



Physiology  
team



It's EASY!

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## Homeostasis I

### **SIMPLE QUOTE:**

*Whatever you are, be a good one.*



# Objectives



At the end of this session, the students should be able to:

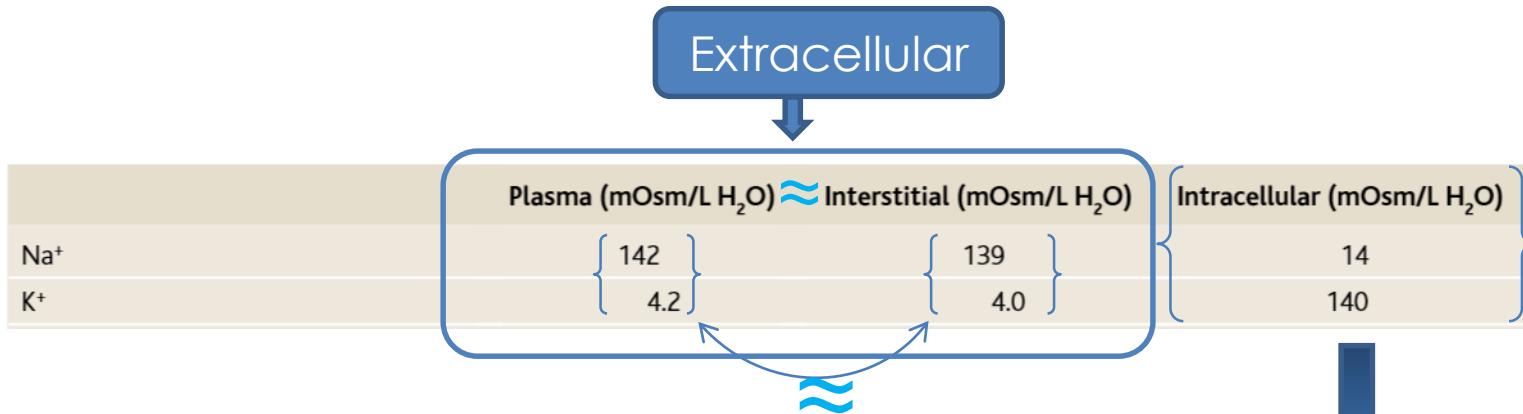
- Understand the concept and importance of homeostasis.
- Understand how the steady state is monitored.
- Review the compensatory responses to any change in the steady state.
- Review the disturbances of volumes of ECF and ICF.

