LECTURE 4

نعتذر اذا السلايدات كثيرة، لان سلايدات البنات تختلف كليًا عن سلايدات الأولاد.
السلايدز مقسمة شي للأولاد وشئ للبنات وحاولنا نجمع بين الاثنين.

-البنات هذا لكتشير ونص

- Red : important
- Black : in male / female slides
- Pink : in girls slides only
- Blue : in male slides only
- Green : notes, Extra

HOMEOSTASIS (1+2)

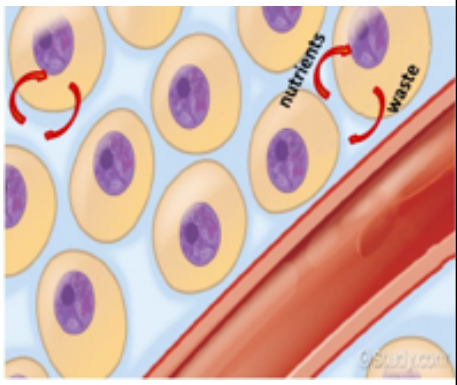
OBJECTIVES :

- Define the concept of the "internal environment" and state its physiological importance.
- Differentiate between the external and internal environments.
- Define and discuss the concept of homeostasis and its importance to the living organism.
- Discuss the physiologic control mechanisms that enable maintenance of the normal steady state of the body.
- Define a feedback mechanism and describe its components.
- Differentiate between positive and negative feedback mechanisms and give examples for each in the body
- Understand the concept and importance of homeostasis.
- Understand how the steady state is monitored.
- Identify and describe the compensatory responses to any change in the steady state.
- Identify and describe the disturbances of volumes of ECF and ICF.

This slide was found only in female slides

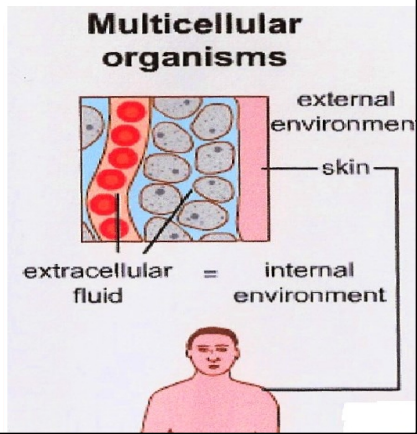
THE INTERNAL ENVIRONMENT"MILIEU INTÉRIEUR"

- All the cells in the body are continuously bathing in fluid.
- Because this fluid is ***outside*** the cell, it is called ***extra cellular fluid (ECF).***
- It is from the ECF that cells get the ions and nutrients needed to maintain life.



- Because,All body cells live in the same environment (i.e. ECF).
- The composition of ECF is almost **similar** between the different species.
- It was named the "***internal environment***" by the French physiologist ClaudeBernard.

ECF = the internal environment.



- The skin separates this environment from the outside world which known as ***the external environment***.

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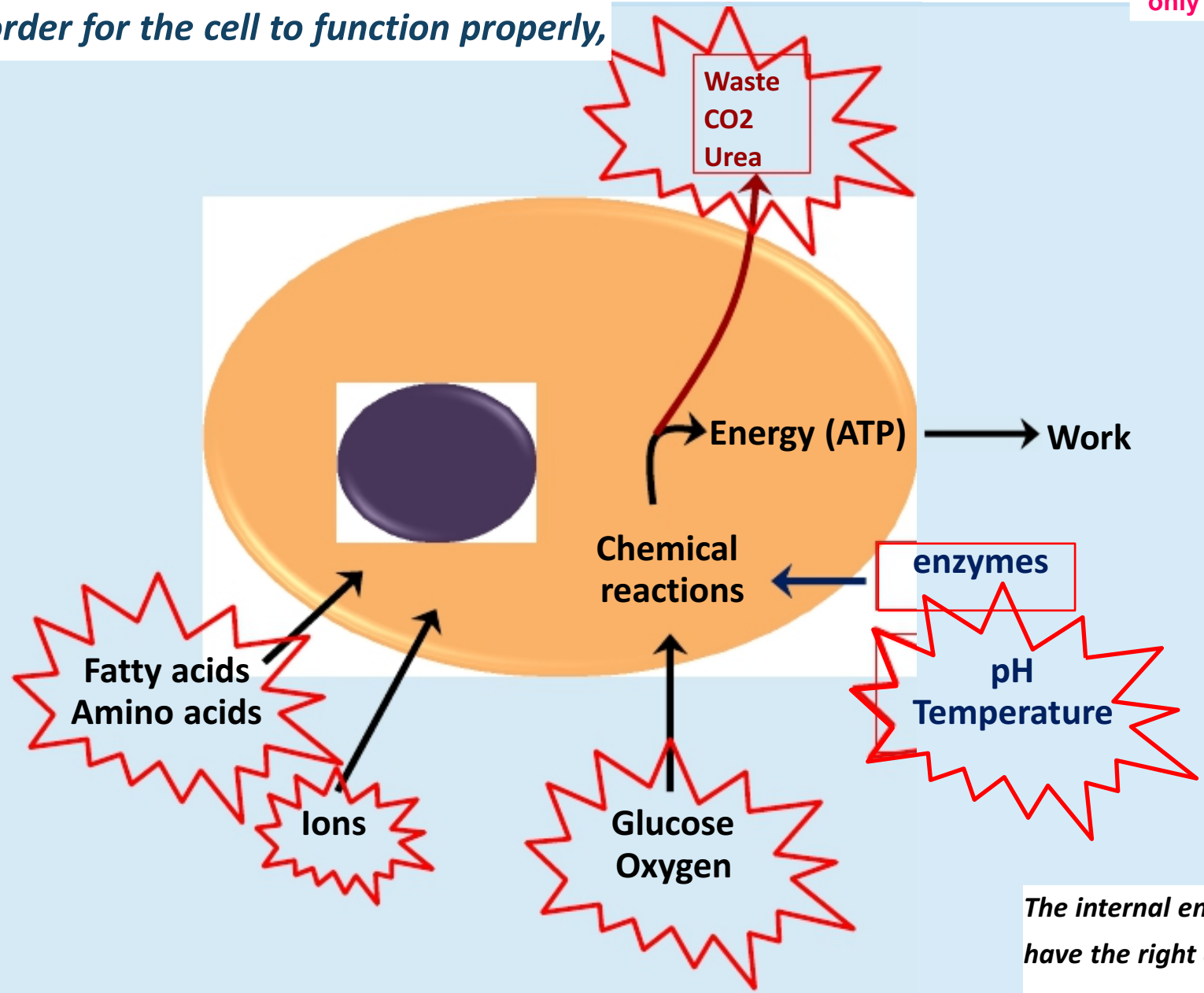
In order for the cell to function properly,



