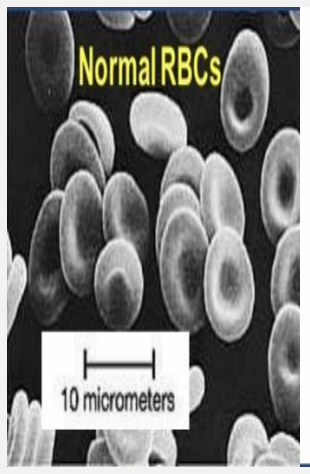
Osmolarity	Tonicity
-describes the concentration of **one** solution. **-Measure** of **one** given solution. -Normal~**300** mOsm/L.	-is used to compare between the osmolarities of **two or more** solutions separated by a semipermeable membrane. -means effective osmolality in relation to plasma (=**285** milliosmol/L) .

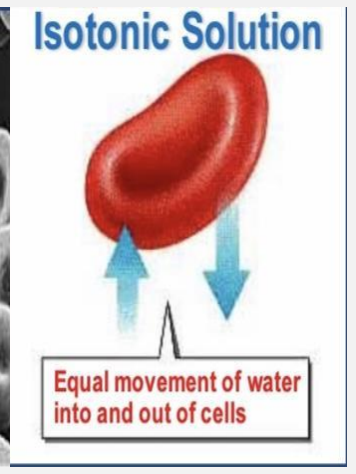
	If environment is:	If solution is:	TONICITY AND ITS EFFECT ON MOVEMENT OF H_2O
Hypertonic	▪ MORE SOLUTES outside cell. ▪ MORE WATER IN CELL. ▪ over time, cell loses water.	- (shrink) 0.9% ⬆️ (3%). of (sodium chloride) - out is higher than in	▪ Osmotically active solutes in a higher osmolality and osmotic pressure than plasma. ▪ RBC will crenate.
Hypotonic	▪ LESS SOLUTES outside cell. ▪ LESS WATER IN CELL, more solutes in cell. ▪ over time, cell gains water.	-(swelling) 0.9% ⬇️ (0.45%). - in is higher than out	▪ Osmotically active solutes in a lower osmolality and osmotic pressure than plasma. ▪ RBC will hemolyse.
Isotonic	▪ same. ▪ No change in cell volume.	- (not swell or shrink) - 0.9% solution of sodium chloride (CaCl) or 5% glucose . - same in and out .	▪Equal tonicity osmolality (300 mosm/l) to plasma. ▪ RBCs will not gain or lose H_2O.











TRANSPORT ACROSS EPITHELIAL MEMBRANES:

• In order for a molecule or ion to move from the external environment into the blood, it must first pass through an epithelial membrane.

• Absorption:
Transport of digestion products across the intestinal epithelium into the blood.

• Reabsorption:
Transport of molecules out of the urinary filtrate back into the blood.

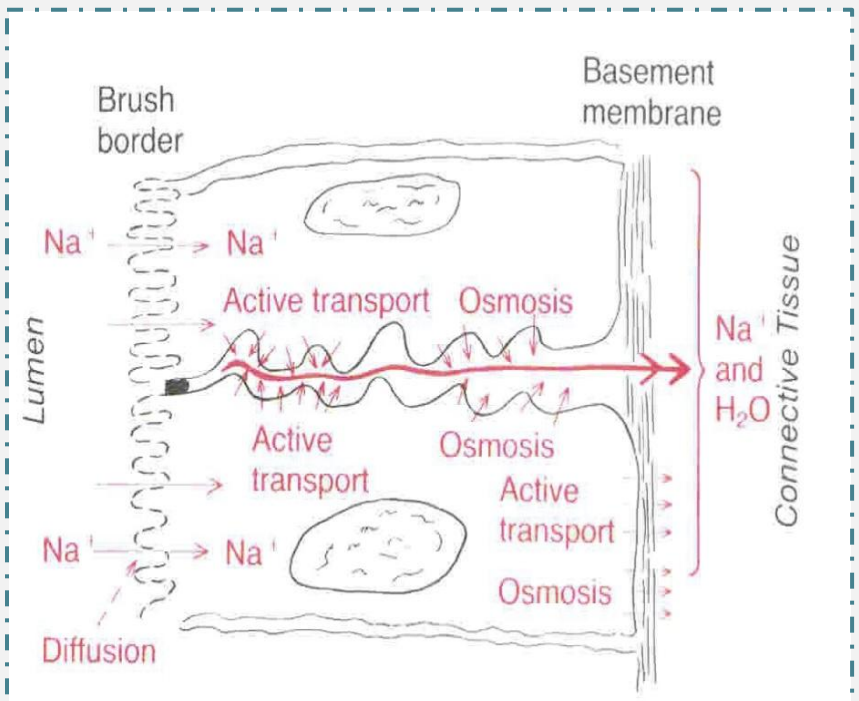
• Transcellular transport:
Moves material through the cytoplasm of the epithelial cells.

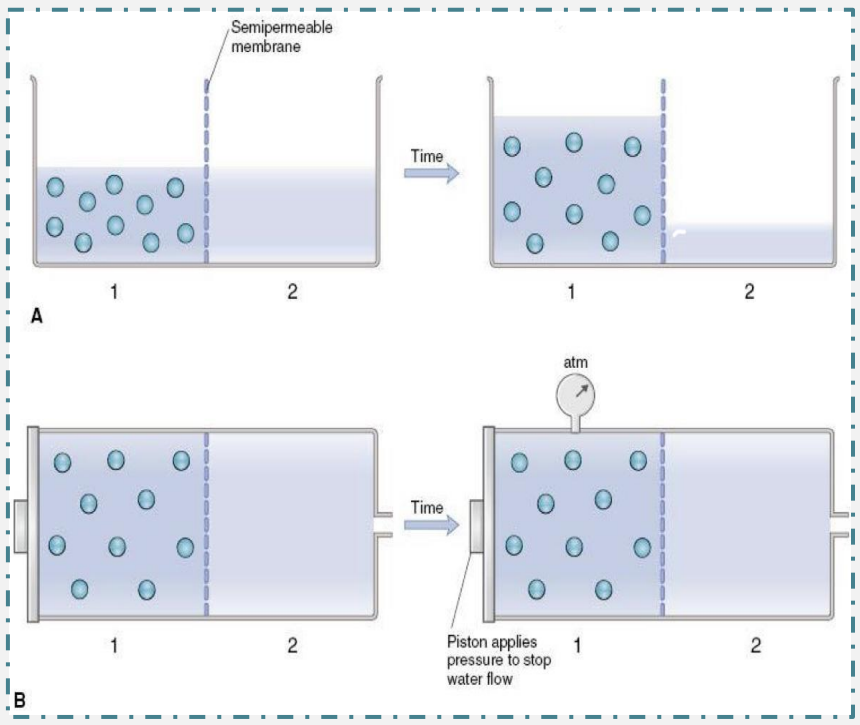
• Paracellular transport:
Diffusion and osmosis through the tiny spaces between epithelial cells.