## Extracellular and Intracellular Fluids



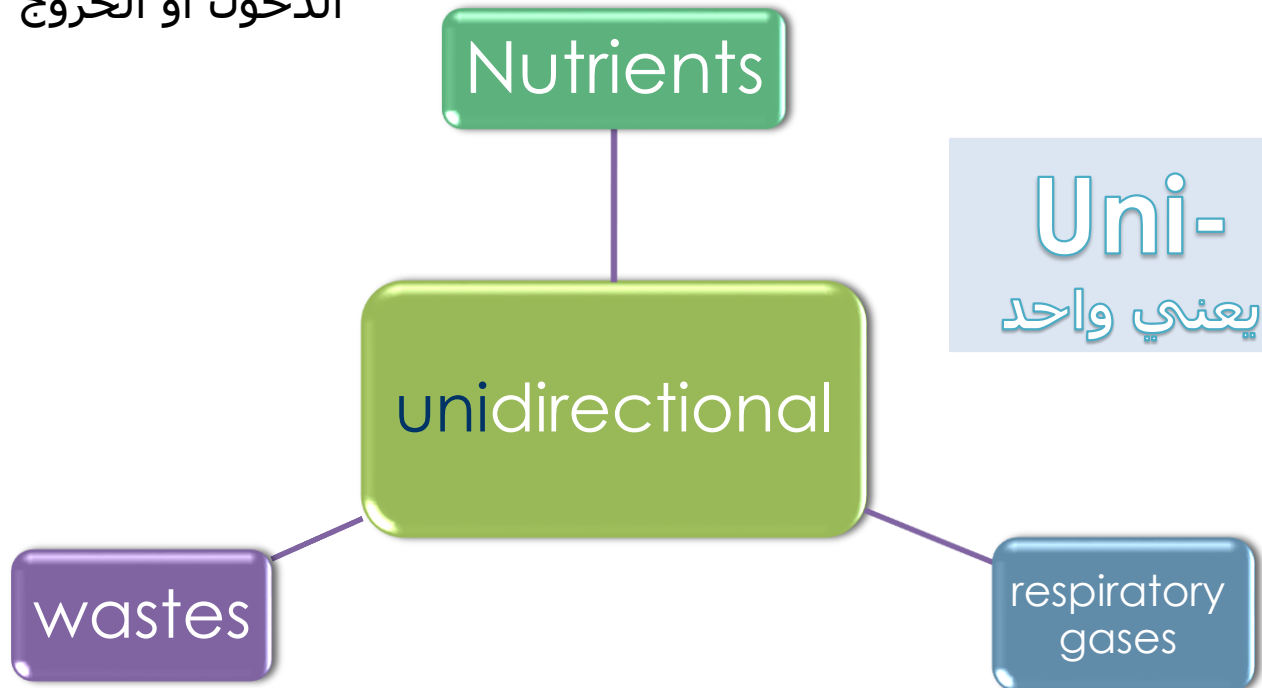
Extracellular

	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



the intracellular fluid contains only **small** quantities of **sodium (Na)** and **large** amounts of **potassium (K)**

- **Ion fluxes** are **restricted** ( مقيد ) and move **selectively** by **active** transport (require energy) .  
الأيونات التي تدخل الخلية تكون مقيدة و محددة و تحتاج إلى طاقة بسبب النقل النشط
- Nutrients, respiratory gases, and wastes move **Unidirectional**.  
المواد التي يكون إتجاهها واحد في الدخول أو الخروج من الخلية .



**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 ( المذاب في السائل ) concentrations are quickly followed by osmotic changes .

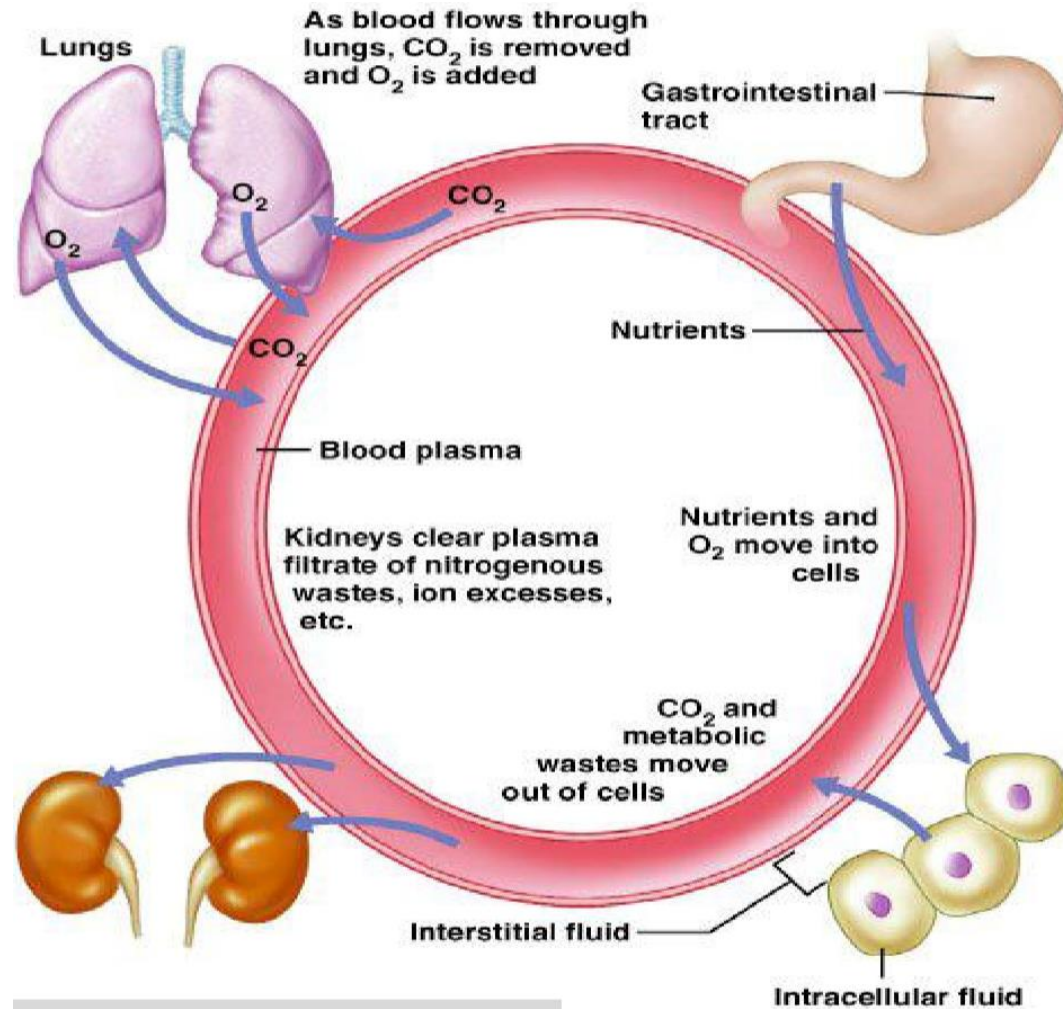
Osmolality : osmoles per **k**ilogram of **w**ater