ECF

The internal environment need to have the right amount/level of these substances/variables.

(not too much and not too little)

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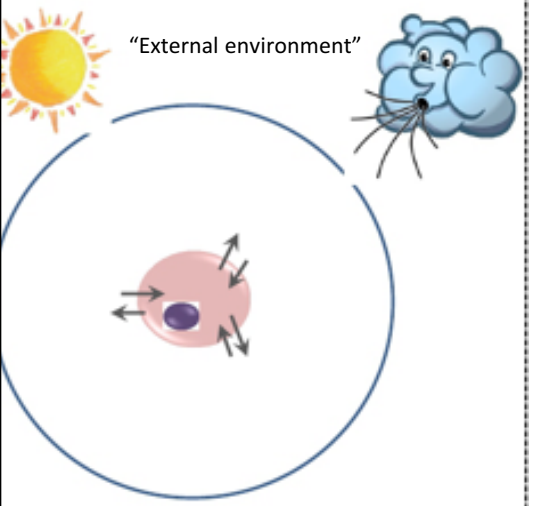
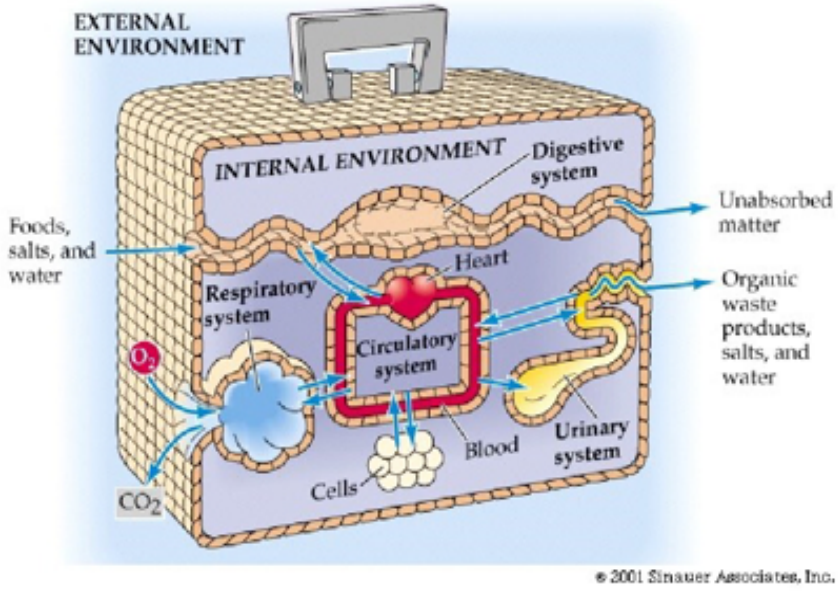
EXTERNAL VS INTERNAL ENVIRONMENT

In Multicellular organisms



In Unicellular organisms

Internal environment = External environment



HOMEOSTASIS

-What is Homeostasis?

It is the ability to maintain a relatively stable internal environment in the changing outside world, (a dynamic state of equilibrium).

- The process by which the body keeps the internal environment constant despite changes in the external environment is known as " Homeostasis ".

Purpose: maintain a stable internal environment (ECF = Interstitial).

All different body systems operate in harmony to provide homeostasis.

HOMEOSTATIC CONTROL MECHANISMS

How is this achieved?

⇩

By feedback mechanisms

Variable → Change in body (Stimuli)

There are three interdependent components of control mechanisms:

1. Receptor: Stimulation. "Sensory nerves."

2. Control center: Set point. "Nervous system / Endocrine system"

3. Effector: Response (The feedback). "Muscle / Gland"

The body has thousands of control systems.

- They function to restore balance when it is lost.
- Control systems operate;
  - ***Within the organ*** itself
  - Throughout the body ⟶ to control ***interrelations between organs***.

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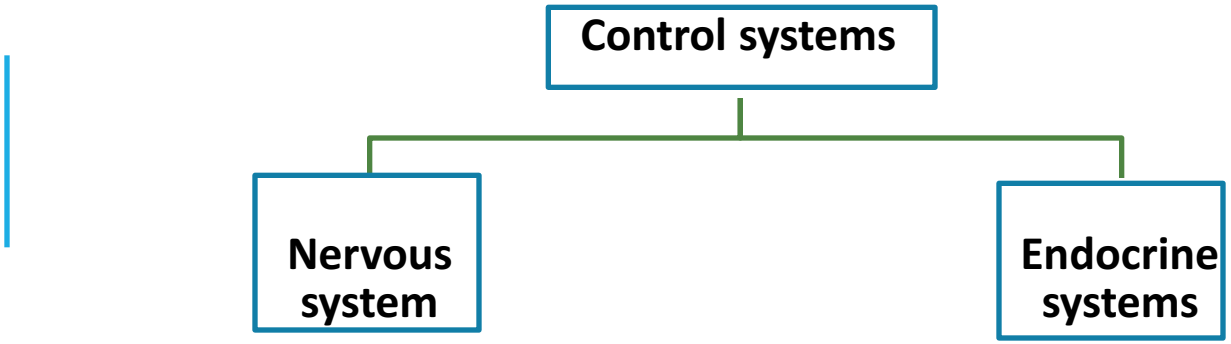