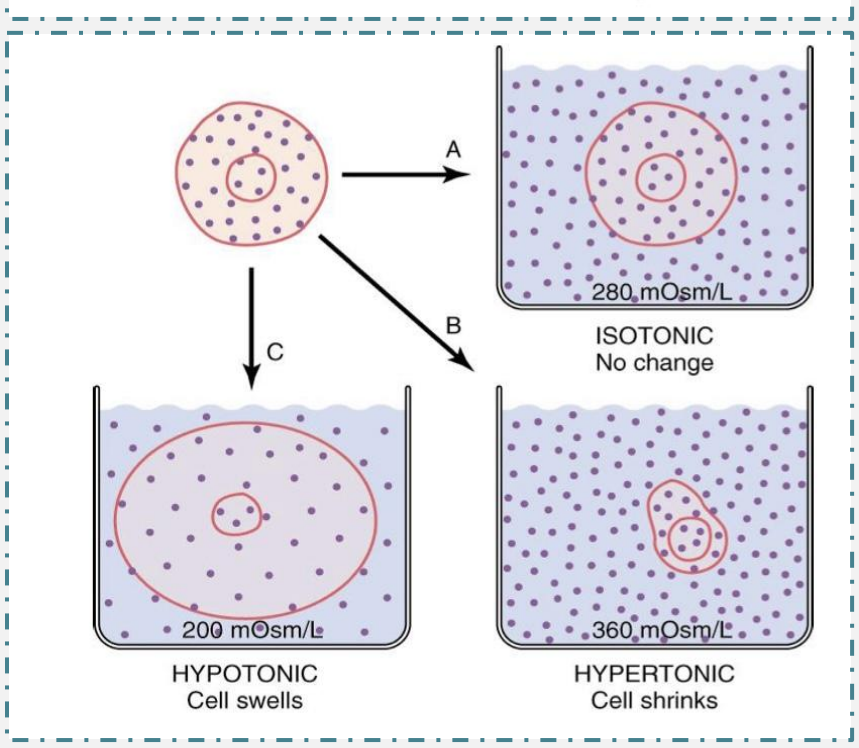
MANAGEMENT OF DEHYDRATION:

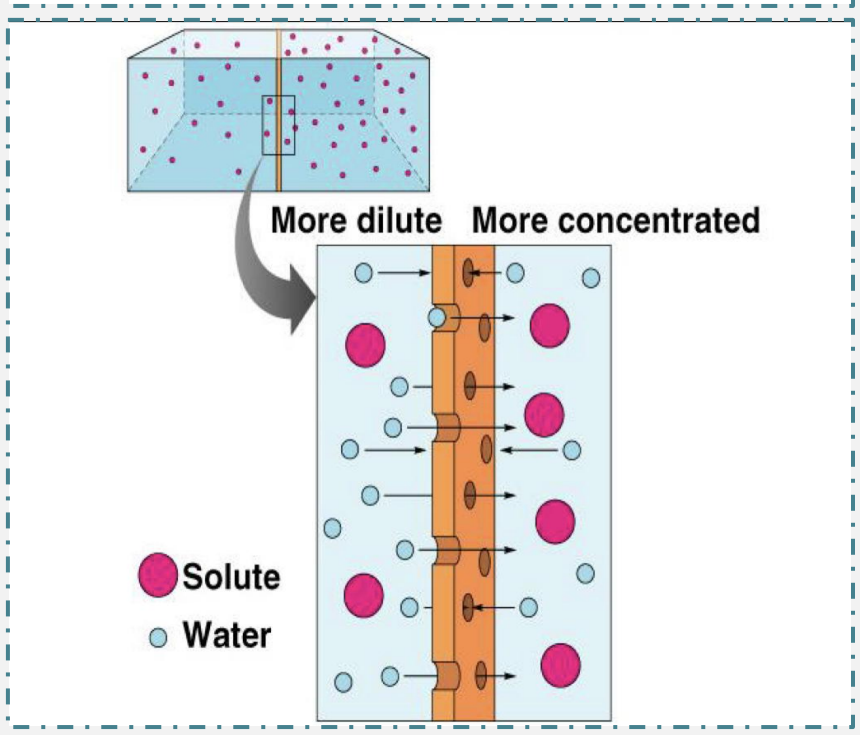
• What are the different methods used for rehydration?
1- Volume replacement
2- Electrolyte replacement

• What are the substances used for rehydration?
Uses of Isotonic, Hypotonic and Hypertonic solution.









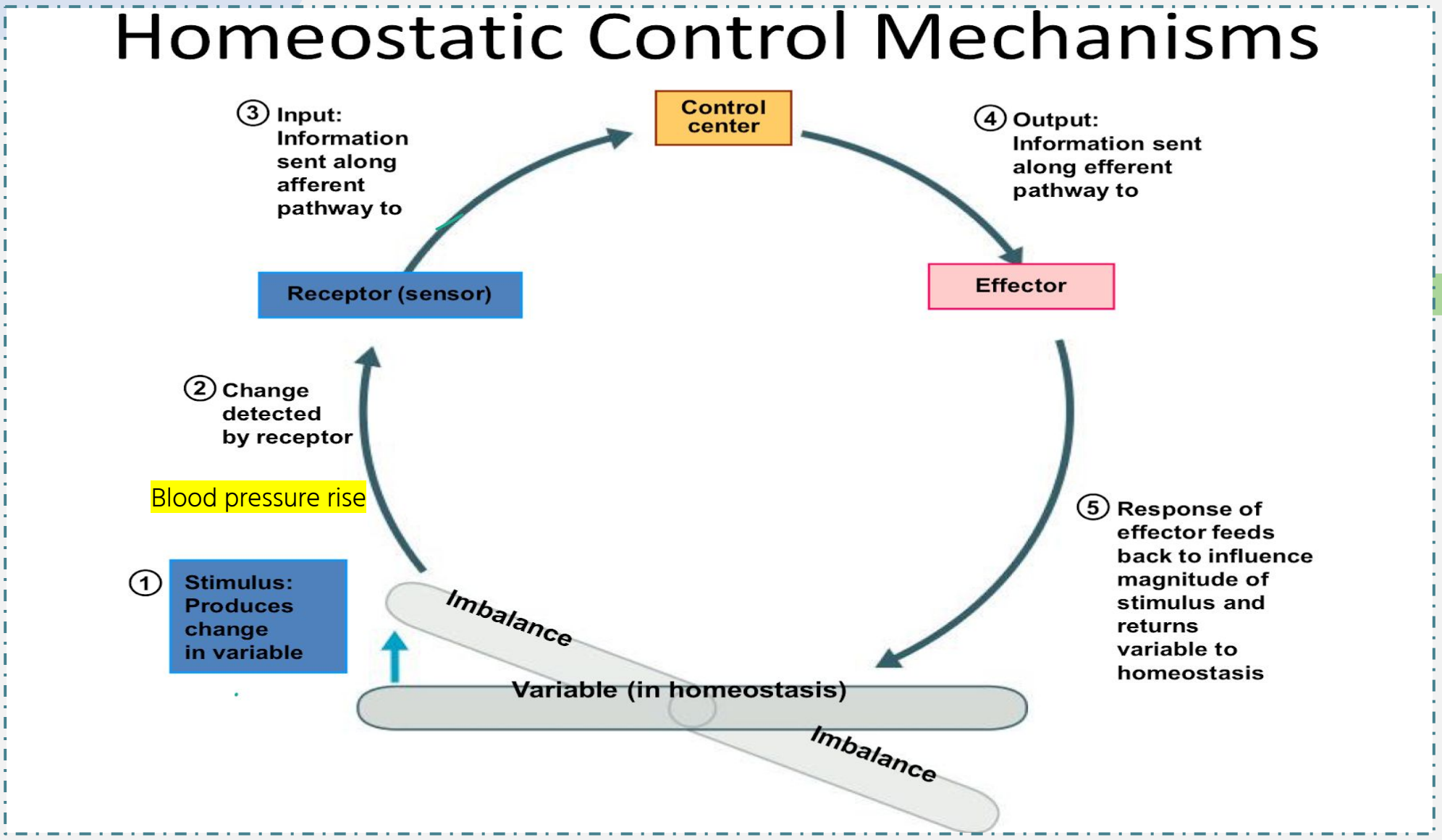
★ Homeostasis;

Homeo= sameness, similarity
stasis=standing

Homeostasis is the ability to maintain a relatively stable internal environment in an ever-changing outside world.

- The internal environment of the body (ECF)is in a dynamic state of equilibrium.
- All different body systems operate in harmony to provide homeostasis.

- The process by which the body keeps the internal environment constant despite changes in the external environments.
- The internal environment must be kept constant in the face of an ever changing external environment.
- Essentially all the functions of the body organs and tissue aim at keeping the internal environment at a nearly constant state.



★ Glucose and other solutions administered for nutritive purposes;

Who needs it?

1. People who can not take adequate(enough)amount of food.

How to give it for them?

2. Drip Slowly.

Where to prepare it?

3. Prepared in isotonic solution.
4. Water is excreted.

★ Homeostatic Control Mechanisms

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.