Osmolarity : osmoles per **l**iter of **s**olution

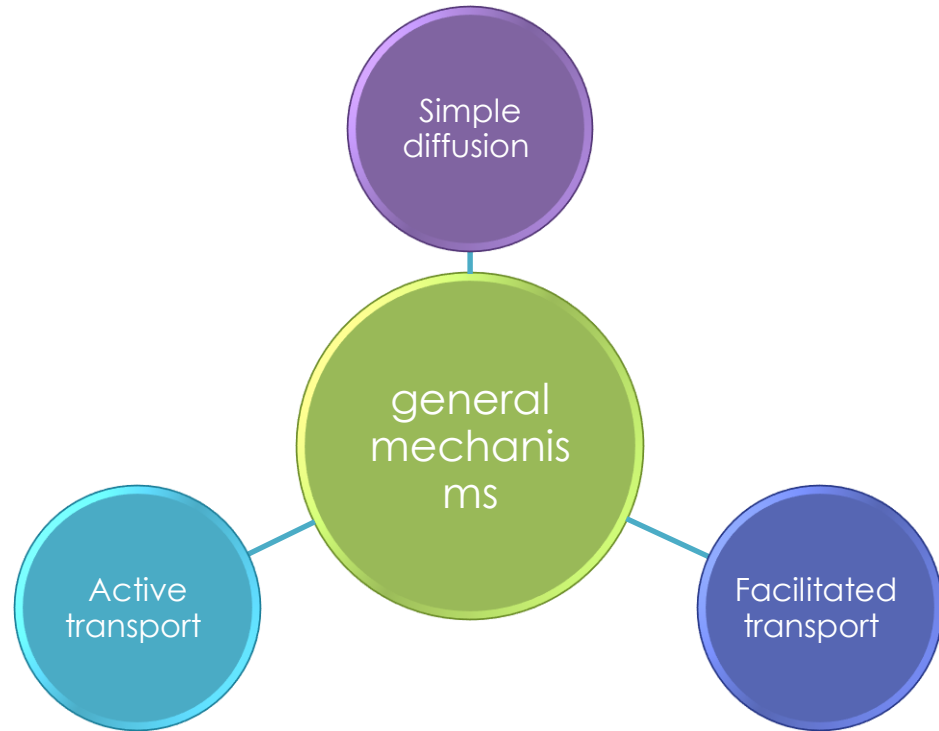
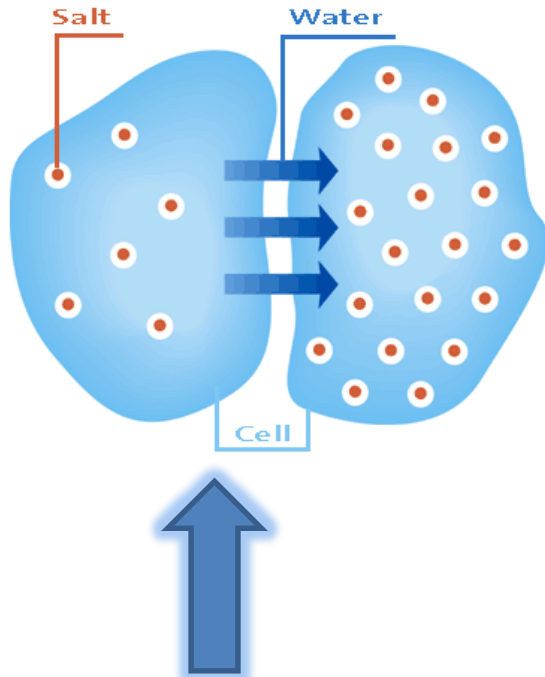
{ **L** = **kilo** }

