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Homeostasis(I)

Objectives

- Understand the concept and importance of Homeostasis
- Understand how the steady state is monitored
- Discuss the physiological 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

Homeostasis

- Homeostasis: the ability to maintain a relatively stable internal environment (Extracellular fluid) 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 variable produces a change in the body.

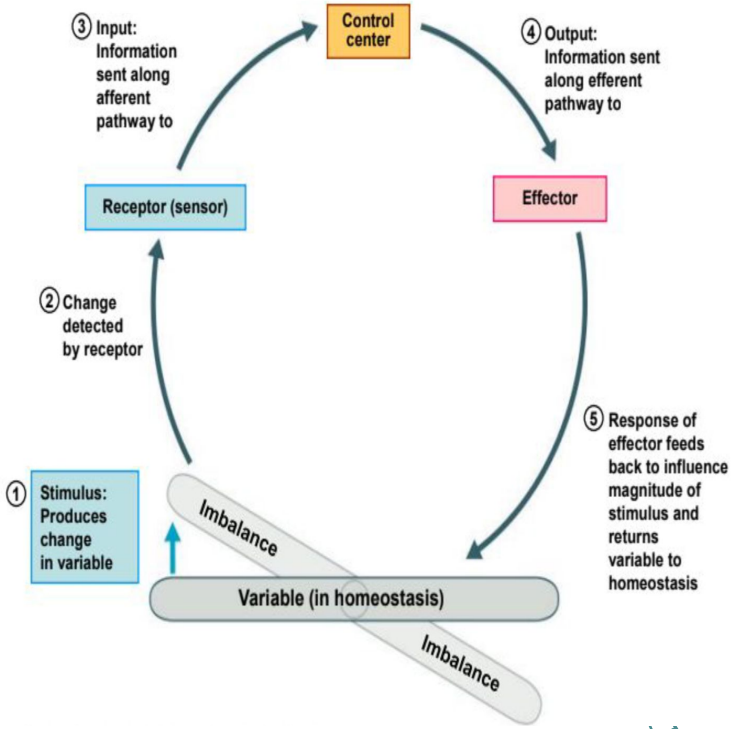
Homeostatic control mechanisms:

The Components of control mechanisms

1- Receptor: monitors the environment and responds to changes (stimuli)

2- Control center : determines the set point at which the variable is maintained

3- Effector : provides the means to respond to the stimulus



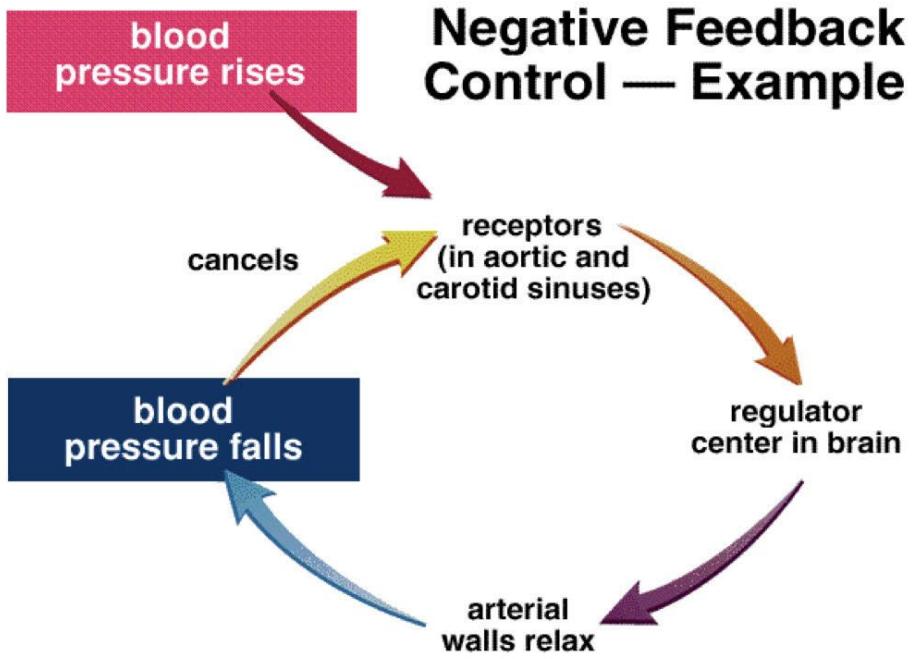
Regulation of body functions:

1 - Nervous system :