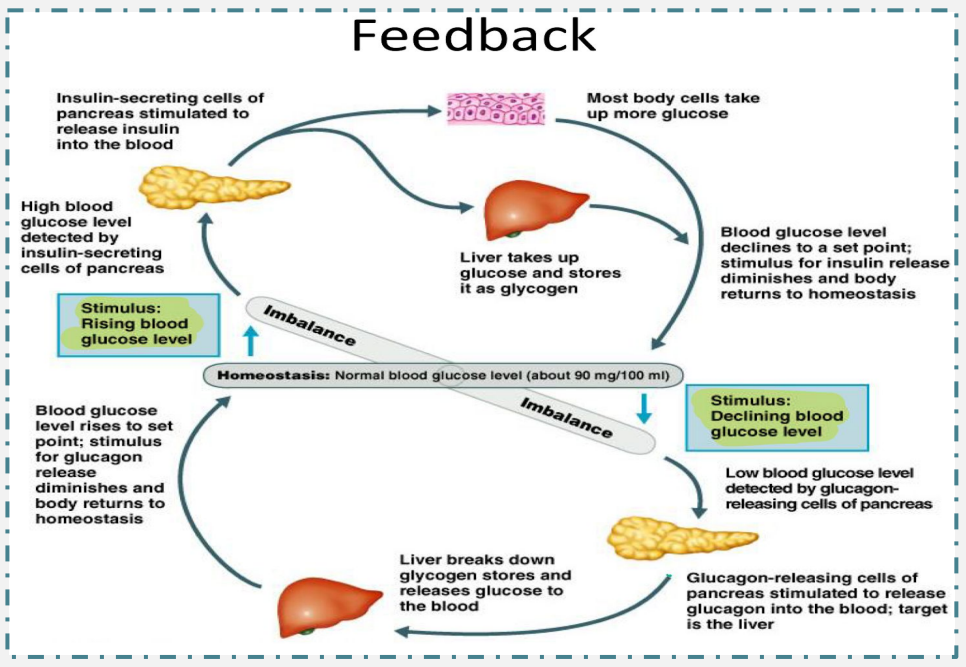
★ Regulation of body functions;

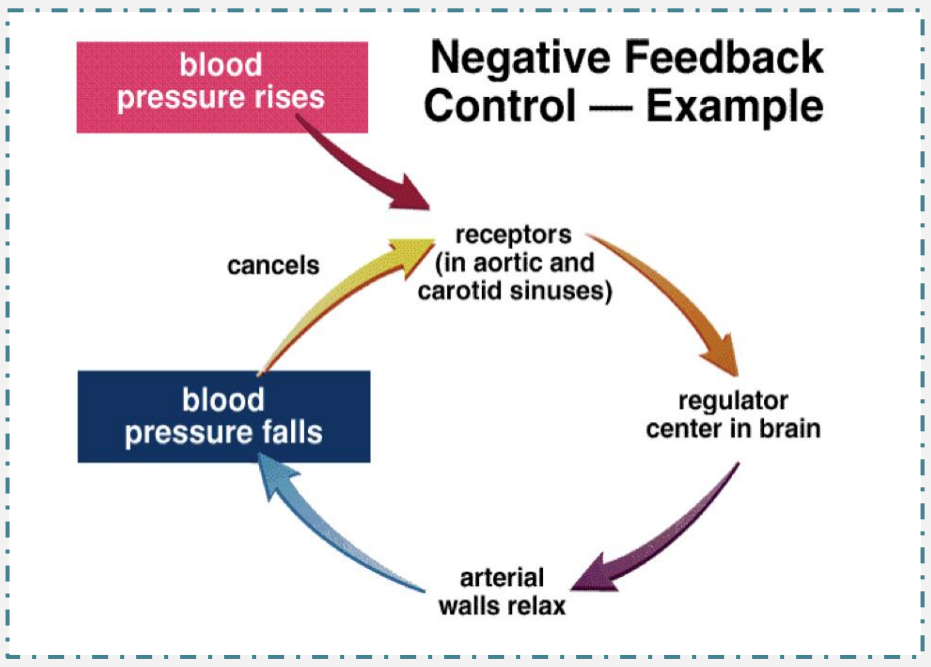
1.Nervous system.

- sensory input. (stimulus).
- central nervous system(CNS). (know the variable).
- motor output.(action).

2. Hormonal system of regulation.(slow regulation).

endocrine gland .pancreas ,thyroid
e.g. insulin control glucose level.





Extra information;

Feedback Mechanism:

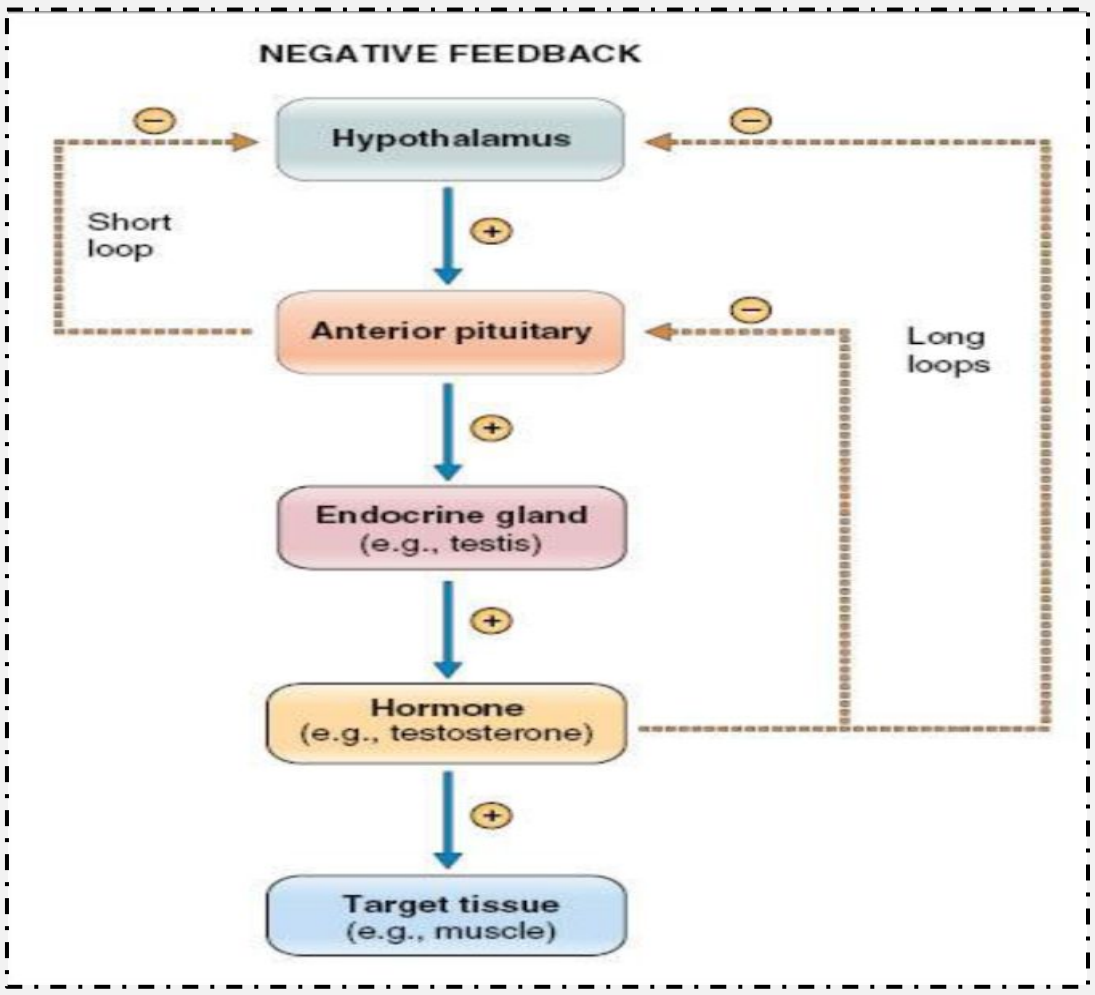
What is meant by feedback?