{ **R** = **Liter** }

## Continuous exchange of Body Fluids



# Mechanisms of Movement



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



## Regulation Of Fluid Exchange



**Osmotic equilibrium** is maintained between intracellular and extracellular fluids .

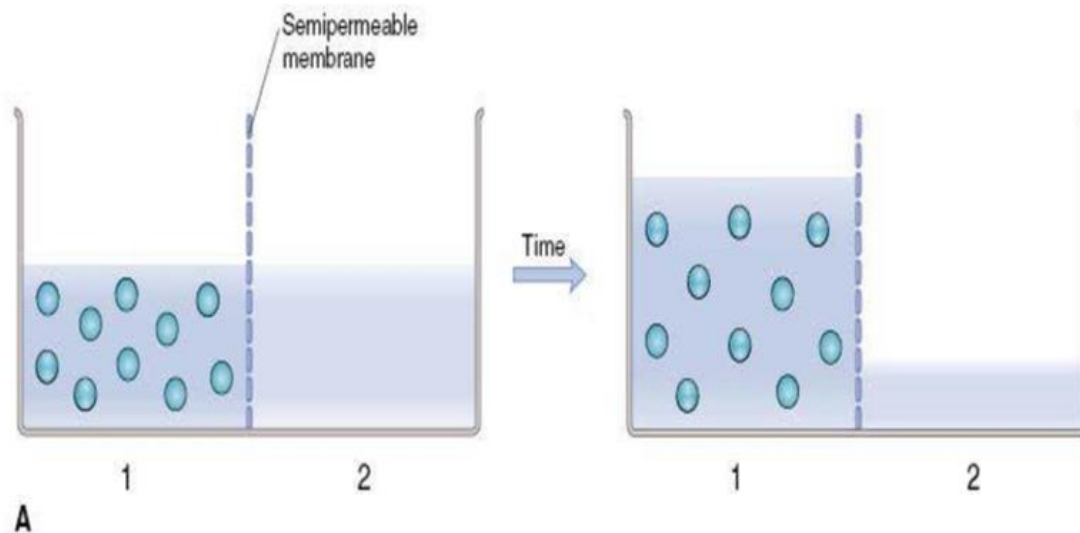
- ✓ **Small changes** in concentration of solutes in the extracellular fluid can cause tremendous (هائل) change in cell volume.

{ Intracellular osmolarity = extracellular osmolarity } → ≈ 300 mosm/L



# Osmosis of Water

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



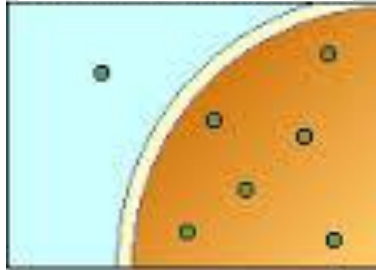
*N.P: water will flow from the hypotonic solution into the hypertonic solution. This note is just for more clarification, its not mentioned in the slides.*



## Isotonic, Hypertonic, and Hypotonic Fluids

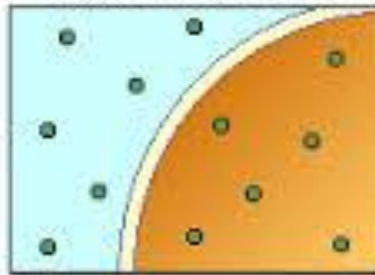


Hypotonic solution



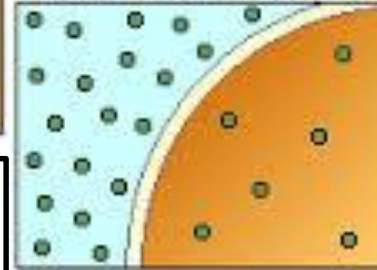
(↓ less) 0.9% solution of sodium chloride & (↓ less) 5% glucose in the plasma.  
The cell will swell.