Protection

Skin

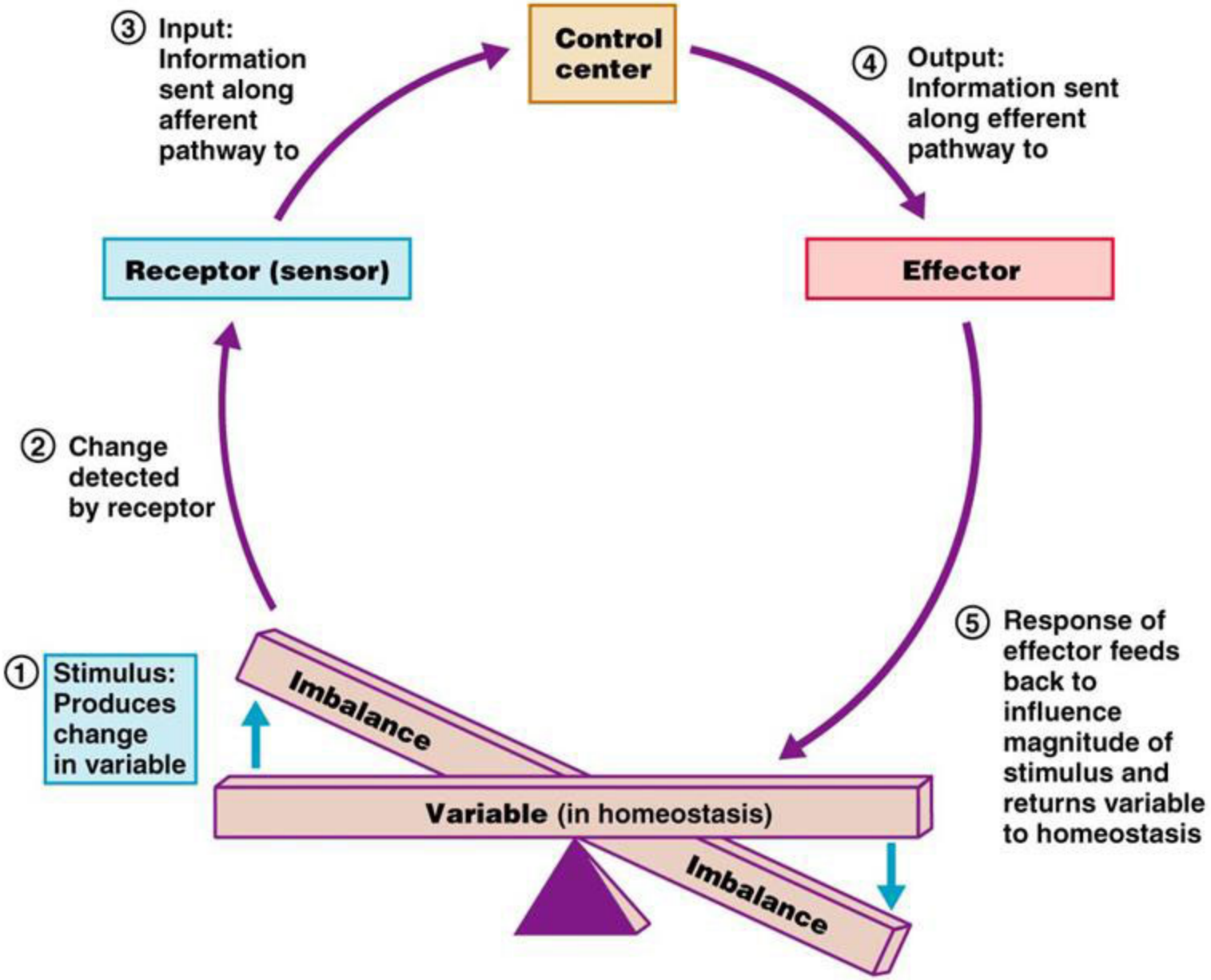
Immune system

Concentrations of Extracellular and Intracellular Electrolytes in Adults

Electrolyte	Extracellular Concentration*	Intracellular Concentration*
Sodium	135–148 mEq/L	10–14 mEq/L
Potassium	3.5–5.0 mEq/L	140–150 mEq/L
Chloride	98–106 mEq/L	3–4 mEq/L
Bicarbonate	24–31 mEq/L	7–10 mEq/L
Calcium	8.5–10.5 mg/dl	< 1 mEq/L
Phosphate/ phosphorus	2.5–4.5 mg/dl	4 mEq/kg†
Magnesium	1.8–2.7 mg/dl	40 mEq/kg†

*Values may vary among laboratories, depending on the method of analysis used.

†Values vary among various tissues and with nutritional status.


③ Input: Information sent along afferent pathway to
Control center
④ Output: Information sent along efferent pathway to
Receptor (sensor)
Effector
② Change detected by receptor
⑤ Response of effector feeds back to influence magnitude of stimulus and returns variable to homeostasis
① Stimulus: Produces change in variable
Imbalance
Variable (in homeostasis)
Imbalance

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

TYPES OF FEEDBACK MECHANISM

1. Negative feedback:

Effector is in opposite direction to stimulus.