- Sensory input
- Central nervous system
- Motor output

2 - Hormonal system of regulation :

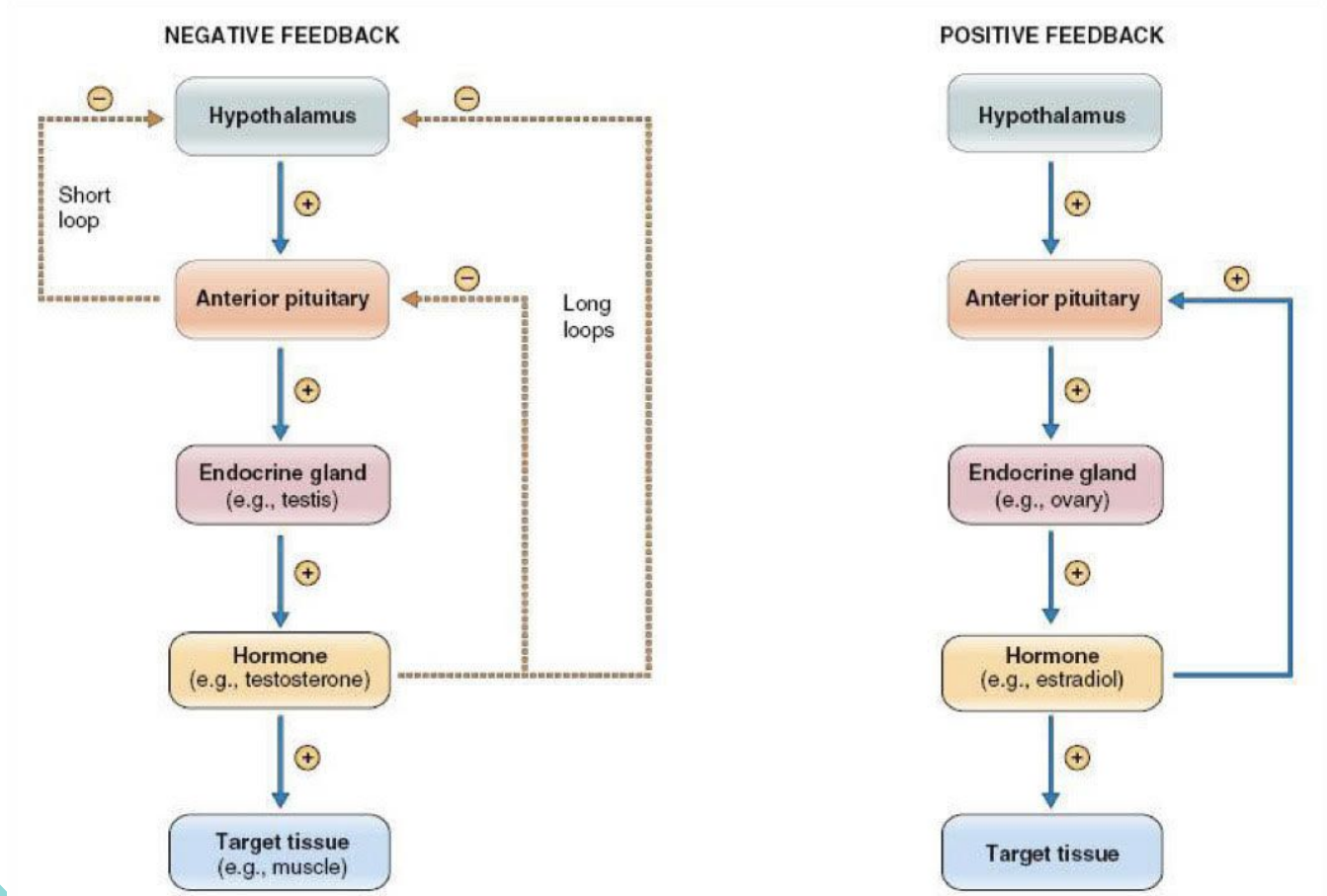
- Endocrine gland
- Pancreas, thyroid
  E.g: insulin control glucose level