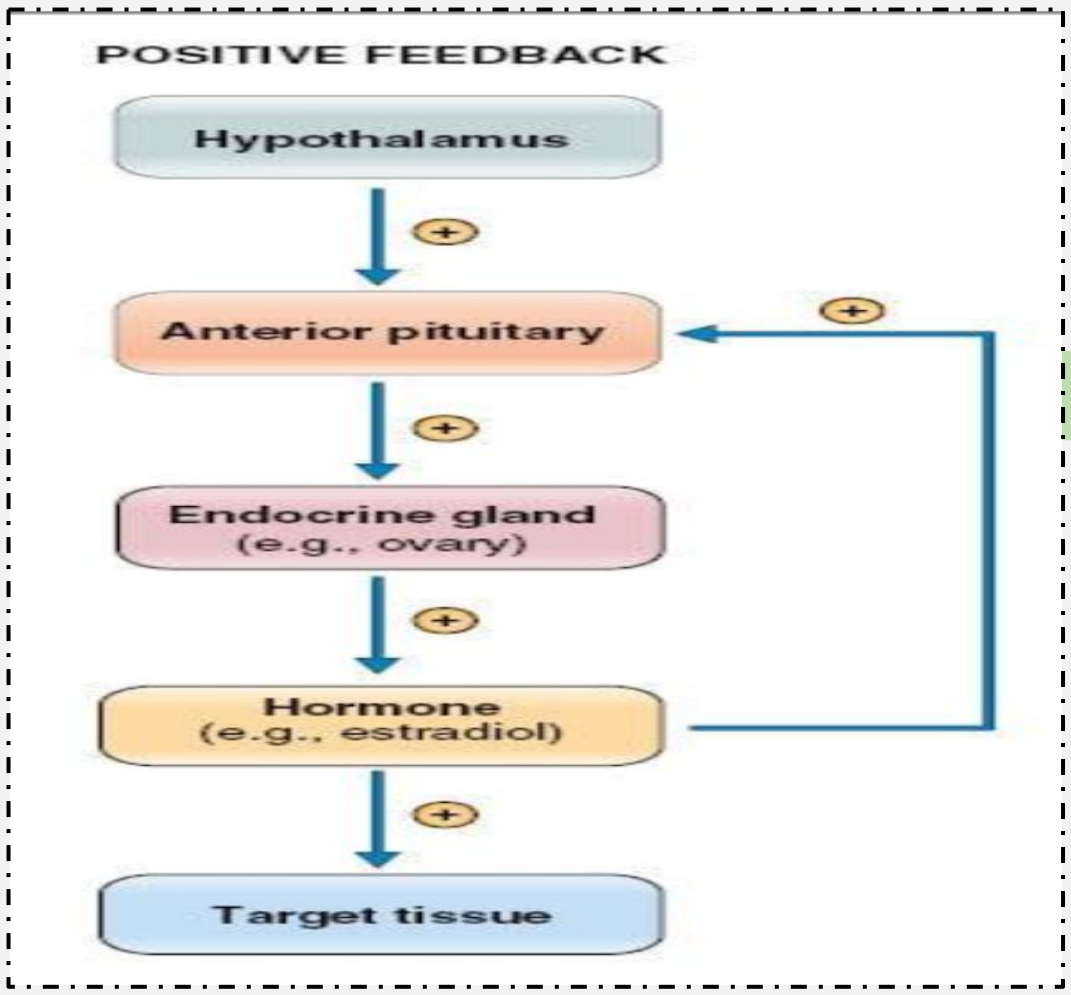
A loop system in which the system responds to perturbation either in the same direction (positive direction) or in the opposite direction (negative feedback).

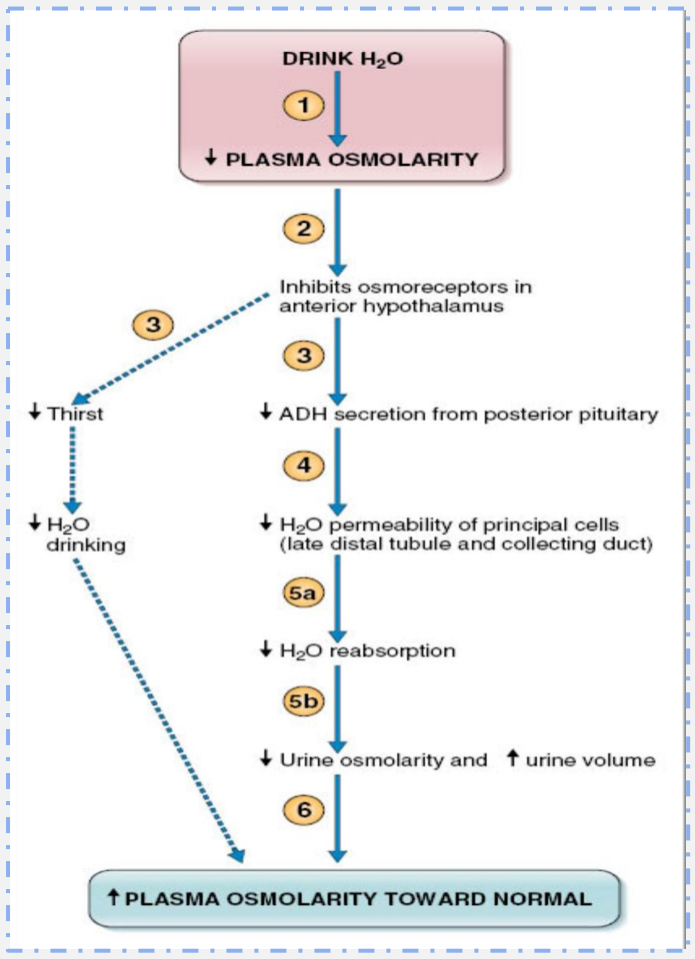
- Apply the knowledge gained in feedback mechanisms to disturbances in the disturbances in ECF volume and osmolarity.

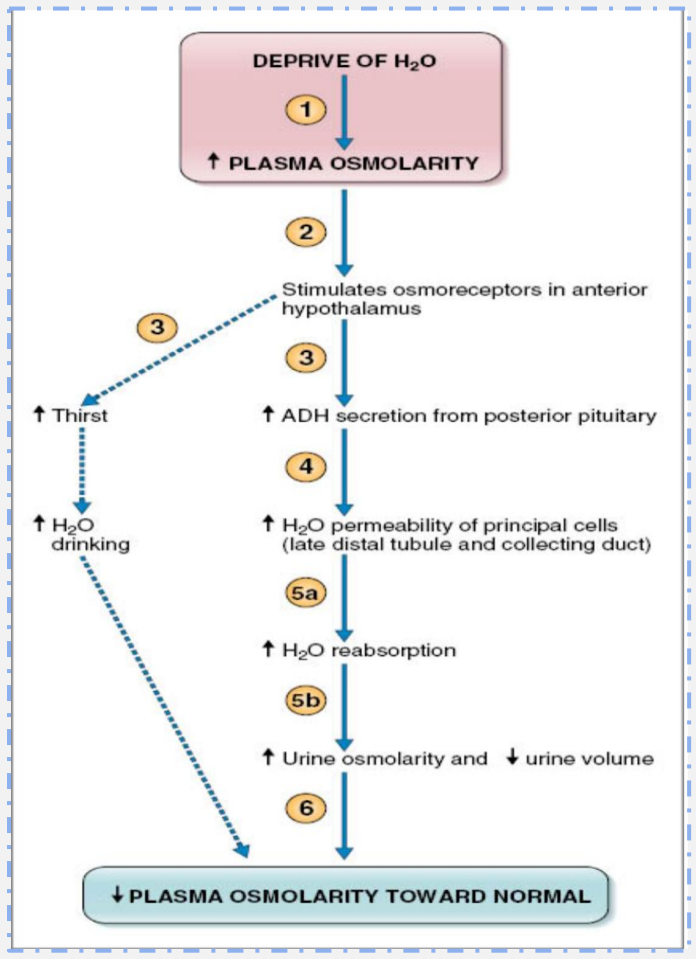
Types of feedback mechanisms;