Isotonic solution



0.9% solution of sodium chloride. 5% glucose .  
same in plasma & cell  
no swell or shrink

Hypertonic solution



(↑ more) 0.9% solution of sodium chloride & (↑ more) 5% glucose in the plasma.  
The cell will shrink.



## Isotonic, Hypertonic, and Hypotonic Fluids



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- MORE SOLUTES outside cell "hypertonic"
- MORE WATER IN CELL "hypotonic"
- over time, cell loses water. Becomes "hypertonic"

**Shrunk**



**same**

**Normal**



**Swollen**



- LESS SOLUTES outside cell "hypotonic"
- LESS WATER IN CELL, more solutes in cell. "hypertonic"
- over time, cell gains water. becomes "hypotonic"

Ion concentration  
in extracellular  
space

**Hypertonic**

**Isotonic**

**Hypotonic**

*N.P: water will flow from the hypotonic solution into the hypertonic solution.*

يخرج الماء بشكل أكبر إلى البلازما بسبب زيادة التركيز في البلازما

خروج و دخول الماء متعادل بين الخلية والبلازما بسبب تعادل التركيز في البلازما والخلية

دخول الماء بشكل أكبر إلى الخلية بسبب قلة التركيز في البلازما

# Concept of Homeostasis

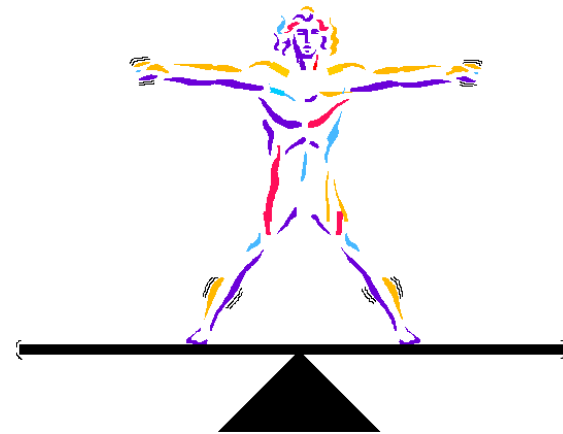


**Homeostasis** : ( The **maintenance** of nearly constant conditions in the **internal environment** ) Claude Bernard (1813 - 1878)

✓ The internal environment of the body ( **Extracellular Fluids** ) is in a dynamic state of **equilibrium**

✓ All different **body systems** operate **in harmony** (الإنسجام) to provide homeostasis

**Extreme** dysfunction → **death**  
**moderate** dysfunction → **sickness**





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# Homeostatic control mechanism



Nervous system

Sensors

**Receptor:** monitors the environments and responds to changes (stimuli)

يتم الكشف عن التغير بواسطة المستقبلات

## Control center:

determines the set point at which the variable is maintained.