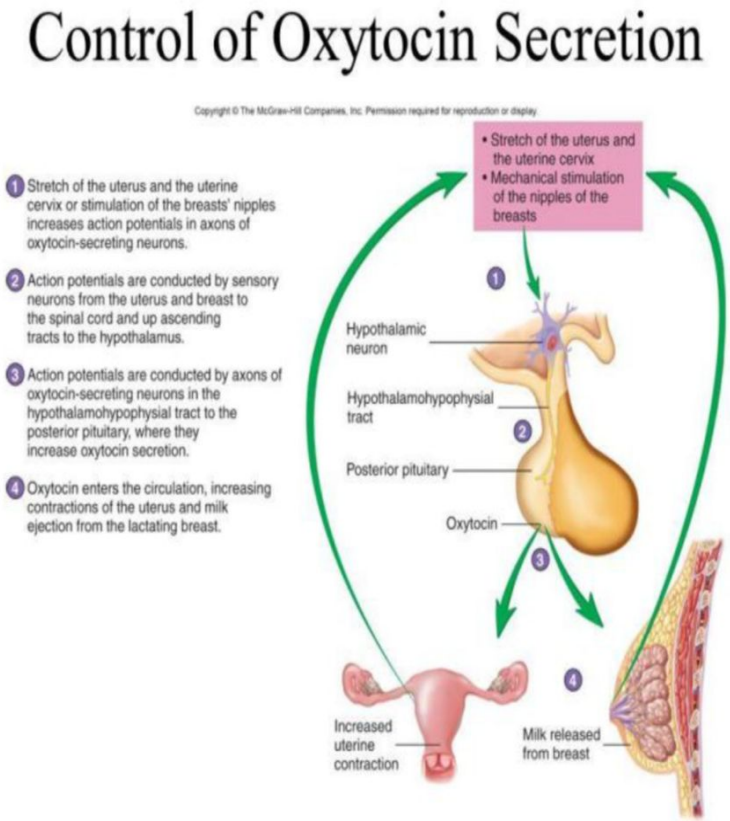
Note : Nervous system is faster than hormonal system

Feedback mechanisms :

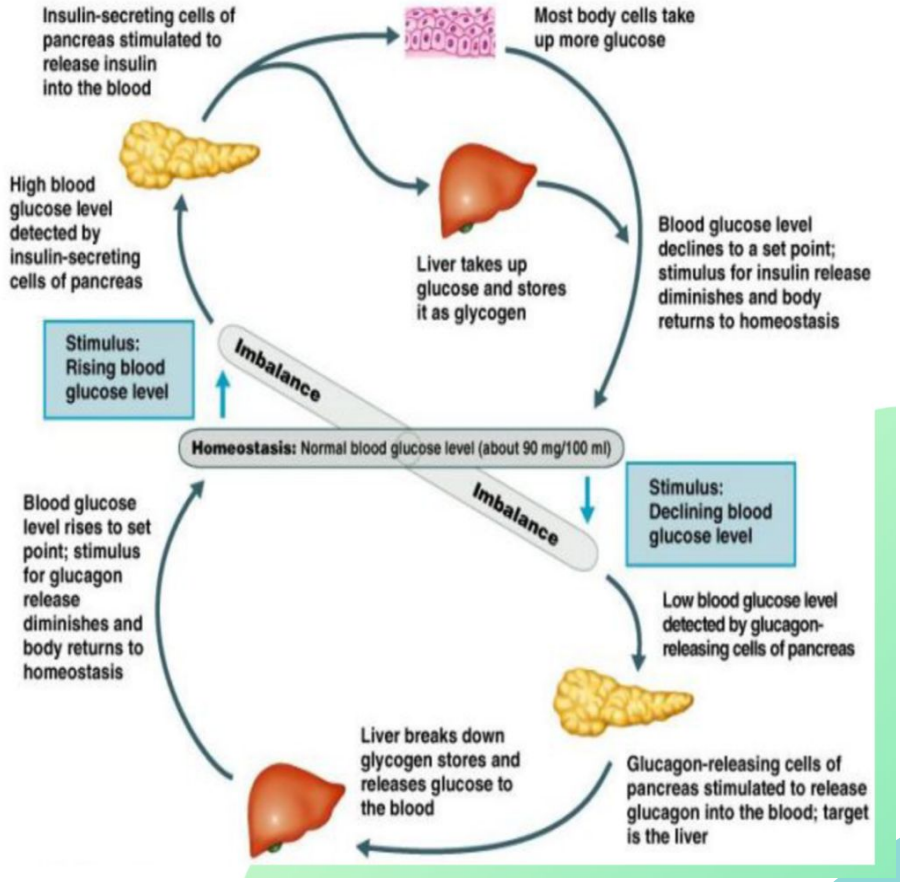
Type	Positive	Negative
Definition	-increases the effect (secretion)	-oppose the effect (secretion) and maintain it
Example	Controls oxytocin secretion (increase it)	-controls Blood pressure & blood glucose & water drink
Note	-only few systems work with positive feedback	-Most systems work with negative feedback