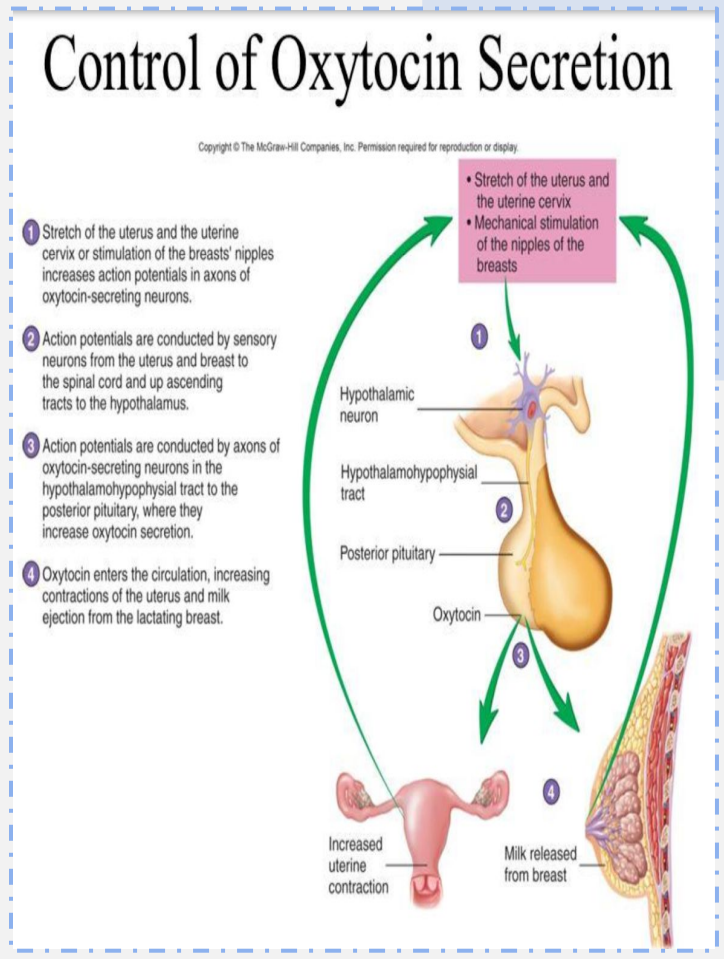
negative feedback	Positive feedback
The effector response of the system is in the **opposite direction** to the stimulus that initiated the response. E.g; • A **high level of in CO_2** In the ECF will increase pulmonary ventilation, increasing the amount of CO_2 expired which will **bring the level of CO_2 in ECF down.** • **Most of the control systems of the body act by negative feedback.**	The effector response is in the **same direction** to the stimulus that initiated the response. (نفس المزاد كل واحد يرفع على الثاني) E.g; • In nerve signaling, **entry of a small amount of Na+** into the cell will open more Na+ channels **causing more Na+ to enter the cell.** • **Only few system display positive feedback.**











Homeostatic Imbalance;

Disturbance of homeostasis or the body's normal equilibrium.

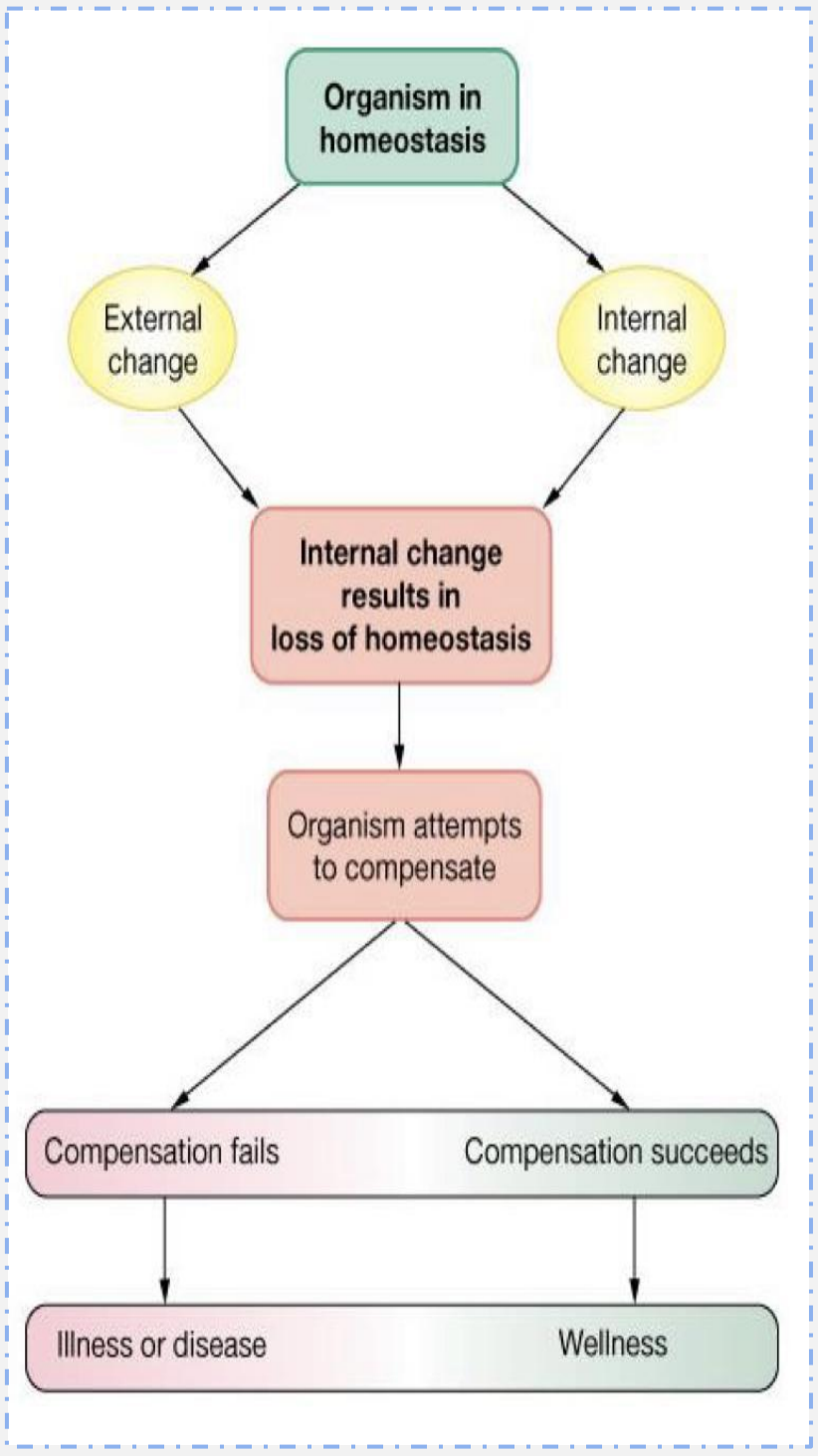
The homeostasis then will produce a reaction that will either be:

1. **Successful compensation;**

- **Homeostasis reestablished (Wellness)**

2. **Failure to compensate Pathophysiology;**

- **Illness**
- **Death**



★ Volumes and Osmolarities of ECF and ICF in Abnormal states;

➢ **some factors can Cause the change :**

- Dehydration.
- Intravenous infusion (IV).
- Abnormal sweating .

Etc..

➢ **Changes in Volume :**

- Volume contraction (removing).
- Volume expansion (adding).

• In normal state osmolarity is always the same for ICF & ECF.