يتم تحديد القيم التي يعود بها الجسم لحالته الطبيعية

The three interdependent components of control mechanisms

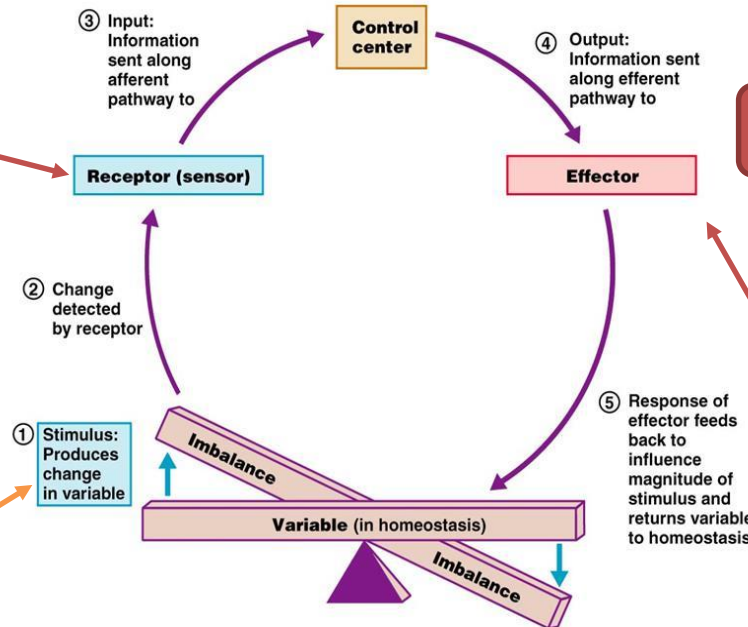
Muscles and glands

## Effector:

provides the means to respond to the stimulus.

تستجيب المؤثرات لهذه القيم وتبدأ بالعمل على تطبيقها للعودة للحالة الطبيعية

The variable produces a change in the body



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Figure 1.4

# Regulation of body functions

Hormonal  
system

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

Nervous  
system

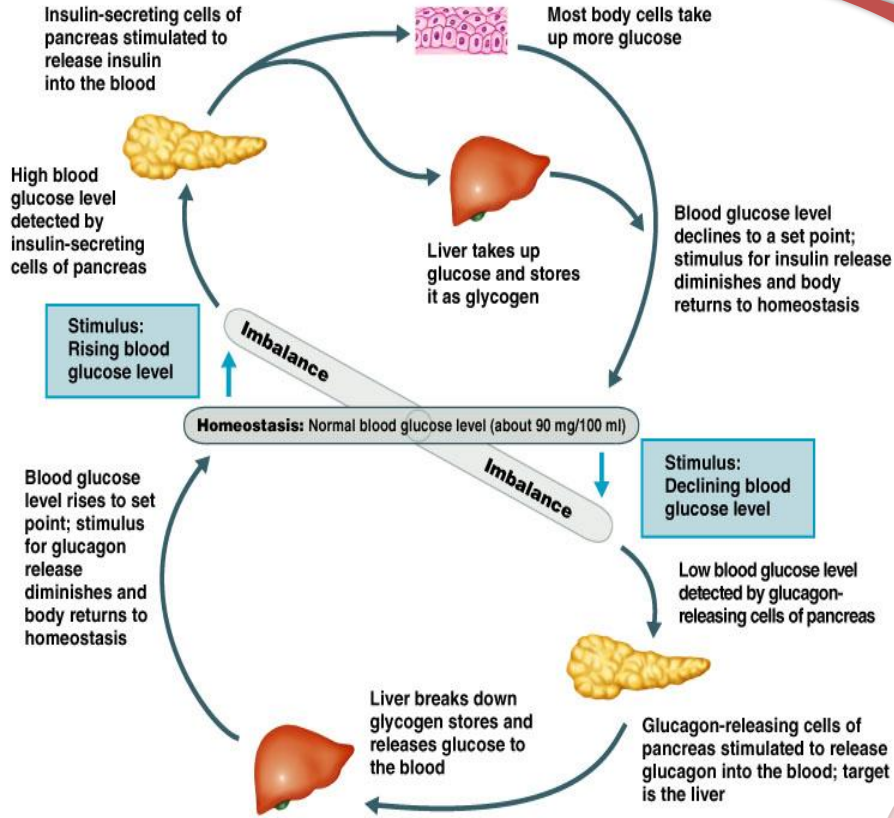
- sensory input.
- central nervous system.
- motor output.



# Examples of Homeostasis



## ارتفاع الجلوكوز



فرز الإنسولين  
( البنكرياس )