NEGATIVE FEEDBACK
Hypothalamus
Short loop
Anterior pituitary
Long loops
Endocrine gland (e.g., testis)
Hormone (e.g., testosterone)
Target tissue (e.g., muscle)
POSITIVE FEEDBACK
Hypothalamus
Anterior pituitary
Endocrine gland (e.g., ovary)
Hormone (e.g., estradiol)
Target tissue

Positive feedback



Negative feedback



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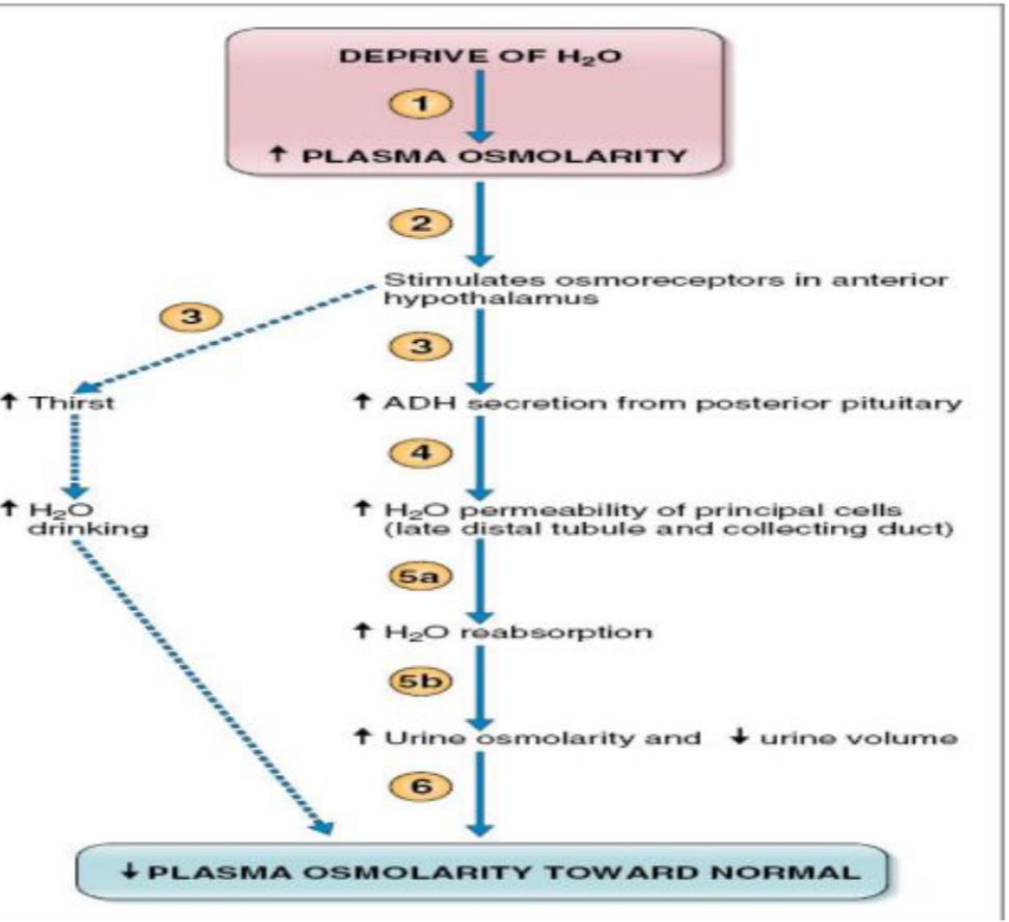
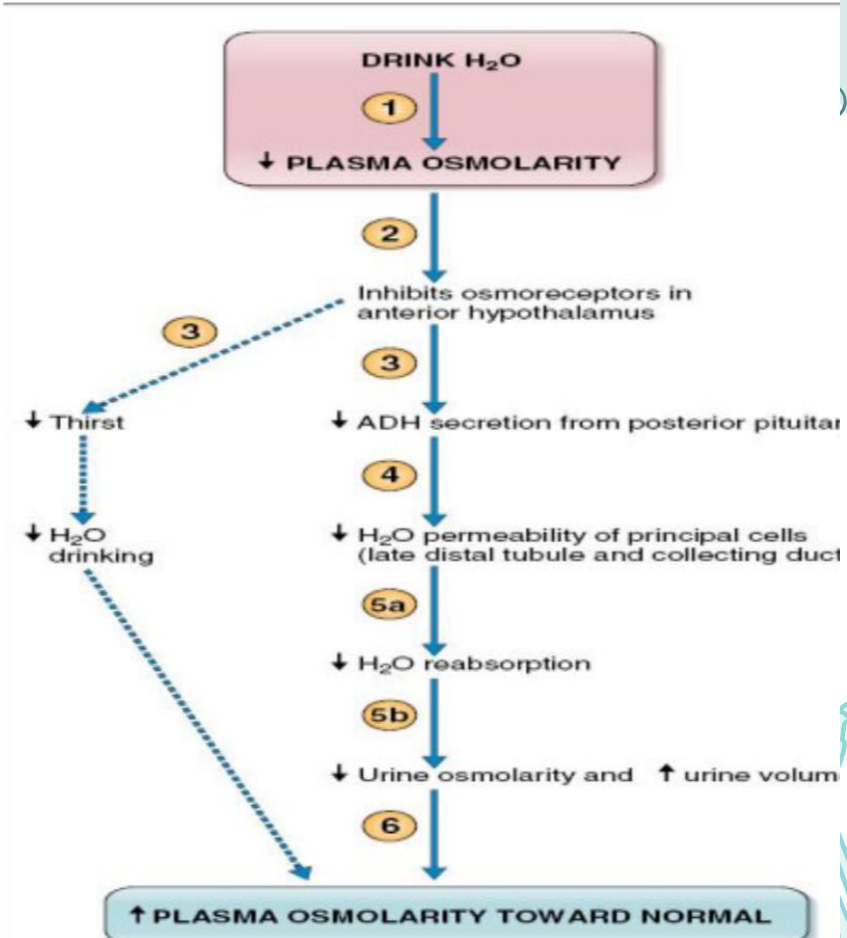