Volume contraction (Removing)	Volume expansion (Adding)
1- Isotonic solution (**Diarrhea**)	1- Isotonic solution (**Infusion of isotonic NaCl**)
2- hypotonic solution (**Water deprivation**)	2- hypotonic solution **(SIADH)**
3- hypertonic solution (**Adrenal insufficiency**)	3- hypertonic solution **(High NaCl intake)**

★ Volume Contraction(decrease in the ECF volume) :

1. **Loss of Iso-osmotic fluid e.g. Diarrhea;**

Diarrhea

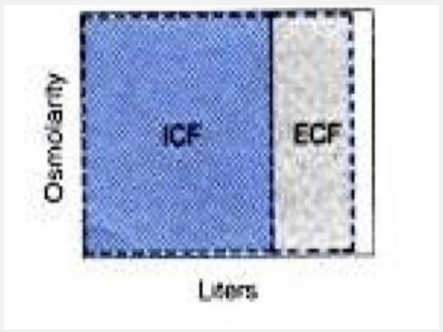
- Decrease the volume in ECF.
- Decrease the arterial pressure.
- osmolarity of fluid lost ≈ osmolarity of ECF.

2. Loss of hypotonic solution e.g. Water deprivation

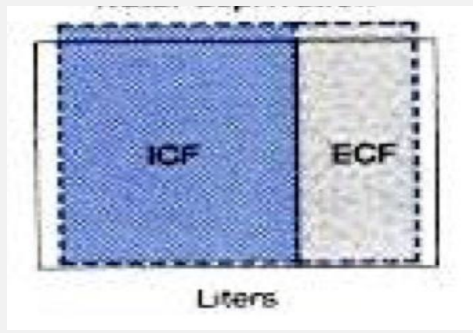
Water deprivation

- Increase the Osmolarity in both ECF and ICF.
- Decrease the volume in both ECF and ICF
- Osmolarity and volume will change .

Diarrhea



Water deprivation



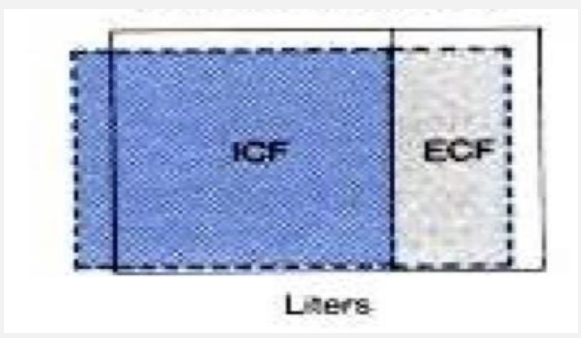
Hyperosmotoc dehydration

3. Loss of hypertonic solution e.g. Adrenal insufficiency

Adrenal insufficiency i.e. Aldosterone deficiency.

- Decrease the Sodium (Na+) in the ECF
- Decrease the osmolarity in both
- Decrease the ECF volume
- Increase the ICF volume

Adrenal insufficiency



★ Volume Expansion;

1. Adding (infusion) of isotonic NaCl

Isomotic expansion

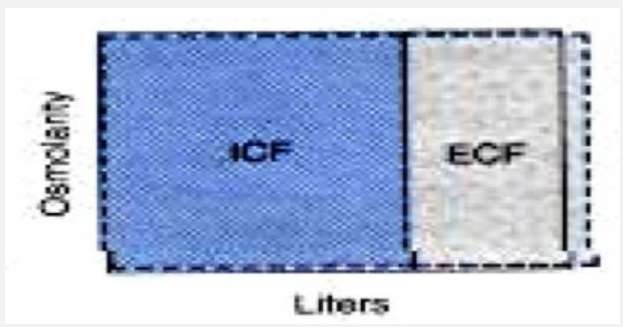
- Increase in ECF volume.
- No change in osmolarity.

2. High NaCl intake

Hyperosmotic volume expansion

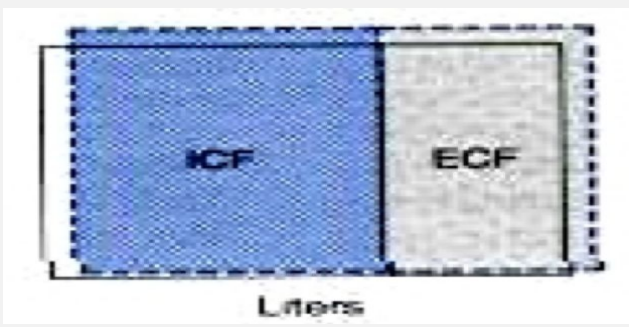
1. Let's say you ate a lot of salt (NaCl).
2. You will have an increase in osmolarity in both ECF & ICF.
3. Decrease in the volume of ICF.
4. Increase in the volume of ECF (to maintain stability).

Infusion of isotonic NaCl



Hypo-osmotic dehydration

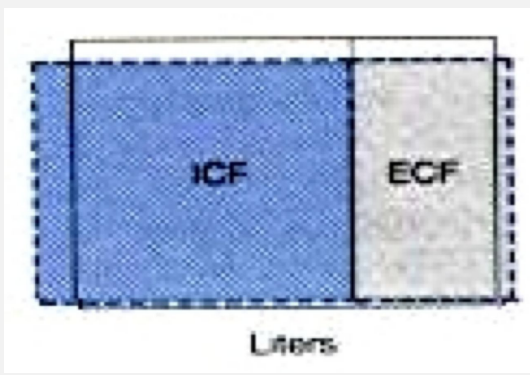
High Nacl intake

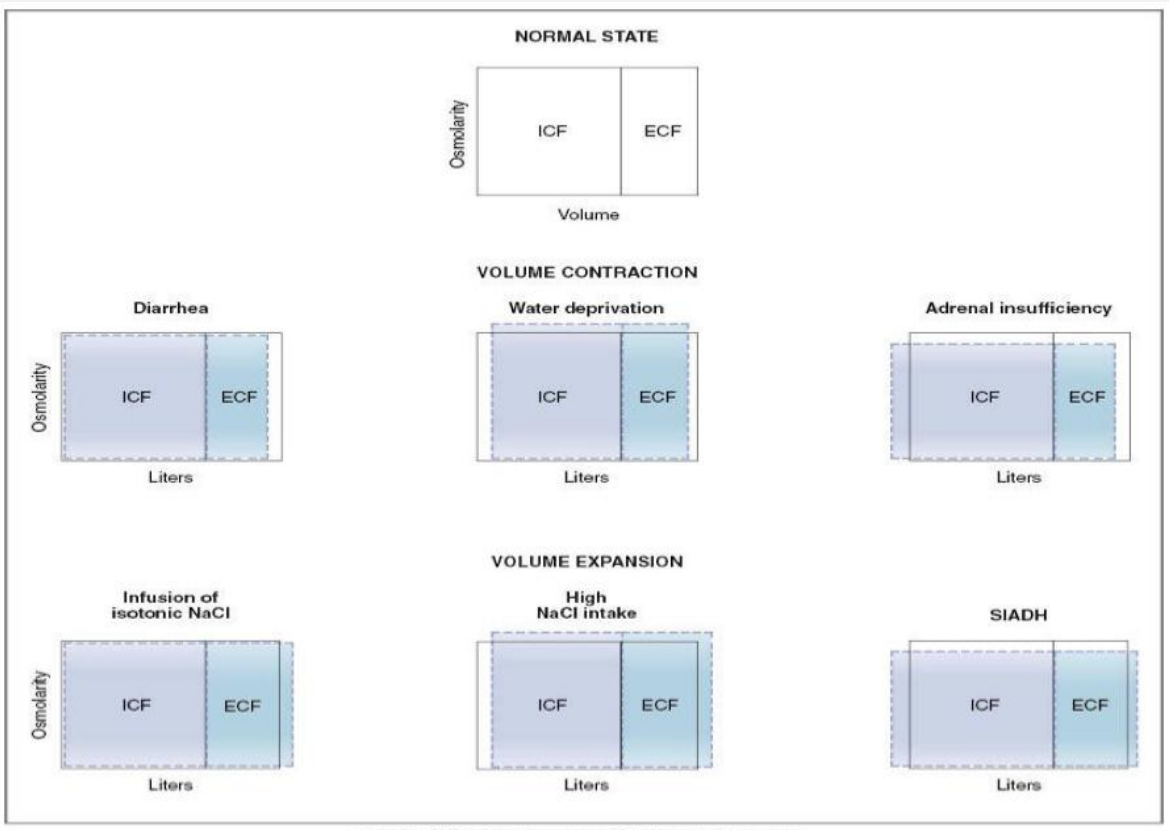


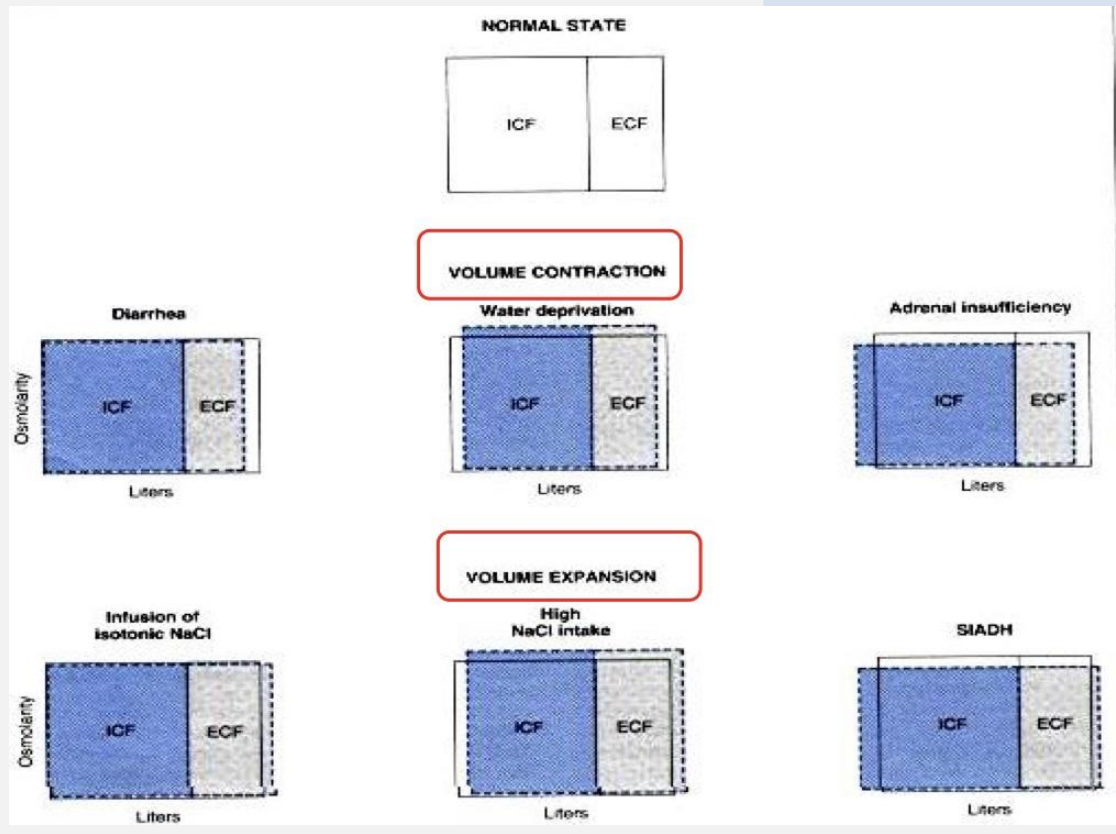
3. Adding hypotonic solution e.g. Syndrome of inappropriate antidiuretic hormone (SIADH)