Self limiting

More common

2. Positive feedback:

- Effector favors the same direction of the stimulus
- Self augmenting
- Less common

EXAMPLE OF POSITIVE FEEDBACK

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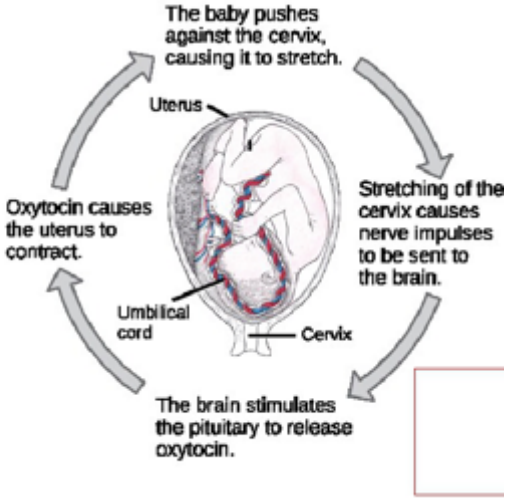

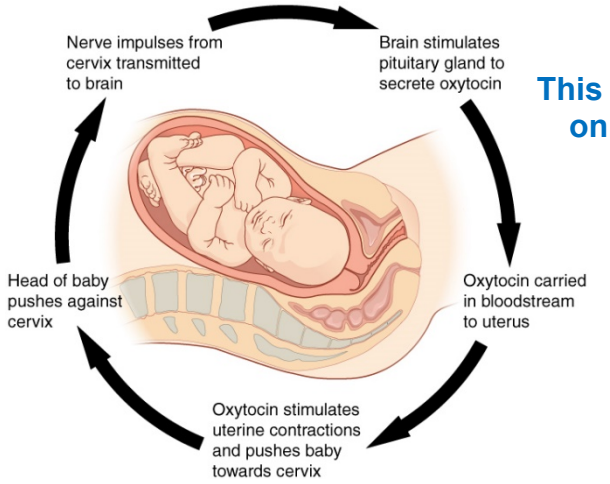

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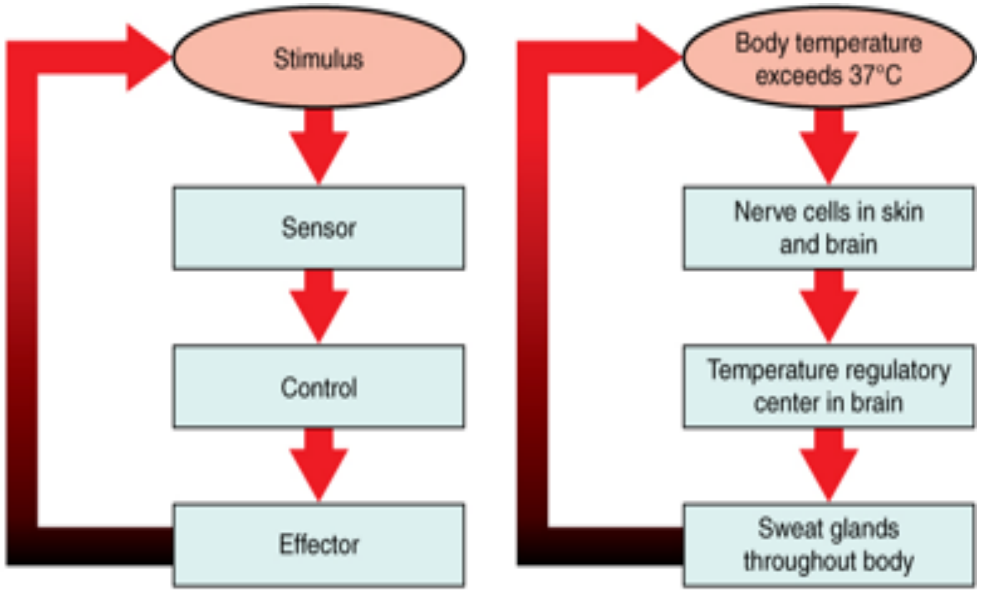
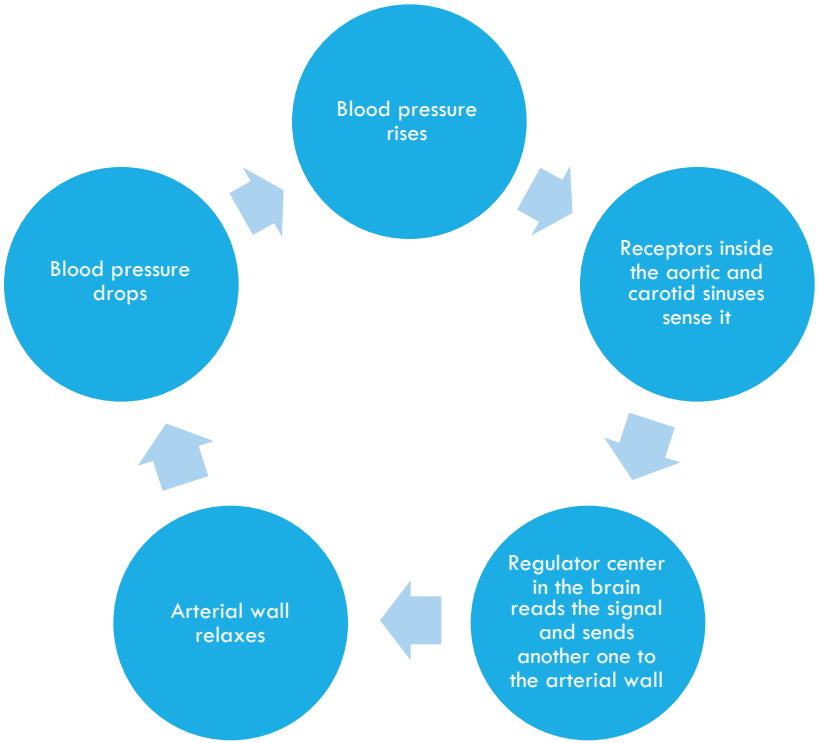
EXAMPLE OF THE NEGATIVE FEEDBACK CONTROL



(a) Negative feedback loop

(b) Body temperature regulation



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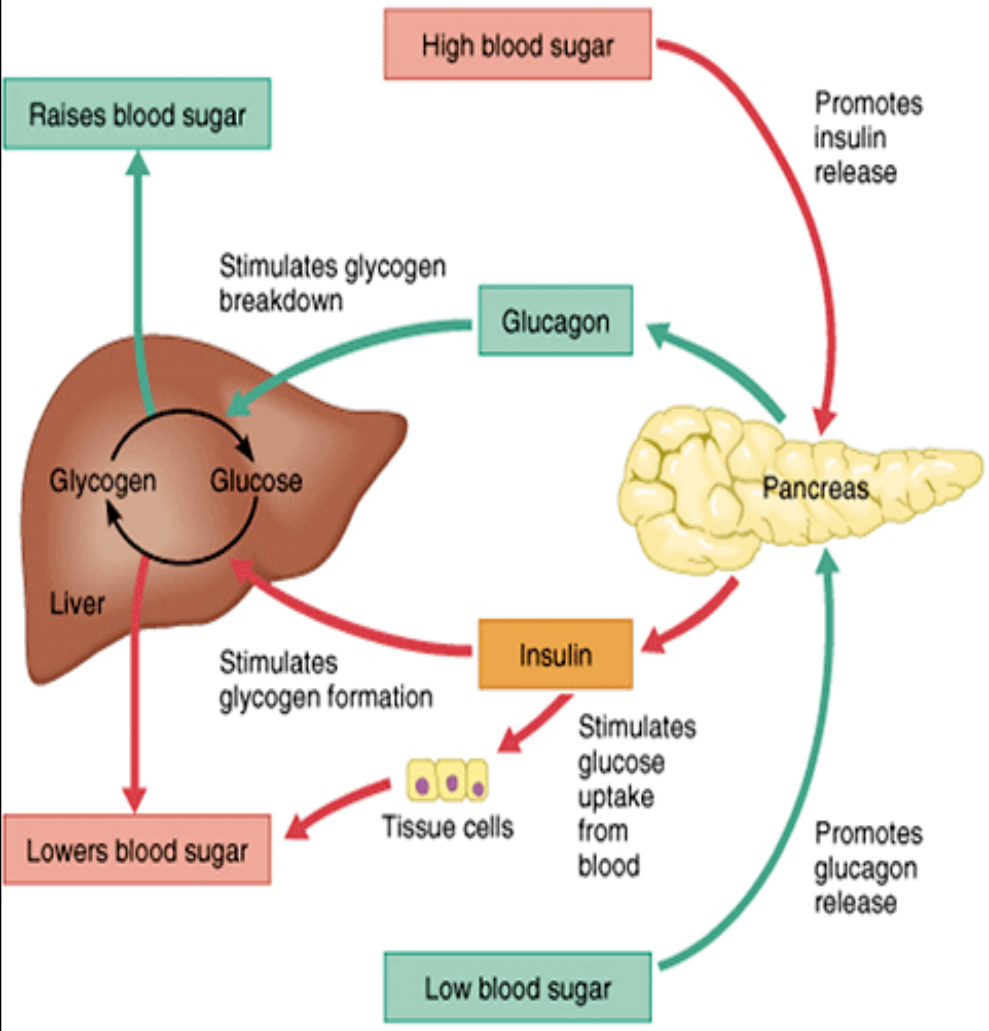
REGULATION OF BODY FUNCTIONS

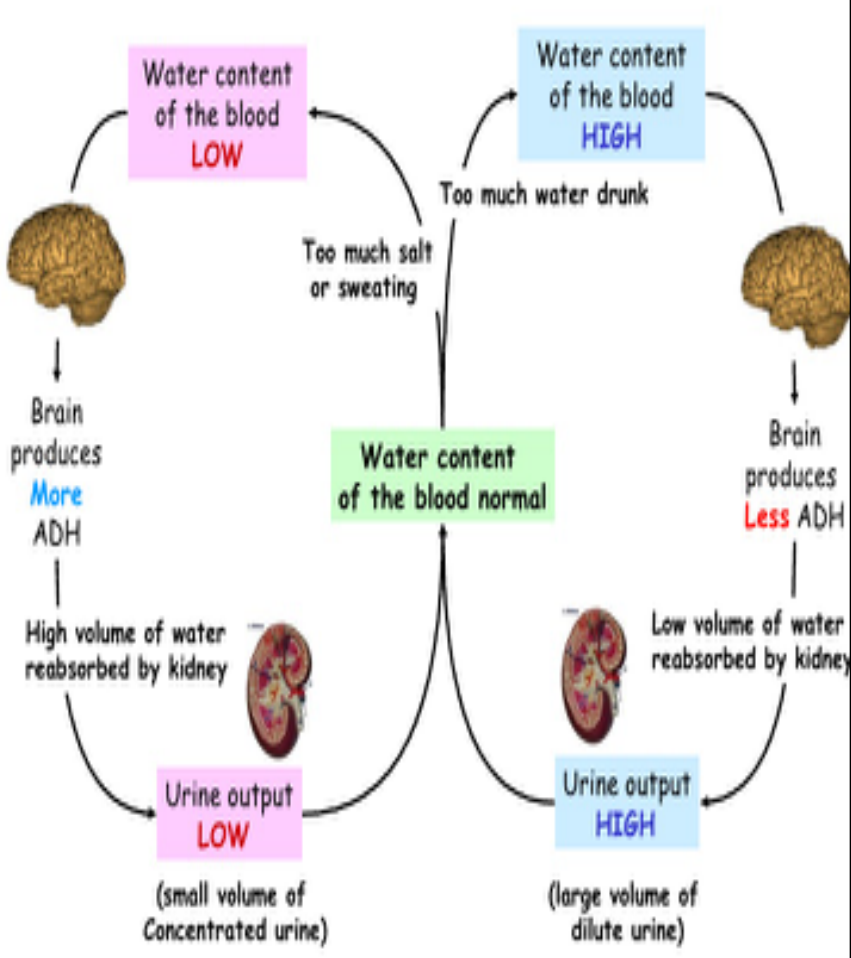
1) Nervous system:

- Sensory input: detect the state of the body, or the state of the surroundings, it comes through the sensory organs (the eyes, ears..)
- Central nervous system (CNS): determines the required reaction to response to the sensations, and produce a signal.
- MOTOR OUTPUT: Perform the desired action.
- Faster

2) Hormonal system of regulation:

- Hormones are being secreted from the major 8 endocrine glands (pancreas, thyroid…) in the body to the extracellular fluid and then to all parts of the body to help regulate cellular functions.
- E.g. : insulin is secreted from the pancreas to help control glucose level.
- Slower


High blood sugar
Raises blood sugar
Promotes insulin release
Stimulates glycogen breakdown
Glucagon
Glycogen
Glucose
Liver
Pancreas
Insulin
Stimulates glycogen formation
Stimulates glucose uptake from blood
Tissue cells
Lowers blood sugar
Promotes glucagon release
Low blood sugar


Water content of the blood LOW
Water content of the blood HIGH
Too much water drunk
Too much salt or sweating
Brain produces More ADH
Water content of the blood normal
Brain produces Less ADH
High volume of water reabsorbed by kidney
Low volume of water reabsorbed by kidney
Urine output LOW
Urine output HIGH
(small volume of Concentrated urine)
(large volume of dilute urine)

HOMEOSTATIC IMBALANCE (NEXT SLIDE SUMMARIZES THIS)

It is the disturbance of homeostasis or the body's normal equilibrium.

It basically produces a change in the normal condition of the internal environment.

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

1. A successful compensation: homeostasis reestablished.
2. Fail to compensate: illness and death

Homeostasis

- Successful compensation
  - Homeostasis
- Failure to compensate
  - Pathophysiology
    - Illness

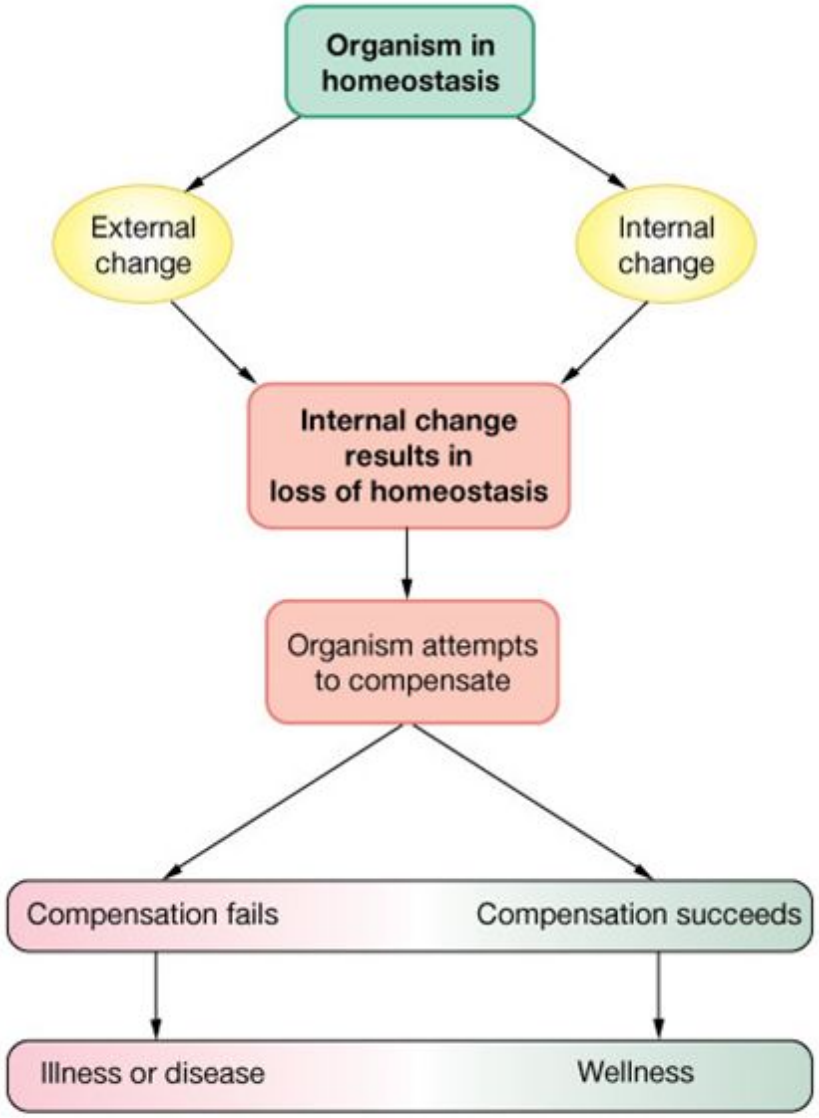


Figure 1-5: Homeostasis

OSMOSIS

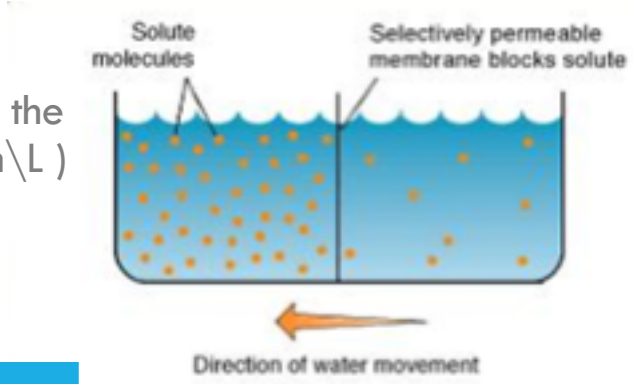
Net diffusion of water from a region of high water concentration to region of low water concentration.

In another words : the movement of water from a region of low solute concentration to a region of high solute concentration .

- 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.

Osmolarity = is the measure of solute concentration, defined as the number of osmoles (Osm) of solute per litre (L) of solution (Osm\L)



Intracellular osmolarity = extracellular osmolarity .
≈ 300 mosm/L

3 Mechanisms for Movement :		
1.Passive	2. Active	Osmosis
A) Simple Diffusion	A) Primary	
B) Facilitated Diffusion	B) Secondary	

This table was discussed in pervious lectures (in the male lectures)

TONICITY

is used to compare between the osmolarities of two or more solutions separated by a semi-permeable membrane

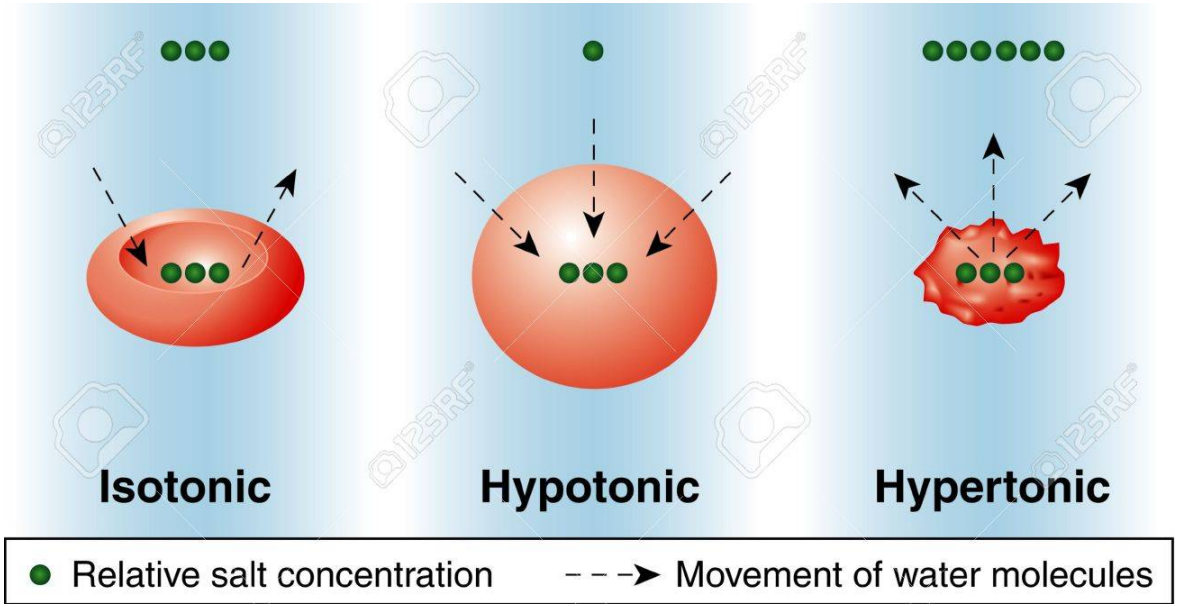
While Osmolarity describes the concentration of one solution

TONICITY VS OSMOLARITY

Tonicity	Osmolarity
• Tonicity is the measure of the osmotic pressure gradient between **two** solutions.	• Osmolarity is the measure of solute concentration per unit VOLUME of solvent.
• Isotonic solutions almost equal tonicity of the plasma.	• Measure of **one** given solution
• Hypotonic solutions have < tonicity than plasma.	• Normal ~ 300 Osm/Litre
• Hypertonic solutions have > tonicity than plasma.	

If environment is :

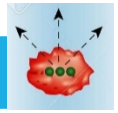
- hypotonic
  - LESS SOLUTES outside cell
  - LESS WATER IN CELL, more solutes in cell.
  - over time, cell **gains** water
- isotonic
  - same
  - No change in cell volume
- Hypertonic
  - MORE SOLUTES outside cell
  - MORE WATER IN CELL
  - over time, cell **loses** water



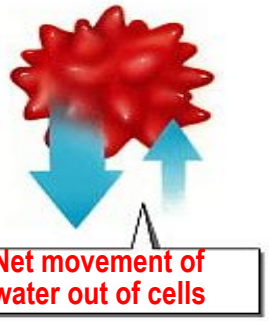
OSMOSIS:

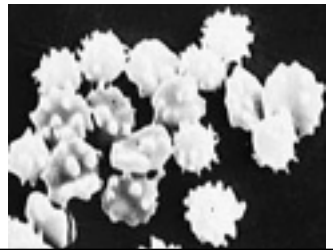
If the environment is:

1. Hypertonic

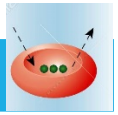


- More solutes Outside
- More water In cell
- > 0.9% (shrink)
- cell loses water

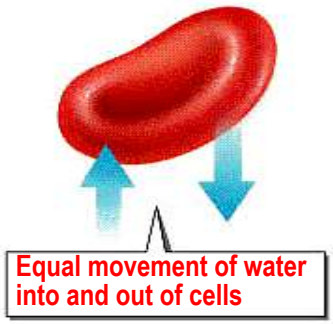


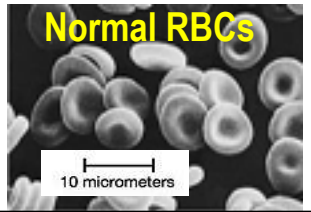


2. Isotonic

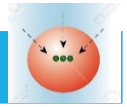


- Same conc. in and out
- No change in cell volume
- 0.9% solution of NaCl

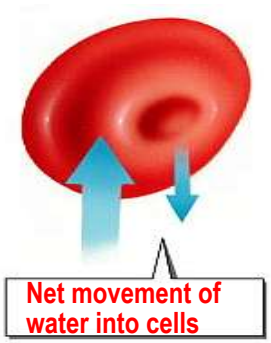


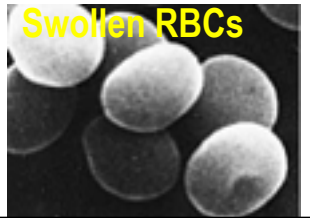


3. Hypotonic



- Less solutes outside
- Less water in cell
- < 0.9% (swells)
- cell gains water





GLUCOSE AND OTHER SOLUTIONS ADMINISTERED FOR NUTRITIVE PURPOSES

Who needs it ? People who can not take adequate amount of food

How to give it for them ? Drip slowly

Where to prepare it ? Prepared in an isotonic solution. And water is excreted.