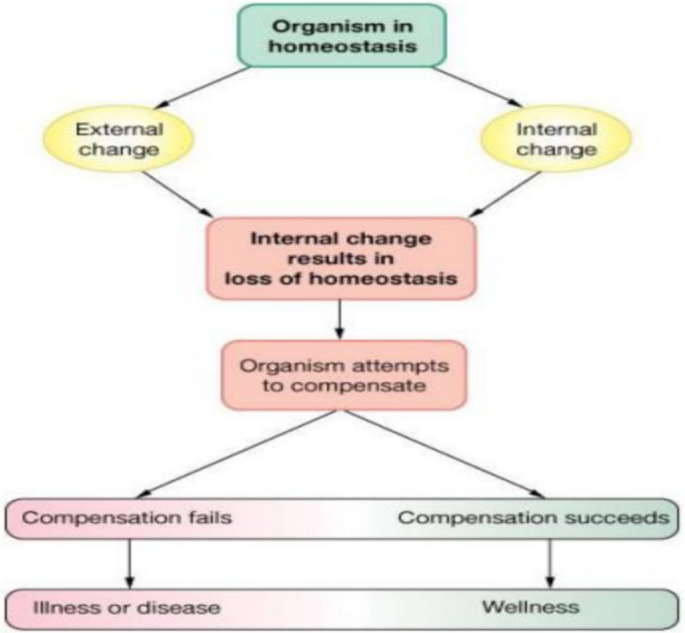
Homeostatic imbalance:

Disturbance of homeostasis or the body's normal equilibrium.

as a reaction of imbalance, it will lead to either:

1- Successful compensation: Homeostasis reestablished

2- Failure to compensate: Pathophysiology which lead to Illness and Death



Osmotic equilibrium and Mechanisms for Movement

Osmotic equilibrium

- Small changes in concentration of solutes in the extracellular fluid can cause tremendous change in cell volume.
- Intracellular osmolarity = extracellular osmolarity
- 285 mosm/L

3 General mechanisms for Movement:

- Simple diffusion (passive)
- Facilitated transport (passive)
- Active transport

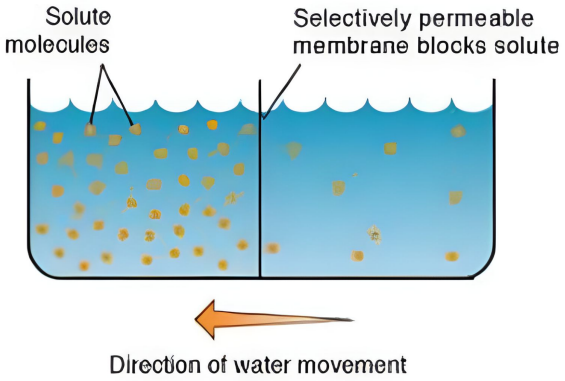
Serum Values of Electrolytes

Cations	Concentration
mEq/L	
Sodium	135 - 145
Potassium	3.5 - 4.5
Calcium	4.0 - 5.5
Magnesium	1.5 - 2.5
Anions	**Concentration**
Chloride	95 - 105
Phosphate	2.5 - 4.5

osmosis

Definition

net diffusion of water from a region of high water concentration to a region of low water concentration.



Tonicity:

Definition

Tonicity: means effective osmolality in relation to plasma (=285milliosmol/L).

Therefore isotonic solutions [e.g. 0.9% saline solution] have almost equal tonicity of the plasma,

hypotonic solutions [e.g. 0.45% saline solution] have < tonicity Than plasma,

hypertonic [e.g. 3% saline solution] solutions have > tonicity Than plasma.

Osmosis and tonicity:

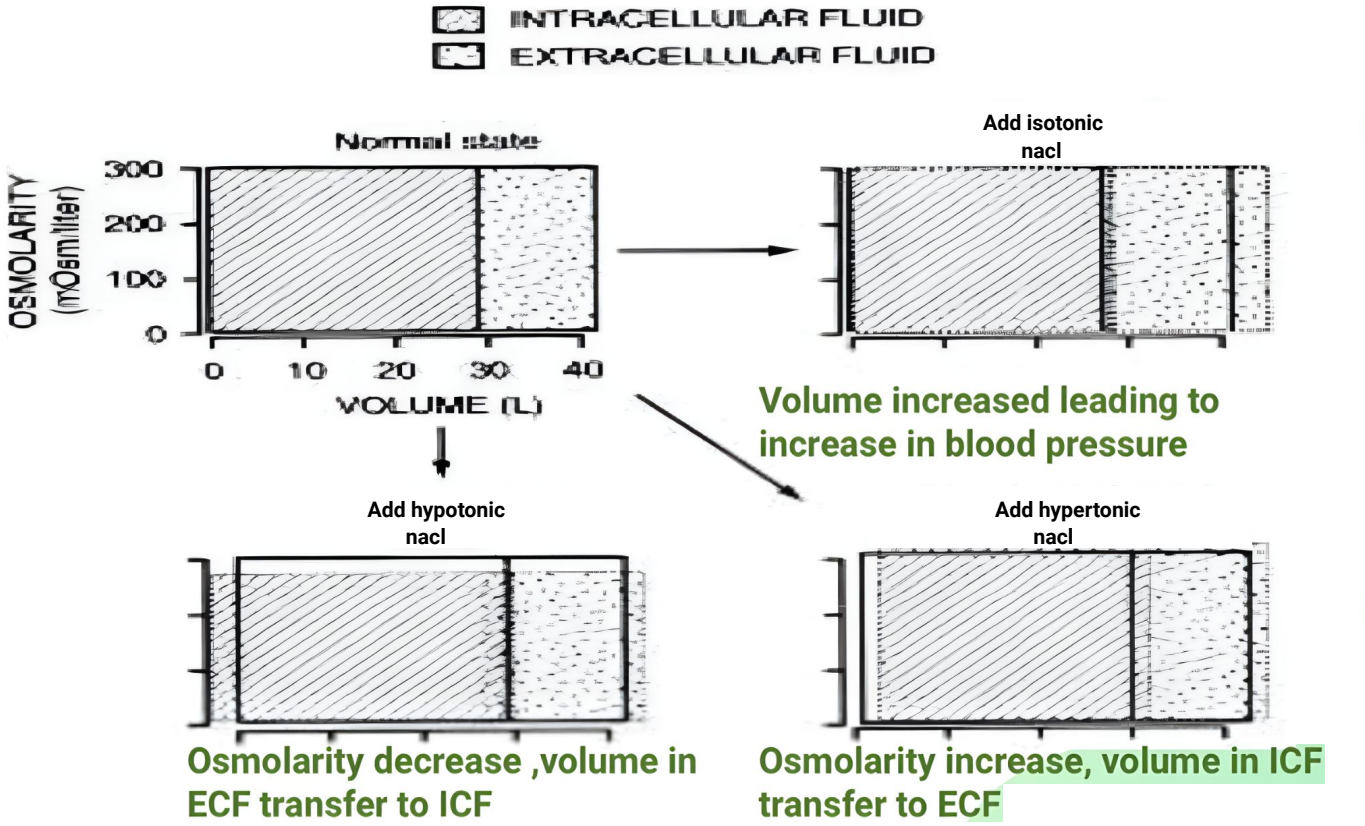
Type of **environment**	Hypertonic:	Isotonic:	Hypotonic:
Notes: Look at page 21 for a picture	• MORE SOLUTES outside cell • MORE WATER IN CELL • over time, cell loses water • (shrink) •solution of sodium chloride 0.9% • out is higher than in	• same solutes • No change in cell volume • (no swells or shrink) • 0.9% solution of sodium chloride stays the same • same in and out	• LESS SOLUTES outside cell • LESS WATER IN CELL, more solutes in cell. • over time, cell gains water • (swelling) •solution of sodium chloride 0.9% • in is higher than out .

Composition of common parenteral fluids (Electrolytes Content mEq/L)

Solutions	*Na+*	*K+*	*Ca++*	*Mg+*	*Cl-*	*HCO3-*	*Osmolality*
Extracellular fluid	142	4	5	3	103	27	280-310 mOsm/L
Ringer's lactate	130	4	3	-	109	28*	Isotonic
0.9% NaCl	154	-	-	-	154	-	Isotonic
0.45 NaCl	77	-	-	-	77	-	Hypotonic
D5% Water (Glucose 5 grams/dl)	-	-	-	-	-	-	Hypotonic
3% NaCl	513	-	-	-	513	-	Hypertonic

*Transformed from lactate to bicarbonate by the liver

Effects of adding saline solution to the EFC:



Glucose and other solutions administered for nutritive purposes

Who needs it?

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

How to give it for them?

Drip Slowly.

In order to maintain volume Where to prepare it?

Prepared in isotonic solution.

Water is excreted.

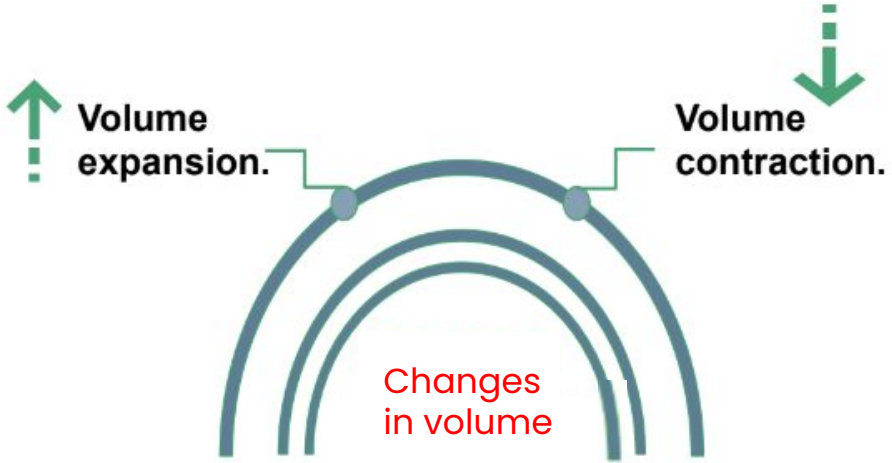
Volumes and Osmolarities of ECF and ICF in Abnormal states

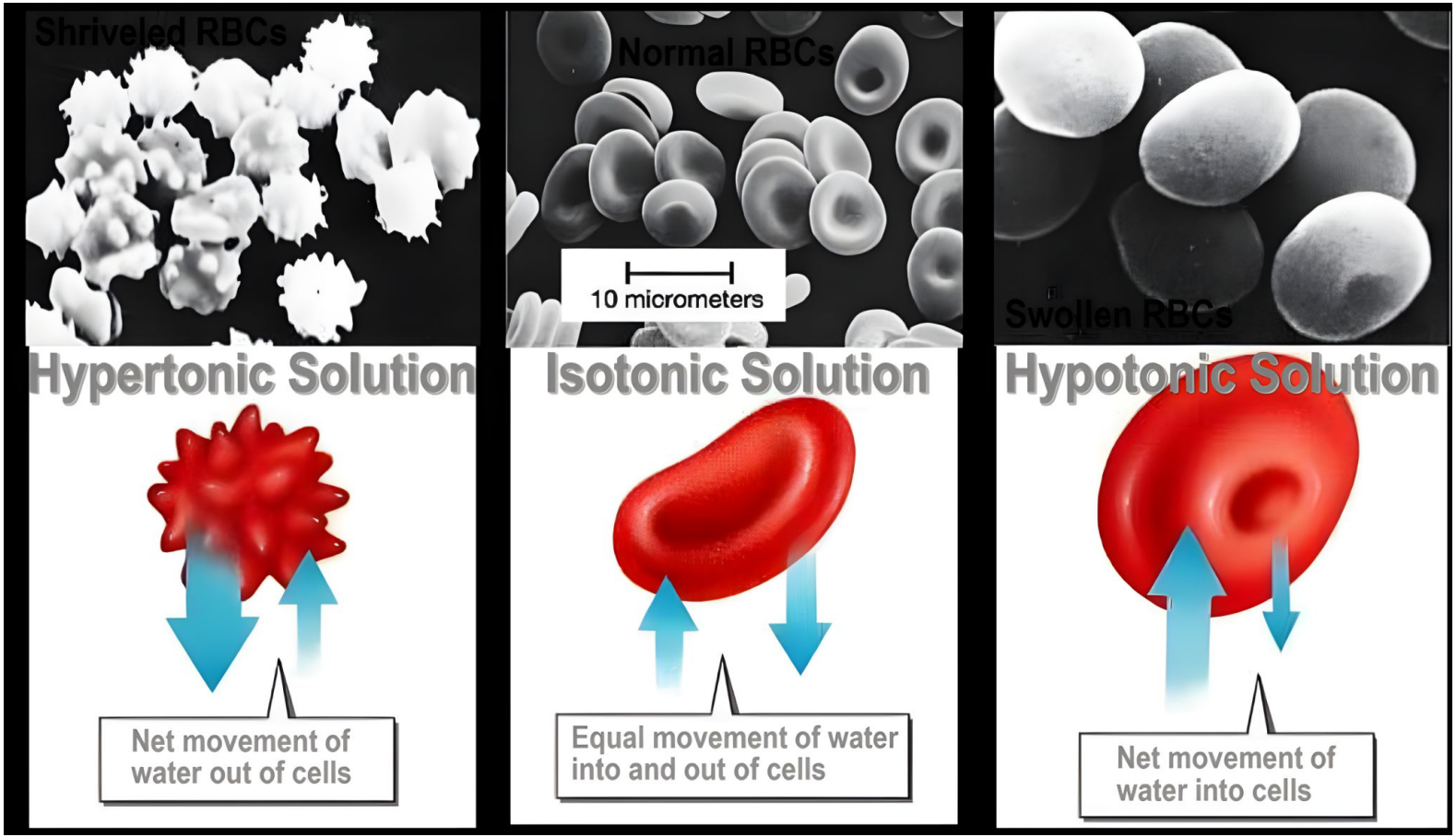
some factors can Cause the change :

1. Dehydration.

2. Intravenous infusion (IV).

3. Abnormal sweating .




Shriveled RBCs
Normal RBCs
10 micrometers
Swollen RBCs
Hypertonic Solution
Isotonic Solution
Hypotonic Solution
Net movement of water out of cells
Equal movement of water into and out of cells
Net movement of water into cells

MCQs

1- Which of the following is an isotonic solution?			
A- 0.45% sodium chloride	B- 0.9% sodium chloride	C- 5% sodium chloride	D- 19% sodium chloride

2- Which of the following represent a positive feedback mechanism			
A- Uterus contraction	B- Blood pressure	C- Decrease Body temperature	D- Increase Body temperature

3- Which of the following is considered as a "positive" feedback mechanism			
A-Thermoregulation	B- Co regulation	C- Blood coagulation	D- Blood pressure

3-C

2-A

1-B

SAQs

1- What is homeostasis?

Answer: the ability to maintain a relatively stable internal environment in an ever-changing outside world

2- What are The Components of control mechanisms?

Answer: A control mechanism consists of three main components: a sensor (receptor), a control center, and an effector.

3- what is the difference between negative and positive feedback?

Answer: negative:opposes the effect and maintains it
positive: increases the effect

1-B

2-A

3-C

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