- Increase in volume
- Decrease of osmolarity

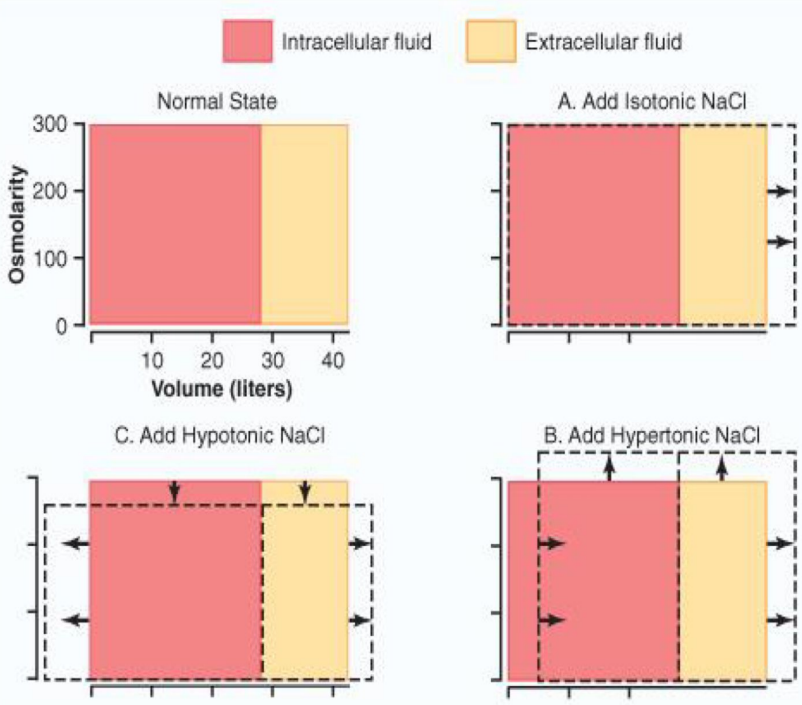
SIADH

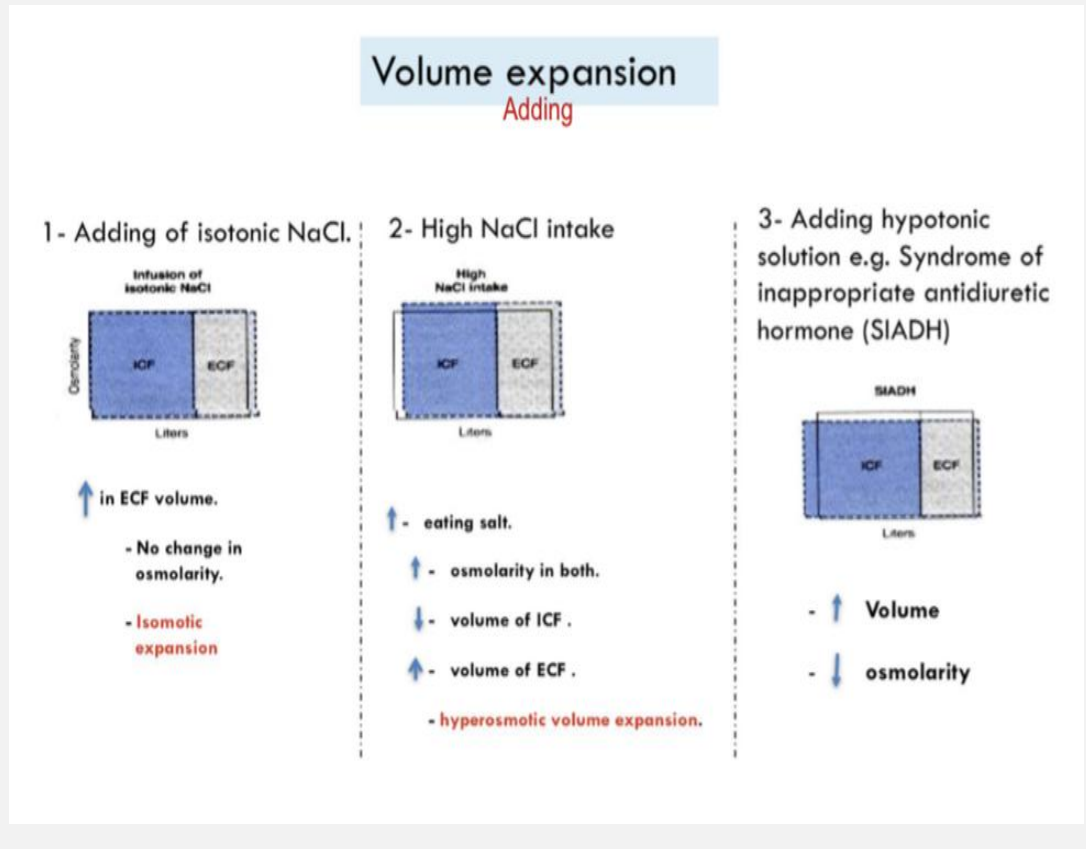


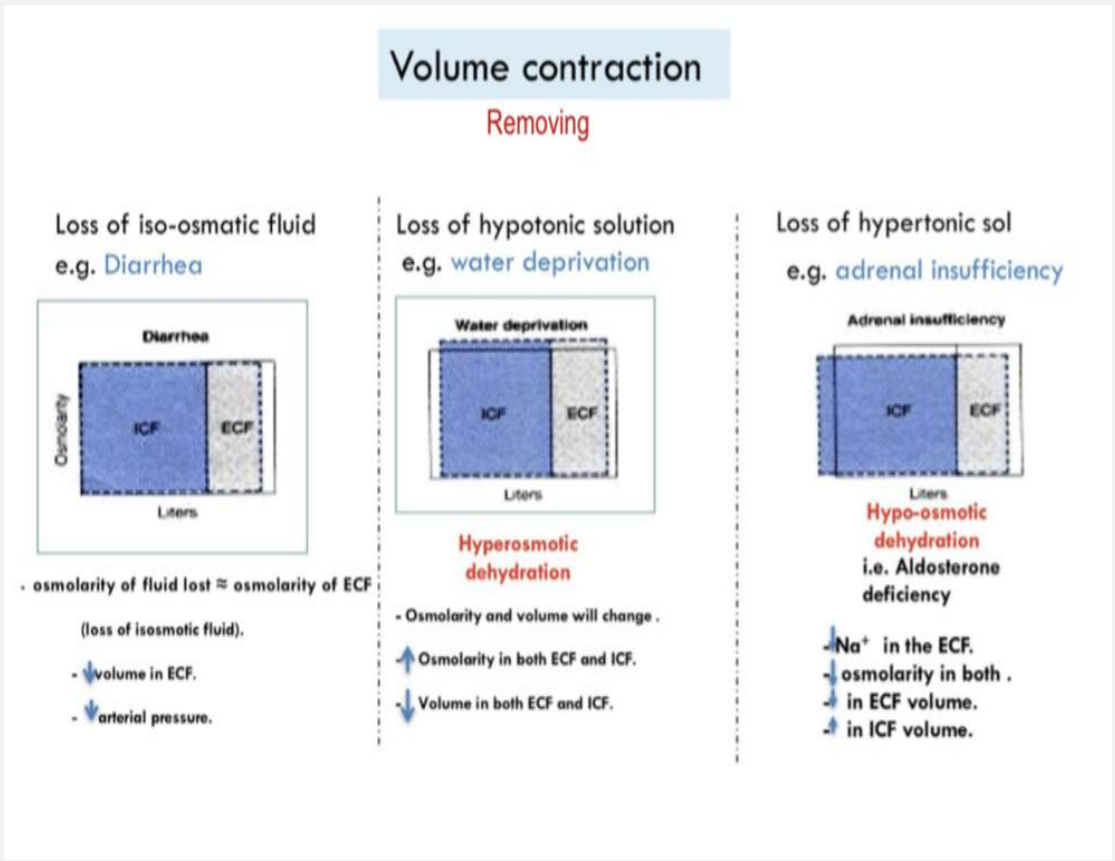




★ Effect of adding saline solution to the ECF;







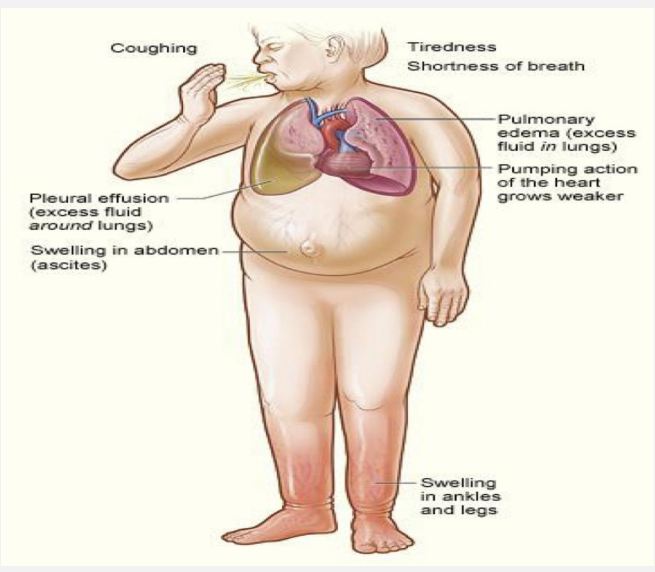
★ Edema:

A Helpful video

A helpful video

Edema is: **excessive fluid in the tissues** which leads swelling. **i.e** the presence of abnormally large amounts of fluid in the intercellular tissue spaces of the body.

In most cases, **edema occurs mainly in the ECF**, but it can involve ICF as well . Normally, fluid is constantly moving in & out of the interstitial space to allow ECF to distribute between plasma and IF (Through capillary walls).



Edema

Intracellular Edema

Inflammation of tissues

Membrane permeability increases

Higher Na inside the cells

Water shifts (from ECF to ICF)

Edema

More common clinically excessive capillary fluid filtration.

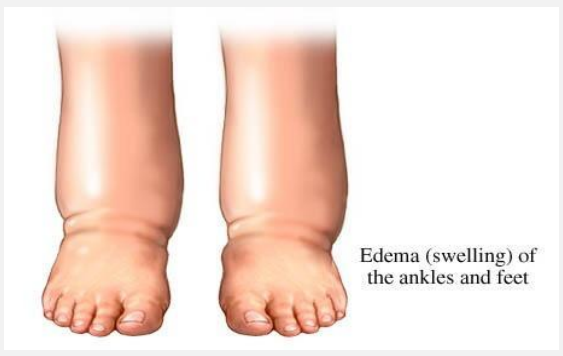
Extracellular Edema

Heart failure increases

Capillary pressure increase

Filtration

Edema



Test yourself

★ MCQs

Q1:The molecules ……. determines the osmolarity			
A- size	B-molecular weight	C-volatility	D-number
Q2:SIADH causes 1-……. In osmolarity, and 2-……. In volume			
A- 1-Increase 2-Decrease in ECF&ICF	B- 1-No change 2-Increase in ECF	C-1-Increase 2-Decrease in the volume of ICF Increase in the volume of ECF	D-1-Decrease 2-Increase in ECF&ICF
Q3:Aldosterone deficiency is an example of			
A- Loss of hypertonic solution	B-Loss of isotonic solution	C-Loss of hypotonic solution	D-Adding hypotonic solution
Q4: Which of the following has the highest percentage in average water output			
A-feces	B-sweat	C-urine	D-insensible loss

1-D 2-D 3-A 4-C

★ SAQ

Q1: Describe what happens to the body physiologically when there's excess water intake

Decrease in ADH secretion which leads to decrease water absorption, then increase in water excretion by kidney

MED441
KING SAUD UNIVERSITY

physiology 441

Foundation Block

Physiology team 441

Male Members

Abdulaziz Alassaf
→ Muan Almoajil
Feras Alzahrani
Meshal Alqahtani
Faisal Bin Moammar
Ahmed Bin Radi
Mansour Aldhalaan
Rayan Ali
Saad Alghadir
→ Naif Al-Hasan
Fahad Alkhattabi
Abdulaziz Alqusiyer
Naif Alfahed
Faisal Alshuaibi
Bader Alshahrani
Bader Rajeh

Female Members

Lama Bin Salamh
→ Munira Alsharif
Shimah Alsalhi
Albandry Bin Habda
Raaoum Jabor
Arwa Alenzi
Ayah Sayed
Lama Aleyadhy
Lujain Alkhalaf
Layan Almasri
Deema Almuhaimel
Ghadah Alarify
Asma Eidah
Reema Alrashedi
Sara Alhomaidhi
Raneem Alanazi
Jumana Alqahtani
Sahar Alhakami
Waad Alhowti
Maha Aljarbaa

Team Leaders

★ Alanoud albawardi
★ Nawaf alshehri

Edited by : Faye Wael Sendi

Physiology.team441@gmail.com