الحالة الطبيعية  
لمستوى الجلوكوز في الدم

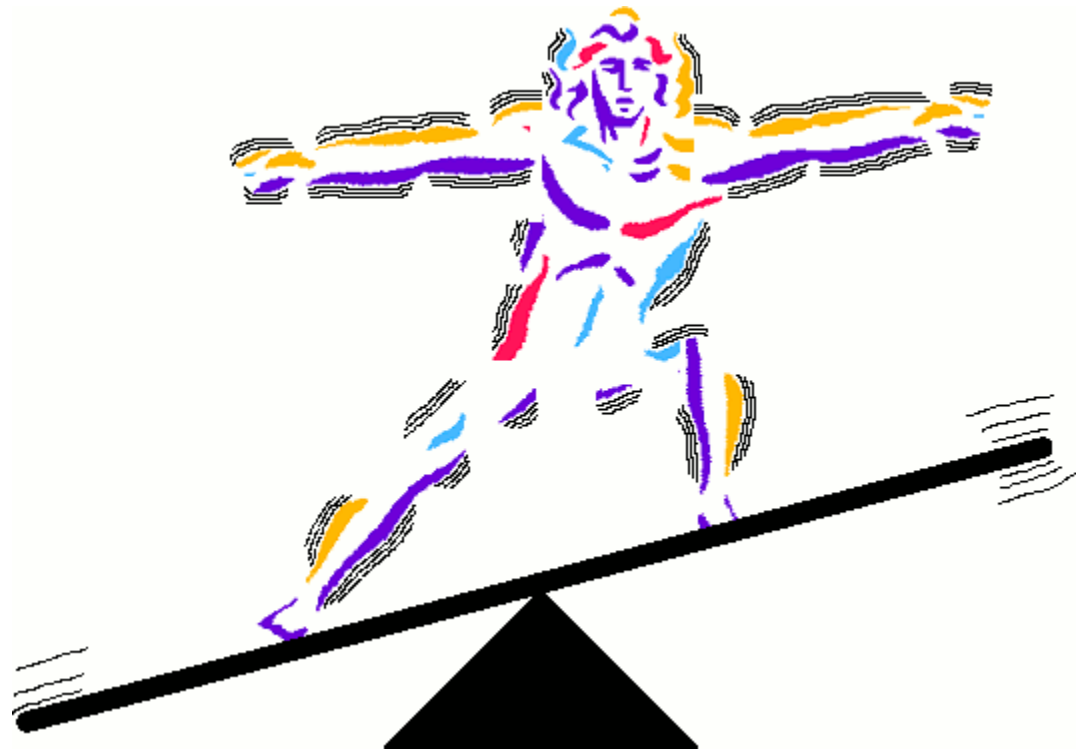
إنخفاض  
الجلوكوز  
( البنكرياس )

الحالة الطبيعية  
لمستوى الجلوكوز في الدم

تحويل الجلوكوز إلى الجلوكوز

# Homeostatic Imbalance

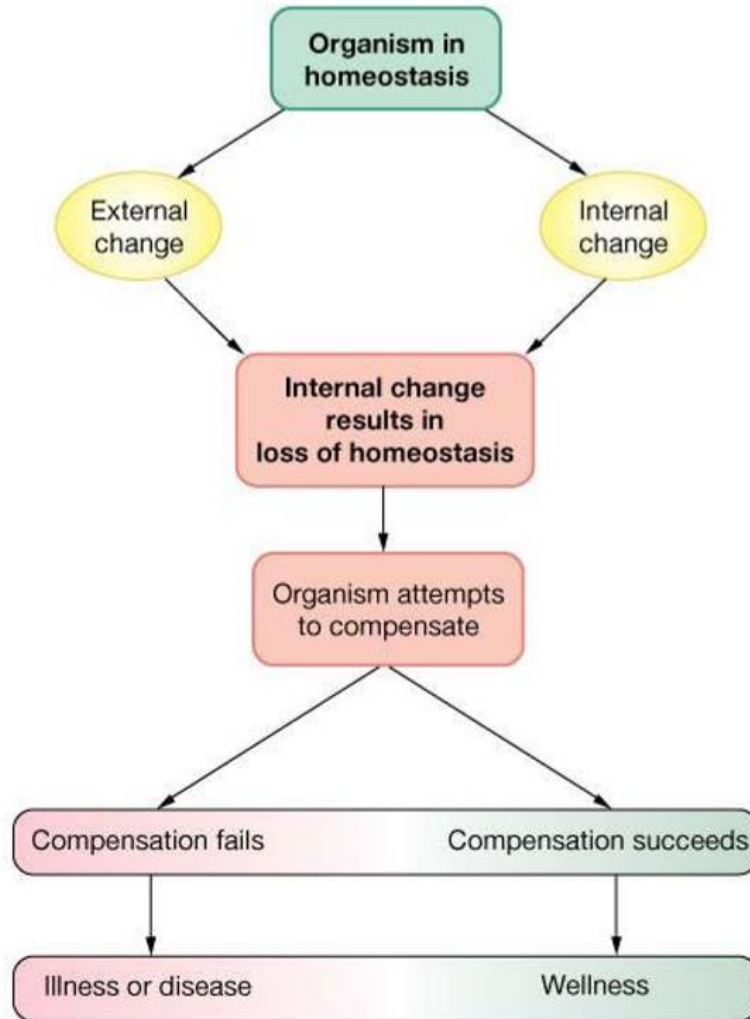
**Disturbance** ( إضطراب ) of homeostasis or the body's normal equilibrium.