VOLUME AND OSMOLARITIES OF ECF AND ICF IN ABNORMAL STATE

نلاحظ هنا ان الطول نفسه بالاثنين osmolarity
مختلف العرض بينما volume

Some factors can cause the change :

- dehydration
- intravenous infusion (IV)
- abnormal sweating.
- etc..

Types of change in volume :

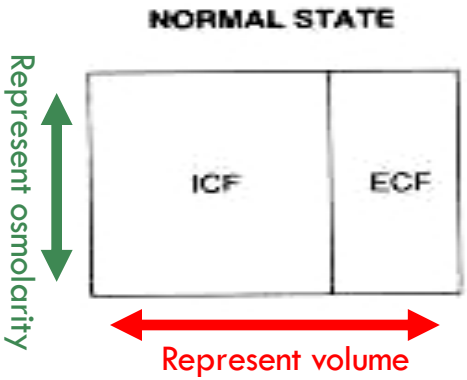
1- volume contraction

(removing)

2- volume expansion

(adding)

Notes :

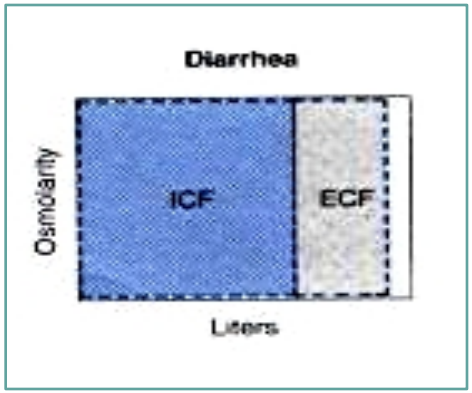


- Osmolarity is always the **same** for ICF and ECF

Volume contraction

Loss of iso-osmatic fluid

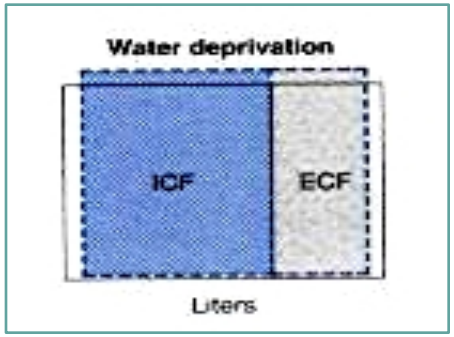
e.g. Diarrhea



- osmolarity of fluid lost ≈ osmolarity of ECF (loss of isosmotic fluid).
- ↓volume in ECF.
- ↓arterial pressure.

Loss of hypotonic solution

e.g. water deprivation

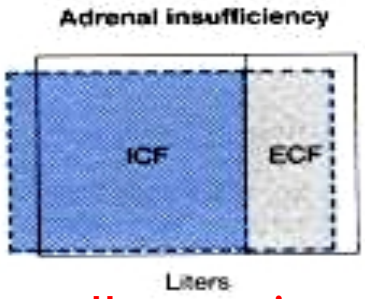


Hyperosmotic dehydration

- Osmolarity and volume will change .
- ↑ Osmolarity in both ECF and ICF.
- ↓ Volume in both ECF and ICF.

Loss of hypertonic sol

e.g. adrenal insufficiency



Hypo-osmotic dehydration

i.e. Aldosterone deficiency

- ↓Na^+ in the ECF.
- ↓ osmolarity in both .
- ↓ in ECF volume.
- ↑ in ICF volume.

Volume expansion

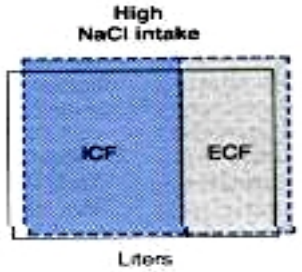
1- Adding of isotonic NaCl.

↑ in ECF volume.

- No change in osmolarity.

- Isomotic expansion

2- High NaCl intake



↑ - eating salt.

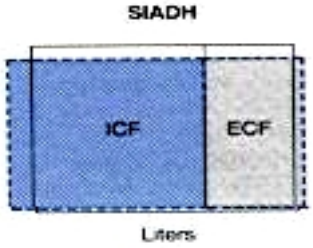
↑ - osmolarity in both.

↓ - volume of ICF .

↑ - volume of ECF .

- hyperosmotic volume expansion.

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



- ↑ Volume

- ↓ osmolarity

QUIZ

1/. Glands are considered..... ?			
A) Receptors.	B) Control center.	C)Effectors	D) Hormones

2/ contraction of uterus is example of .....?			
A) positive feed back.	B) negative feed back	C) effective reaction	D) slow reaction

3/ Failure to compensate leads to .....?			
A) homeostasis	B) illness	C) death	D) either B or C

4/ Diarrhea is example of .....?			
A) volume contraction	B) loss of isosmotic fluid	C) gain of isosmotic fluid.	D) both A and B

Key answers:

1) C
2) A
3) D
4) D

THANK YOU

Boys team members	Girls team members
• عمر الدوسري	• اروى الامام
• زياد الدوسري	• ديما المزيد
• عبدالله الغامدي	• جود الخليفة
• محمد الحمد	• جود العتيبي
• عوض العنزي	• رغد المبارك
• فيصل القفاري	• ريناد المطوع
• عبدالله باسمح	• ريما المطوع
	• طرفة آل كلثم
	• مي بابعير
	• نجود العلي
	• نورة المزروع

Team leaders:

- عمر الشيناوي
- ايلاف المسيحل