# Control of Homeostasis

Successful compensation (إصلاح))  
↓  
homeostasis re-established



Failure to  
compensate

- Pathophysiology  
illness  
death



# Summary



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- (Na↓) (K↑) in **intra**cellular fluid .
- **Ion fluxes :**
  - 1- **restricted .**
  - 2- **move by active transport.**
- **Plasma** : is the only fluid that circulates throughout the body.
- **Osmolalites** of all body fluids are **equal**.
- **Homeostasis** : ( The **maintenance** of nearly constant conditions in the **internal environment** ).
- **Homeostatic control mechanism** : **Receptor** → **Control Center** → **Effector** .
- **Regulation of body functions :**
  - 1- **Hormonal** system. 2- **Nervous** system.
- **Osmotic equilibrium** is **maintained** between **intracellular** and **extracellular** fluid.
- Intracellular osmolarity = extracellular osmolarity ≈ **300 mosm/L**
- **Osmosis** : Is the flow of **water** because of differences in **solute concentration**.
- **Osmosis of water is not diffusion of water.**
- **Isotonic** (no swells or shrink ) - **Hypertonic** (shrink) - **Hypotonic** (swelling)

## Some Youtube Videos



### 1) Concept of Homeostasis :

[https://www.youtube.com/watch?v=5HS66q\\_OA8g](https://www.youtube.com/watch?v=5HS66q_OA8g)

### 2) Examples of Homeostasis :

<https://www.youtube.com/watch?v=XZxuQo3yIII>

### 3 ) Isotonic, Hypertonic, and Hypotonic Fluids :

<https://www.youtube.com/watch?v=iU8qx4-Z8Mk>

### 4) Fluid and electrolytes

<http://bk.psu.edu/clt/bisc4/ipweb/systems/systems/fluids/index.html>

(For the first 5 lectures)



## Check your understanding!



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**Q1: which of the following determine the set point of maintain the body?**

- A- Stimulus
  - B- Control Center
  - C- Effector
  - D- Receptor
- 

**Q2: diffusion of water Is the flow of water across a semipermeable membrane because of differences in solute concentration .**

- A – true
  - B – false
- 

**Q3: Isotonic solution :**

- A- shrink
  - B- swelling
  - C- None of the above
- 

**Q4: Intracellular osmolarity :**

- A – 150 mosm/L
  - B – 700 mosm/L
  - C – 300 mosm/L
- 

**Q5: Quantities of sodium in extracellular fluid is :**

- A – 139 mosm/L H<sub>2</sub>O
- B - 14 mosm/L H<sub>2</sub>O
- C – 4.2 mosm/L H<sub>2</sub>O



## Check your understanding!



Q6: Quantities of potassium in intracellular fluid is :

- A – 300 mosm/L H<sub>2</sub>O
- B - 140 mosm/L H<sub>2</sub>O
- C – 4.2 mosm/L H<sub>2</sub>O

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Q7: Quantities of potassium in extracellular fluid is :

- A – 300 mosm/L H<sub>2</sub>O
- B - 4.2 mosm/L H<sub>2</sub>O
- C – 142 mosm/L H<sub>2</sub>O

---

Q8: Osmolalities of all body fluids are :

- A – equal
- B – different
- C- None of the above

Done by :

Mohammad Saud Al-Shabanat

1) B  
2) B  
3) C  
4) C  
5) A  
6) B  
7) B  
8) A

Answers: