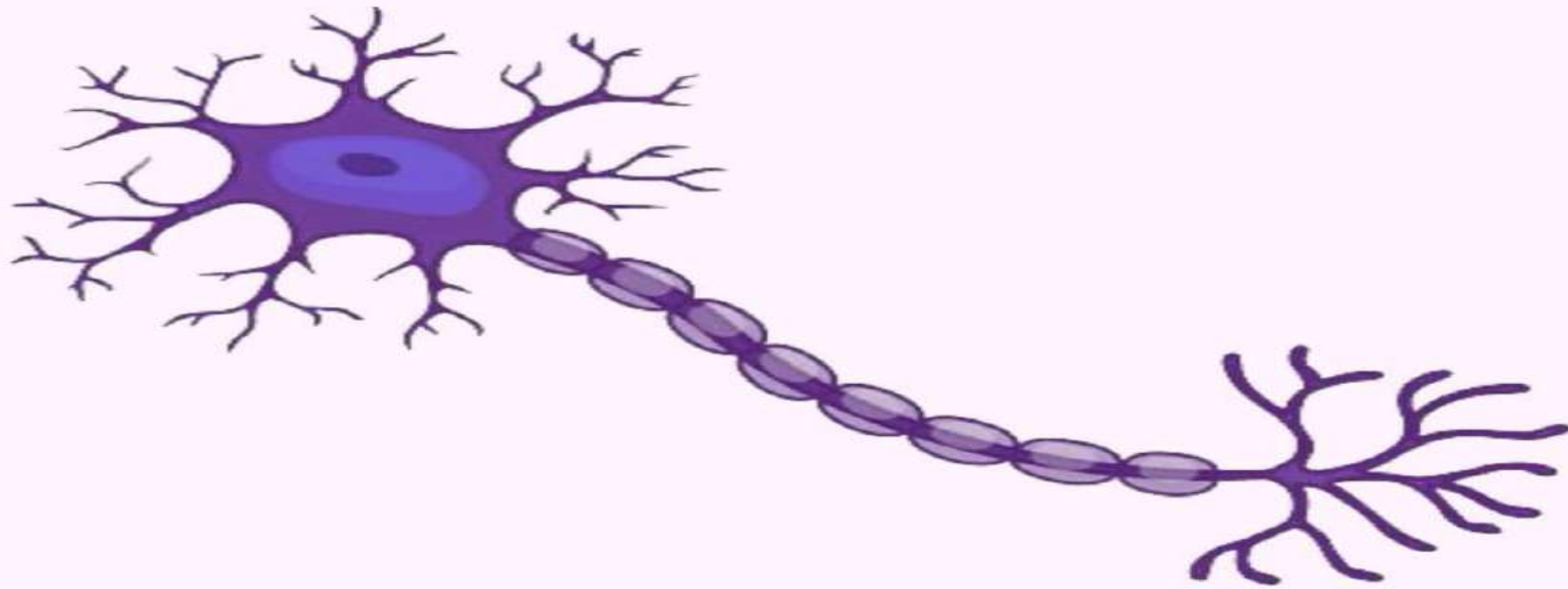




PHYSIOLOGY



LEC NO. : 1.

DONE BY : Asia alwedyan

وَقُلْ رَبِّ زِدْنِي عِلْمًا

Introduction to Physiology

**Course: Human Physiology
Dentistry**

Lecture No. 1

- 1. Levels of organization in the body**
 - 2. Levels of Homeostasis and body fluids**
- Prepared by: Prof. Said Khatib

Presented by: Prof. Said Y Khatib
sykhatib@just.edu.jo

What is Anatomy?

The study of body structures and the relationships among them

- How to form an organ or a tissue

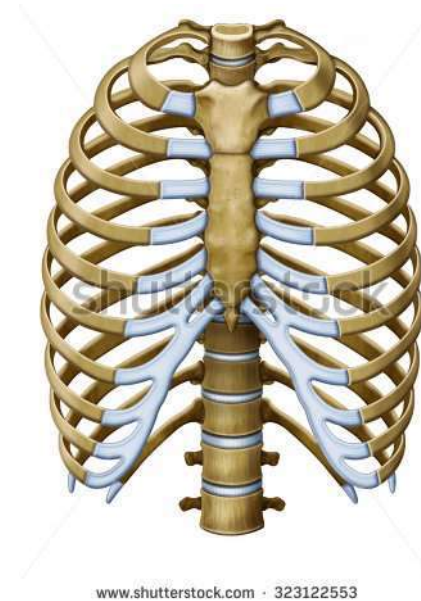
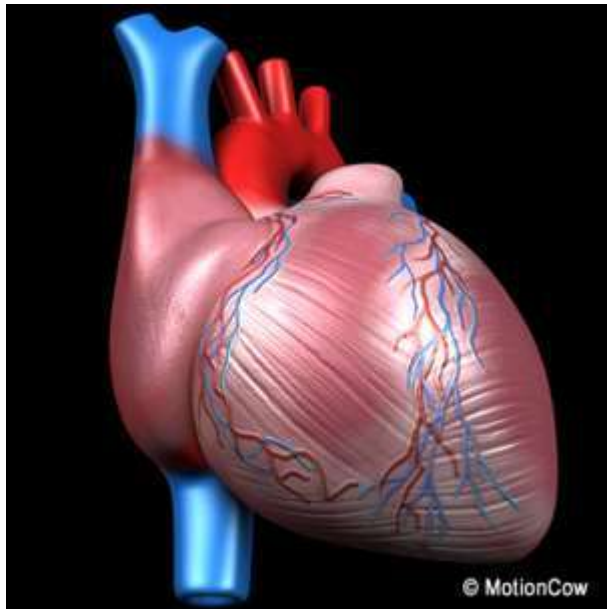
What is Physiology?

The study of body functions

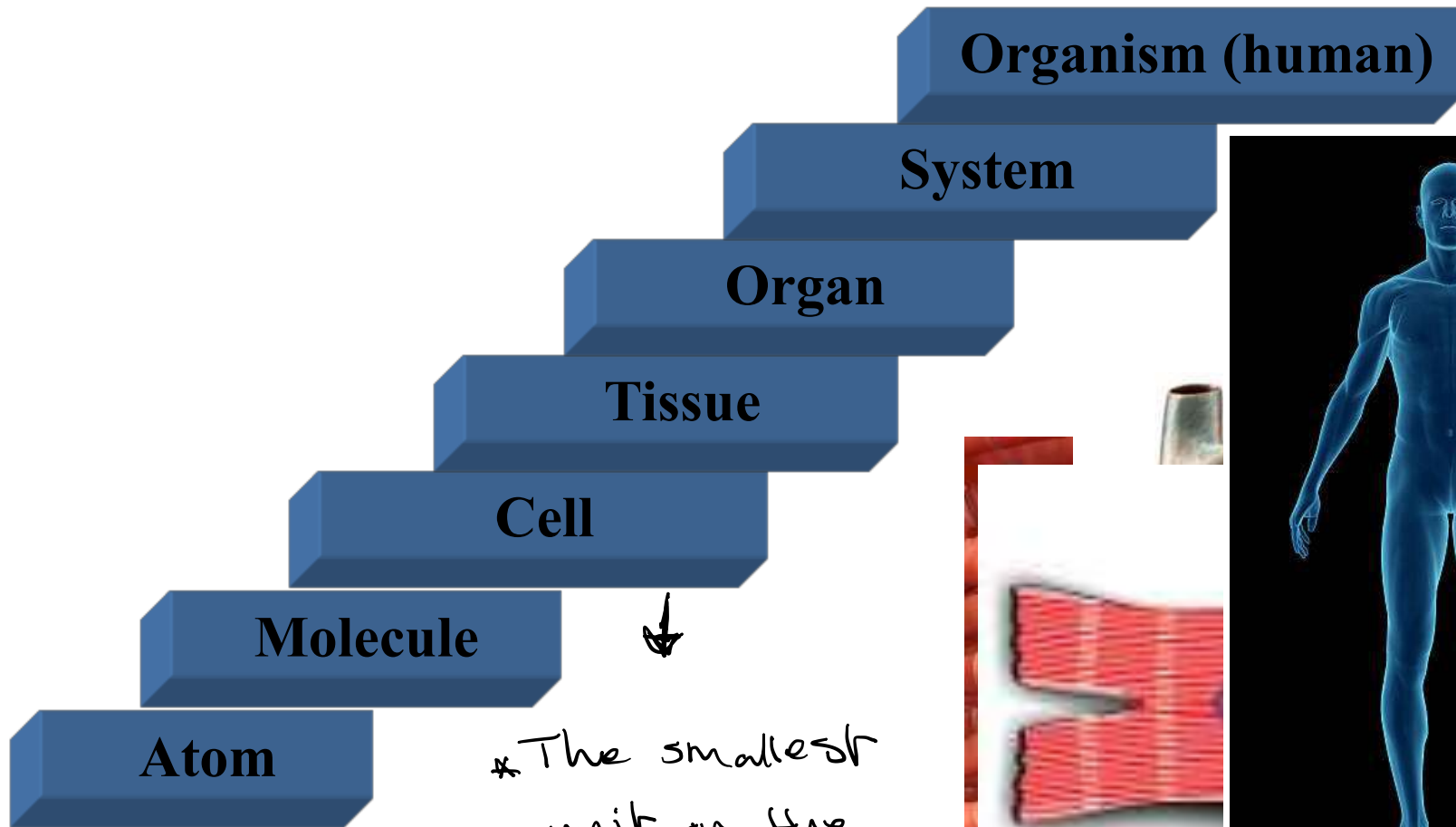
- How it works , how the organ is adapted to function its work

Structure-Function Relationship

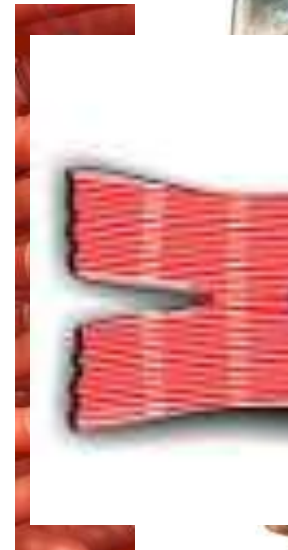
Physiological mechanisms are possible through structural design



Levels of Organization in the Human Body



↓
*The smallest unit on the body.



Cell

❑ The **basic unit** of structure and function in the human body



The amoeba above is made of only one cell and it must perform all the jobs of the organism

❑ The **smallest unit** capable of carrying out the processes associated with life

- To maintain any system we have , we must maintain the cell to be alive , so the tissue and the organ will be alive

-

All the machanesims in our life occurs in the cell



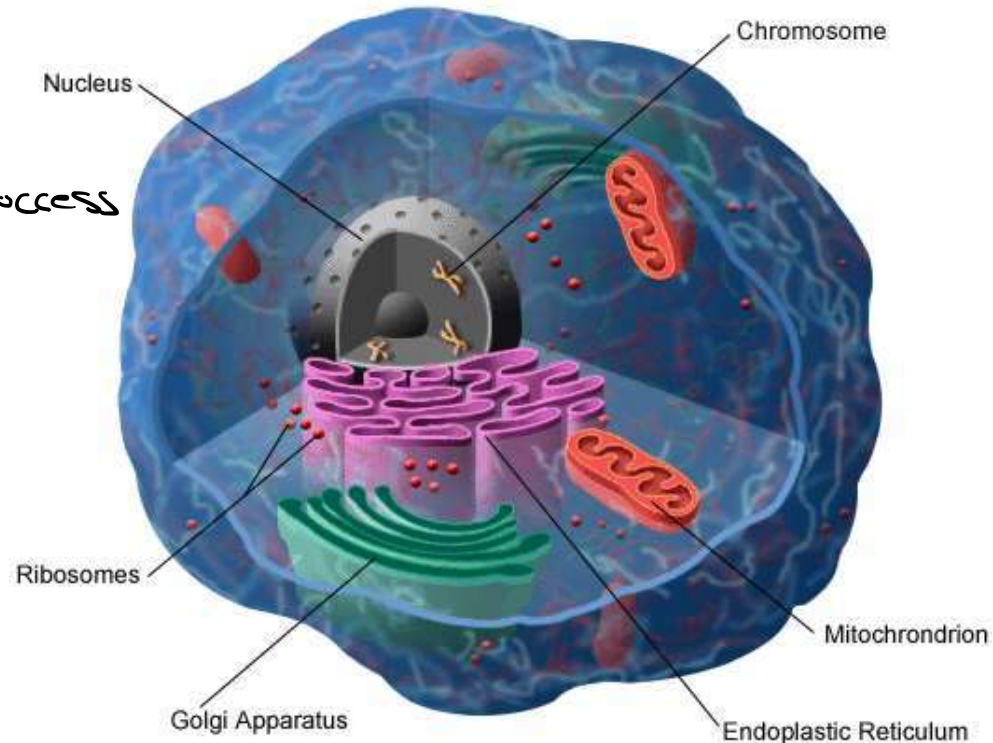
Sponge is multicellular, all cells are similar

Cell, basic unit of life

Cell functions: Type your text **1- Basic** **2- Specialized**

• Basic cell functions:

- obtain food & O₂ \rightarrow metabolic process
- perform chemical reactions
- eliminate CO₂ & wastes
- synthesize proteins & cell components



Tissue

- **Groups of cells of similar structure & specialized functions**

- **4 primary tissue types**

Tissue

سبب اختلاف الخلايا عند وضع الهدف
هو انزيمات التي توجد داخل هذه
الخلايا.

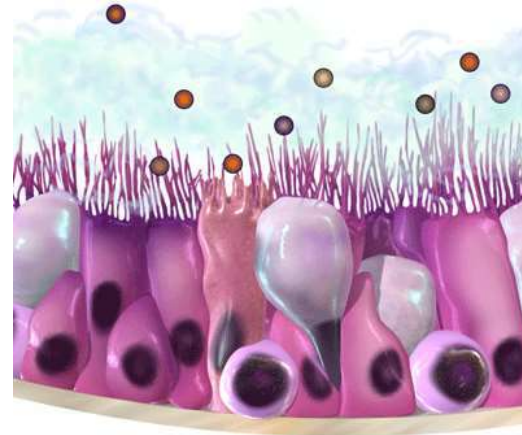
- We have different type of cells but all of them perform the same metabolic activity and they are vary in the enzymes that represent particular



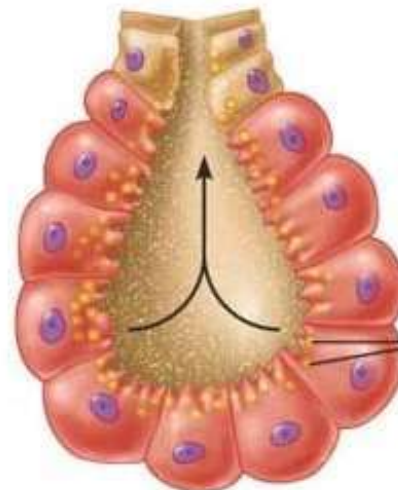
- Each cell has been adapted with the biochemical at the metabolic activity which suits that particular organ , But all of them had metabolic activity which worked out by enzymes

Epithelial

Cells specialized for exchanging materials between cell & environment



Sheets
Skin, digestive tract lining



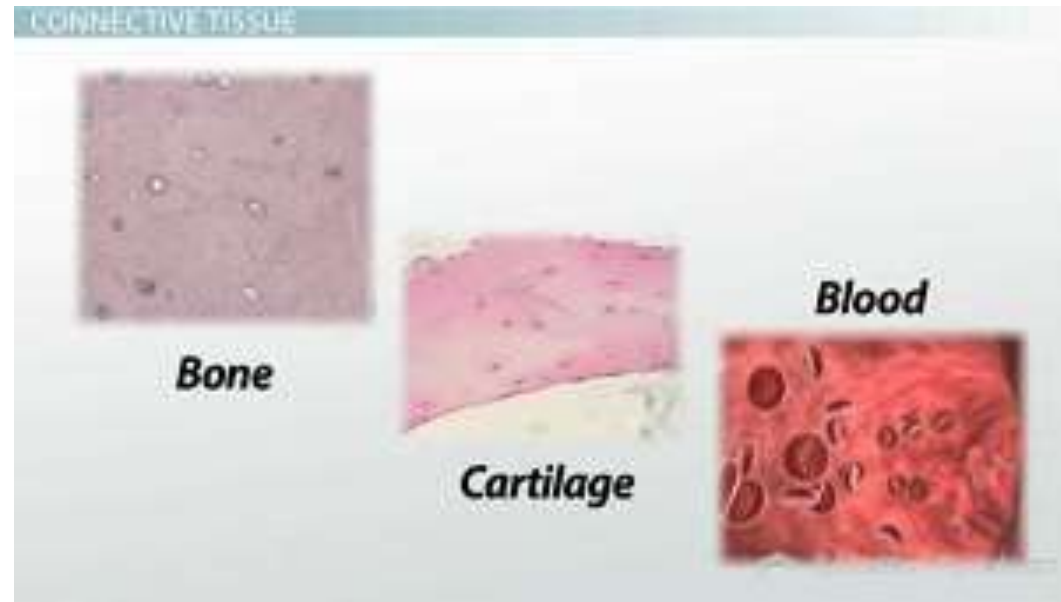
glands

Tissue

Connective

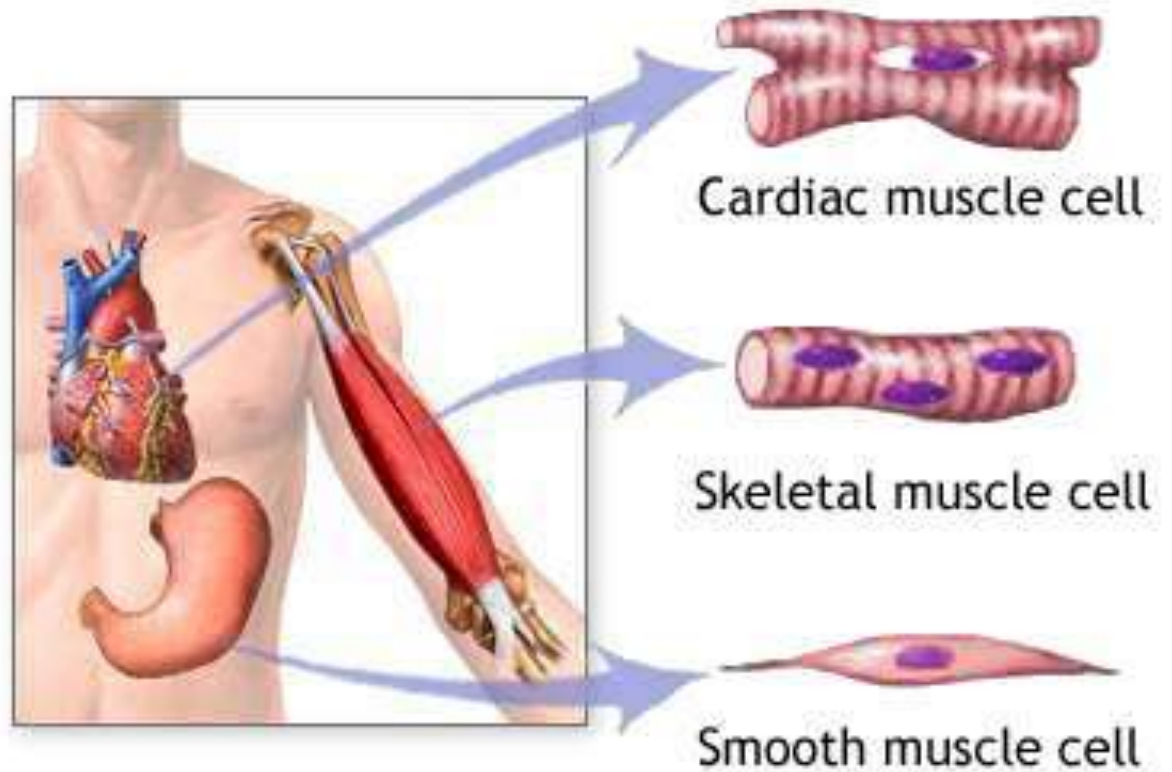
Few cells within abundant
extracellular material

**Supporting/anchoring various
body parts**



Tissue

3 Muscle



Tissue

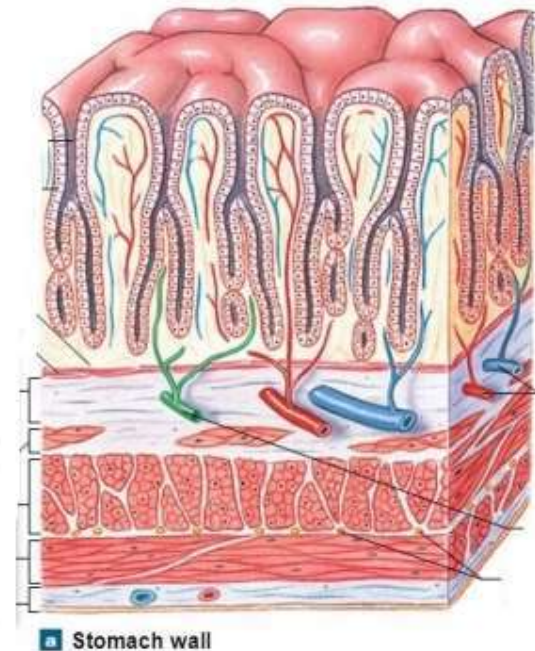
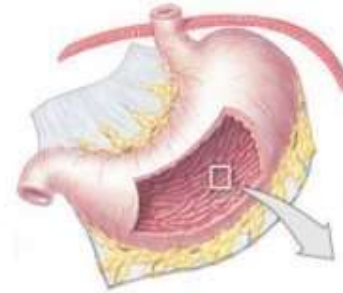
4 Nervous

Initiating & transmitting
electrical impulses

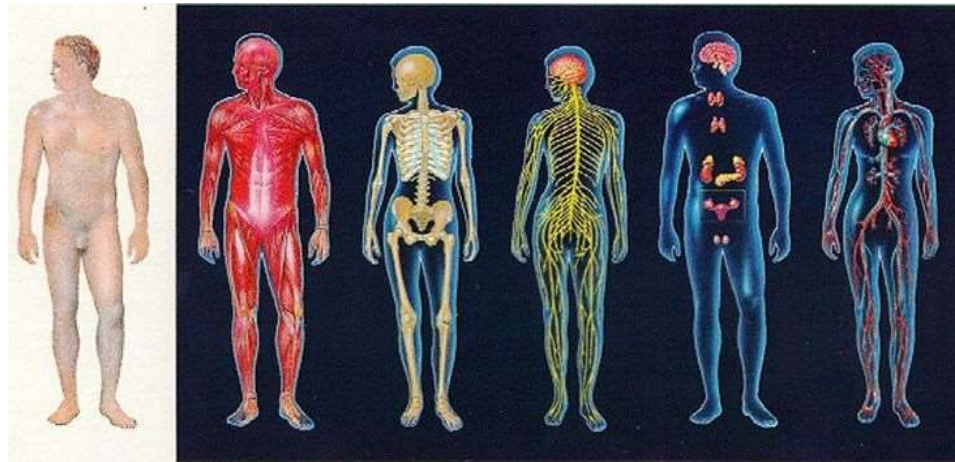


Organ, made up of several tissue types

- The **inside** surface of the **stomach** is lined with **epithelial tissue**
- The **wall** of the stomach contains **smooth muscle**
- **Nerve tissue** in the stomach controls **muscle contraction**
- These tissues are **bound together** by **connective tissue**



Body system, a group of related organs



Integumentary System

Muscular System

Skeletal System

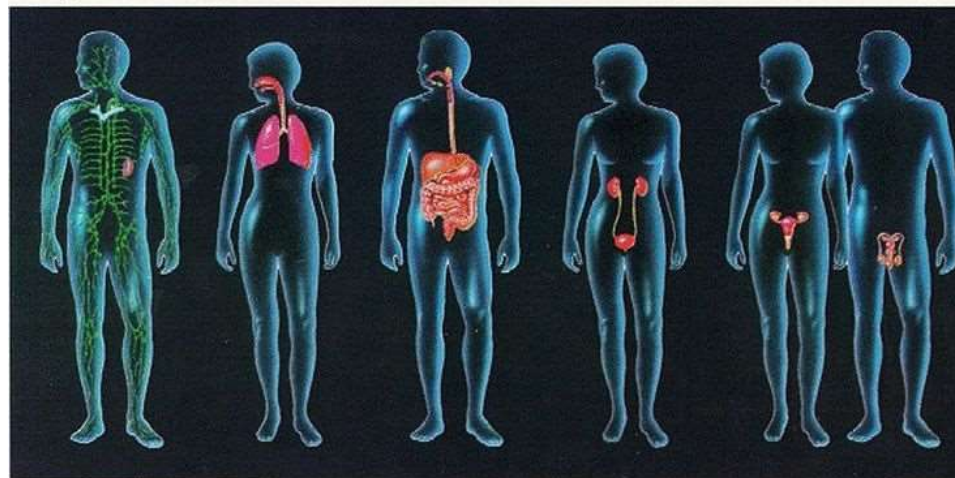
Nervous System

Endocrine System

Circulatory System

- The body is composed of systems and each system is specialized in specific function, but they are integrated

كل واحد يؤدي وظيفته
 لكن كلهم متكاملين ببعض
 وكلهم يعتمدوا على بعض



Lymphatic System

Respiratory System

Digestive System

Urinary System

Reproductive System

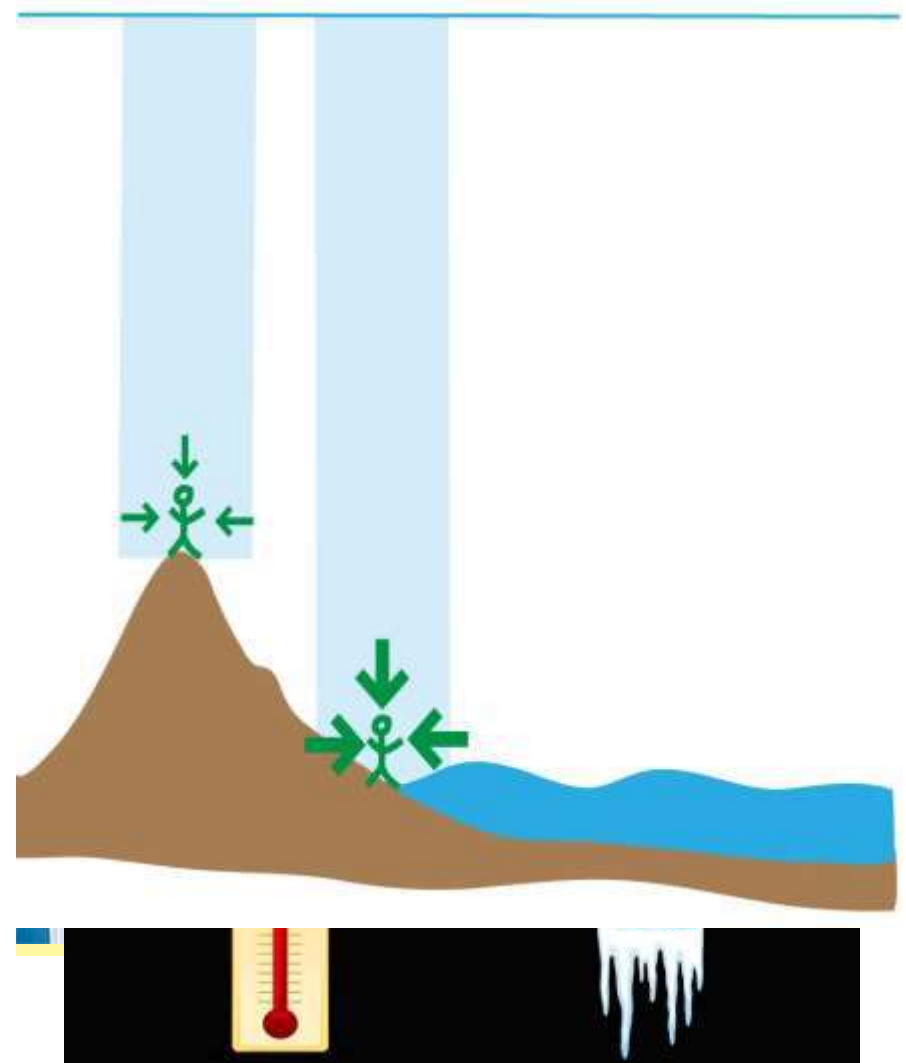
- Ex : the function of the GI system is controlled by the central nervous system

(THE CENTRAL NERVOUS SYSTEM CAN CONTROL THE FUNCTION OF ALL ORGANS IN THE

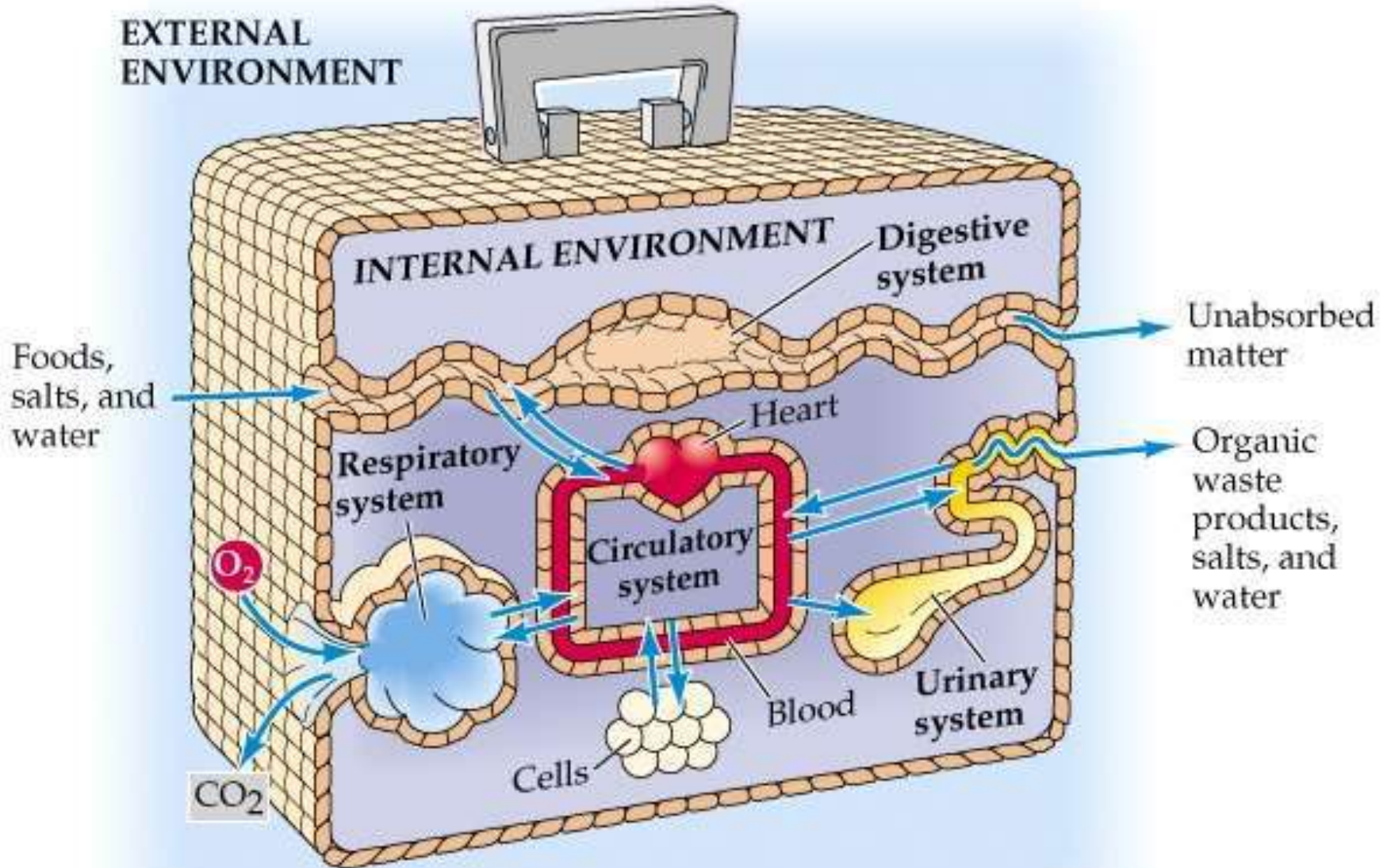
Characteristics of the Living Human Organism

- **Survival Needs**

1. **Nutrients**
2. **Oxygen**
3. **Water**
4. **Normal body temperature**
5. **Atmospheric pressure**



Plan of Human Body



External & Internal Environments

– Interior of body separated from external environment by a layer of epithelial tissue

– Exchange between blood and external environment

- Lungs
- Gastrointestinal tract
- Kidneys

✳️ أُنَّ عضو يتصل مع البيئة الخارجية (part of external environment) يحيط

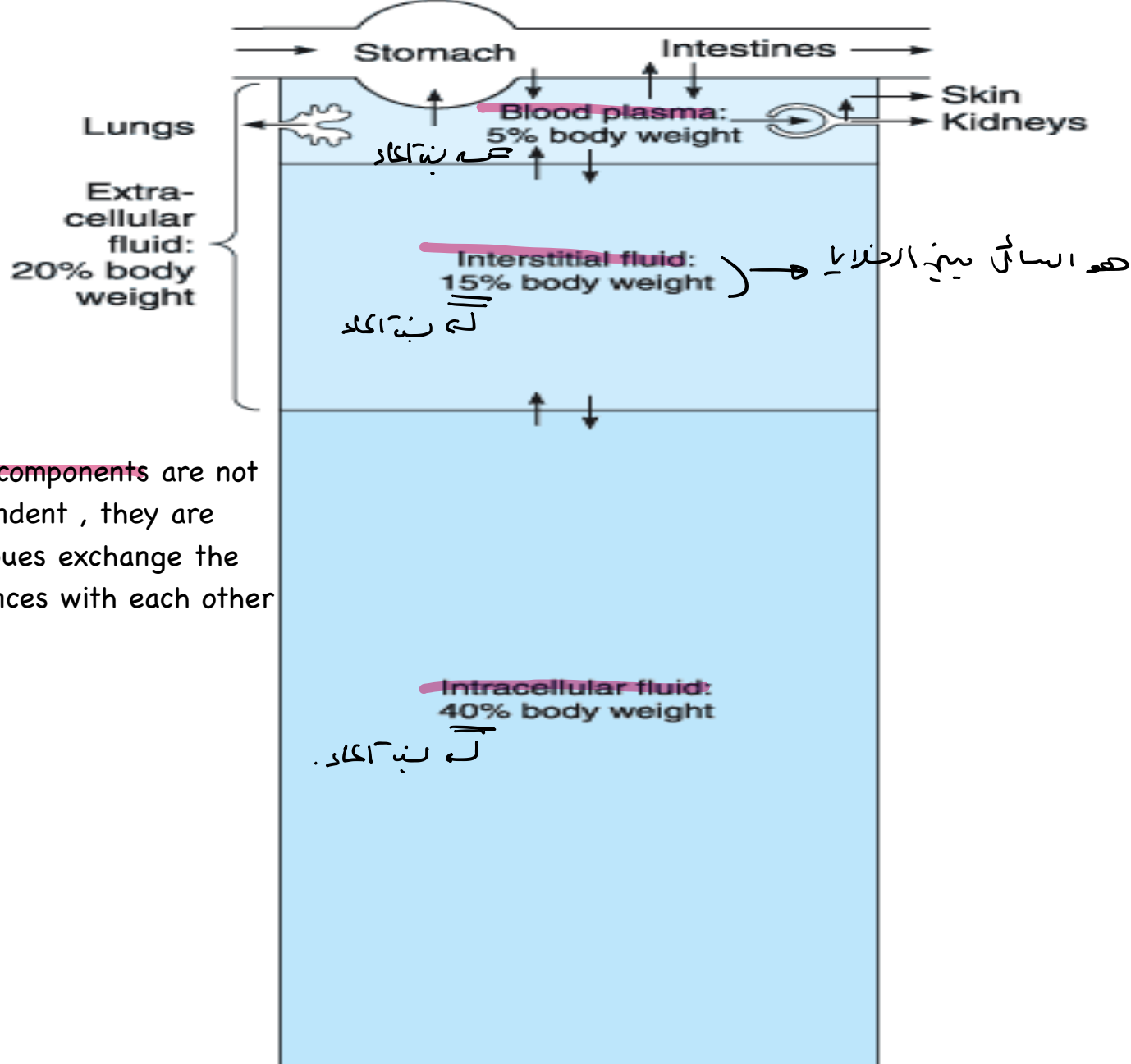
All the cavities in the gi system , cavities of the respiratory system., the cavities in the urethra are all external

القبة الصدغية

– Lumens of respiratory, gastrointestinal, & urinary systems are part of external environment

✳️ القويق داخل الرئة external
✳️ اعتبارا من قوالب الرئة الخارجية .. internal

part of external environment ← cavity الـ جوا المعدة
part of internal environment ← المعدة ✳️



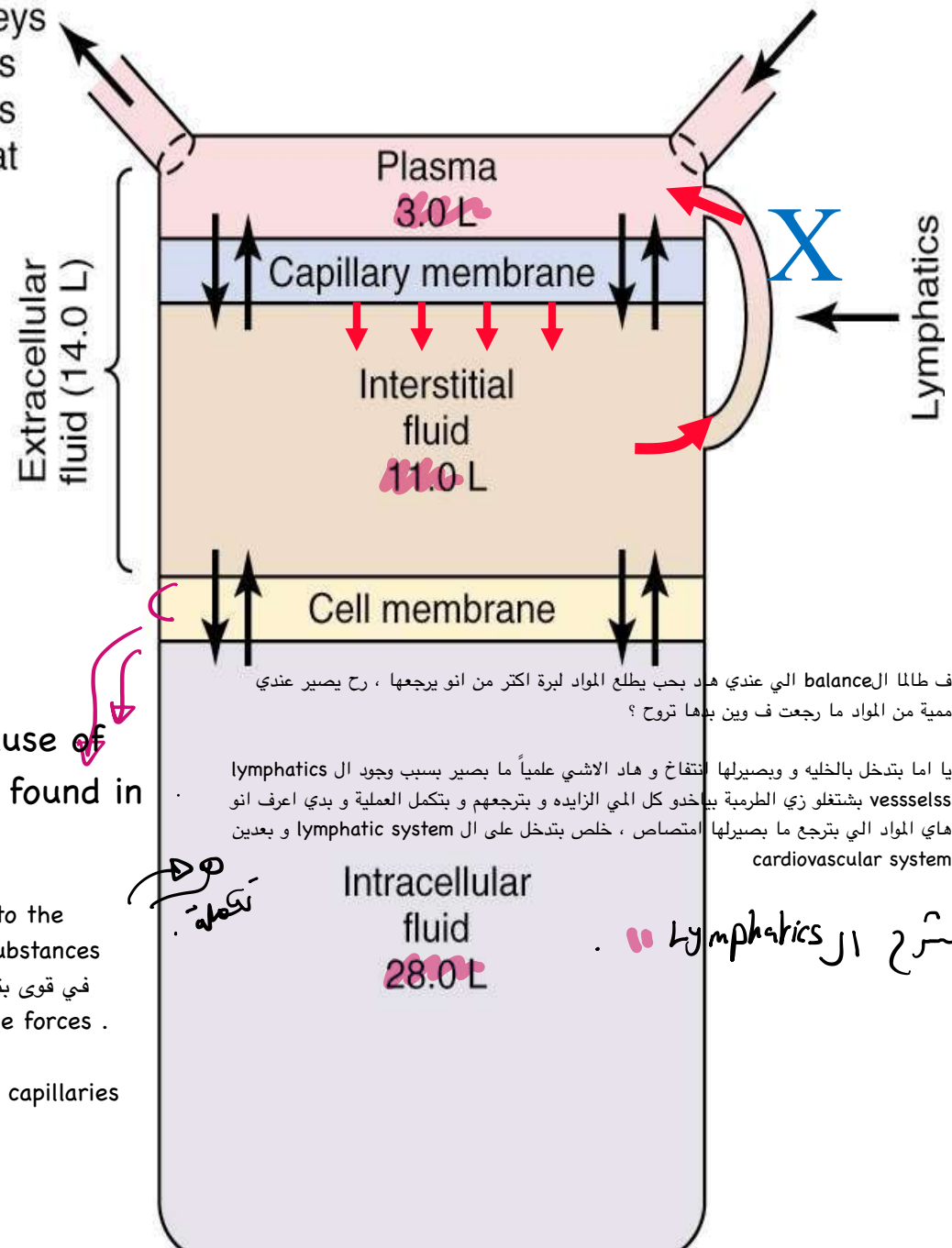
● These components are not independent, they are continuous exchange the substances with each other

● note :
 المكتبة التي تت...

القوى التي تتطلع لبرة هي
 التي بتودي المواد من ال
 plasma → interstitial
 fluid.

- OUTPUT**
- Kidneys
 - Lungs
 - Feces
 - Sweat
 - Skin

INTAKE



Lymphatics

Lymphatic Failure

= Edema

These exchange is occur because of the transport system that is found in the caell membrane

ف طالما ال balance الي عندي هاد بحب يطلع المواد لبرة اكثر من انو يرجعها ، رح يصير عندي ممية من المواد ما رجعت ف وين بدھا تروح ؟

يا اما بتدخل بالخليه و بصيرلها انتفاخ و هاد الاشئ علمياً ما بصير بسبب وجود ال lymphatics vessels بشتغلو زي الطرمية بيأخذو كل المي الزايده و بترجعهم و بتكمل العملية و بدي اعرف انو هاي المواد الي بترجع ما بصيرلها امتصاص ، خلص بتدخل على ال lymphatic system و بعيدين cardiovascular system

● We have forces that push the substances from the plasma to the interstitial fluid and we have forces that draw back some substances to the capillary such as water , metabolic product etc (في قوى بتدخل) and we have balance between the forces . (لجوا و في قوى بتطلع المواد لبرة)

The balance favor outward movment (so ال capillaries التي بتطلع من ال) هي كمية اكثر من الكمية التانيه الي بترجع لل capillaries)

شرح ال Lymphatics

تكملة

Table 1-1. Total Body Water (As Percentage of Body Weight) in Relation to Age and Sex.

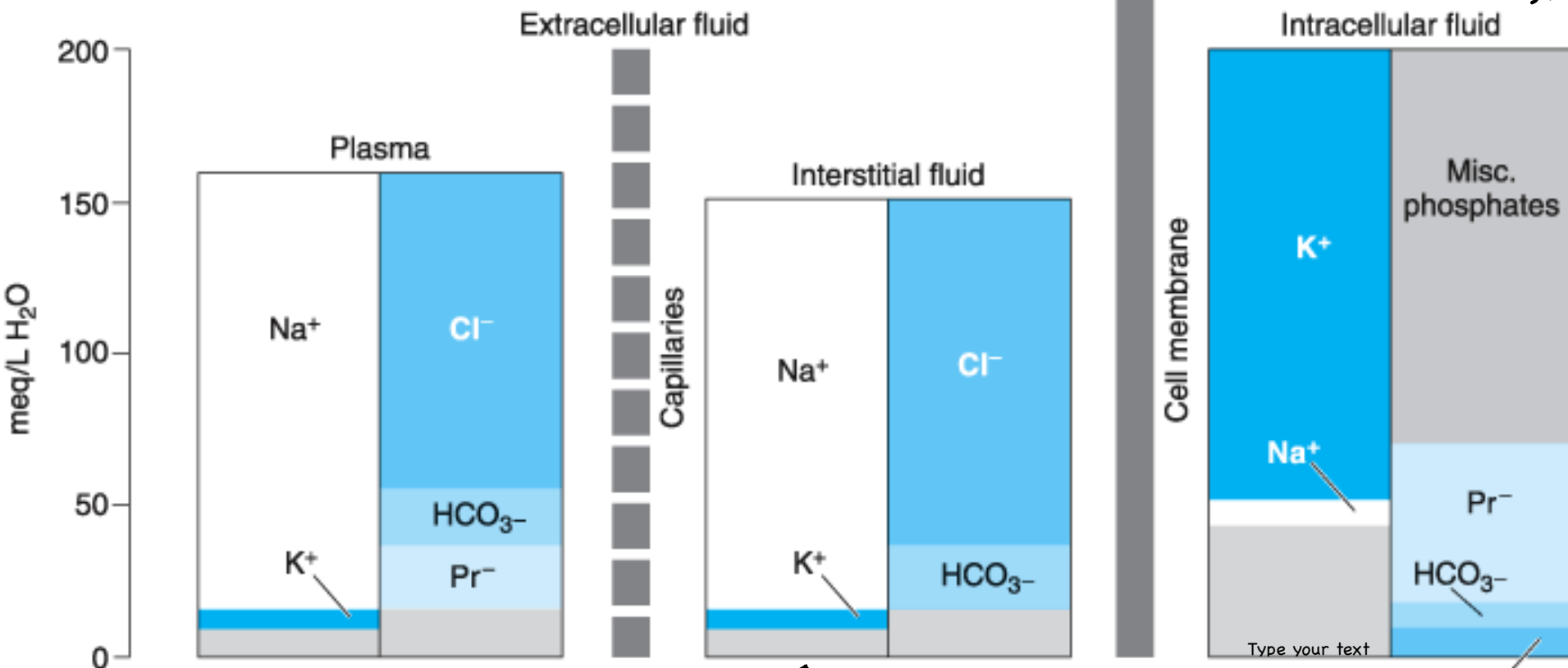
| Age (years) | Male (%) | Female (%) |
|-------------|----------|------------|
| 10-18 | 59 | 57 |
| 18-40 | 61 | 51 |
| 40-60 | 55 | 47 |
| Over 60 | 52 | 46 |

٢ ايجر سبتة في ال
new born

كل حازار عرنا ، كل فانتسنة كحمة المياه في جسم الانسان وانكس اكثر .
 بي ان ال cell بيكس اتم
 volume

extracellular space.
 ↓
 is rich of sodium (Na⁺)

intracellular space.
 ↳ is rich of potassium (K⁺)



الفرق في تراكيز الايونات بخلي بصير عندي اتزان عشان ما تخرج و تطلع المواد من تركيز عالي لمنخفض الي بسبب انتكماش الخلية او انتفاخها ، لانو انتكماش الخلية و انتفاخها باثر على وظائف الخلايا . مشان هيك يعتبر فرق التراكيز بالايونات خارج الخلية و داخلها اشي مهم للحفاظ على الخلية

● The first important function of the distribution in (K⁺/ Na⁺) ions is to maintain the osmolarity inside and outside the cell , so there is no gain and loss of water .

● The second issintial function of this distribution is to maintain the cell potential

The negative resting cell potential is very issintial to enable you to stimulate the cell , so to maitain the negative resting membrane potential there is a sodium potassium

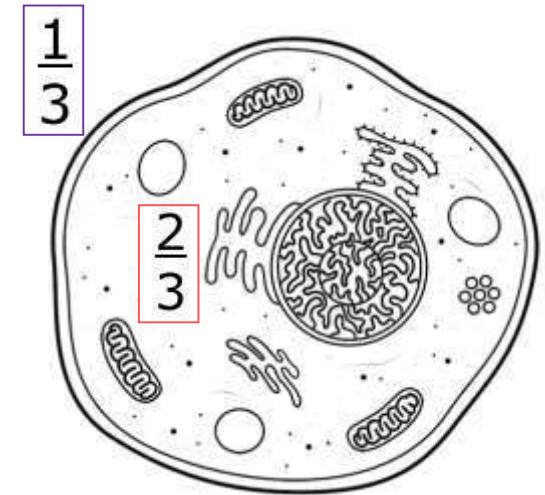
هو بسبب ان تكونه الخلية صفة . و ربيحنا عننا خلية ما عندهم cell potential ، يعتبر خلايا صفة الارتفاع

Body Fluids

الانسان بخسر سوائل عن طريق التعرق /
التنفس / العمليات الاخراجية

☐ Mostly water

• In healthy bodies
the fluids you



The Internal Environment



- ❑ The interior of body, the environment of cells inside the body
- ❑ Internal environment = fluid surrounding cells

The ECF is the internal environment

What is in the ECF?

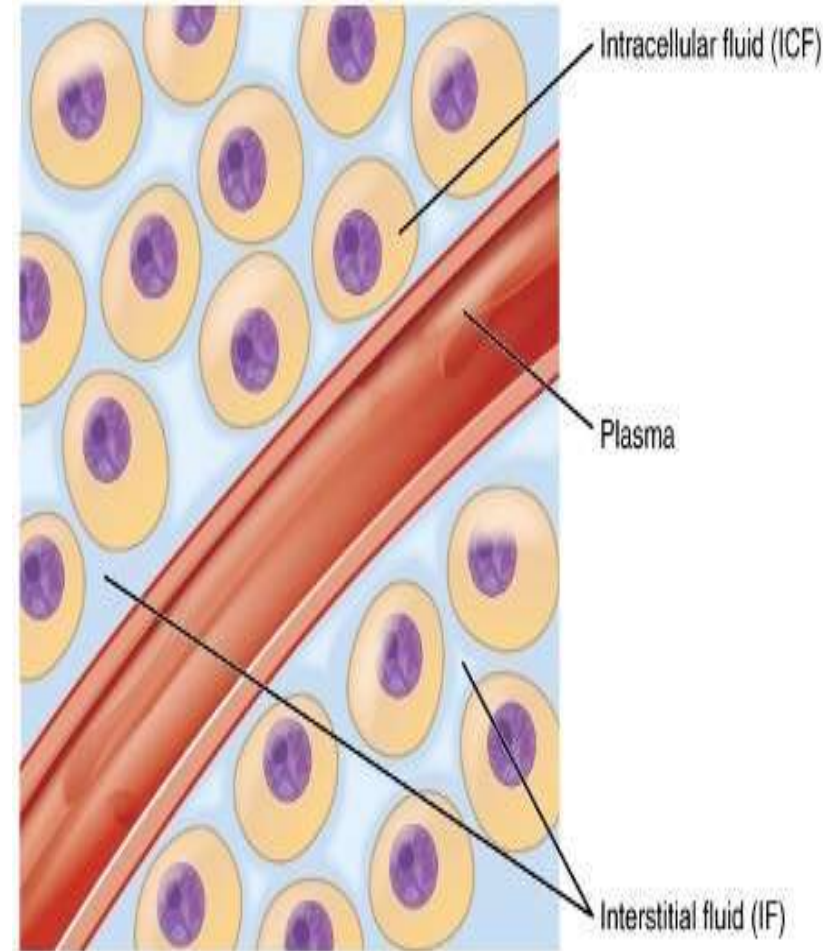
- Ions
- O_2
- Nutrients (glucose, f.a, a.a)
- Waste products (CO_2 , garbage)

Homeostasis

لص الاتزان .

- We have to maintain balance between the fluid التي برة والي جوا الخلية
عن طريق ال homeostatic mechanisms

- Body cells are surrounded by watery internal environment through which life-sustaining exchanges are made
- **Extracellular fluid (ECF)**
 - Fluid environment in which the cells live (fluid outside the cells)
 - Two components
 - Plasma, interstitial fluid
- **Intracellular fluid (ICF)**
 - Fluid contained within all body cells



Homeostasis

= **State of constancy of conditions within the body**

= **Maintaining a dynamic steady state of the internal environment**

“Essential for cell survival”

كل سيستم الو homeostatic machanism

- All of the Homeostatic mechanisms work in order to maintain the function of each organ to be normal to perform its function perfect so the body will stay in

خاص فيه بشتغل بكل الاوقات و الازمان

- We allow some changes to occur but with acceptable range

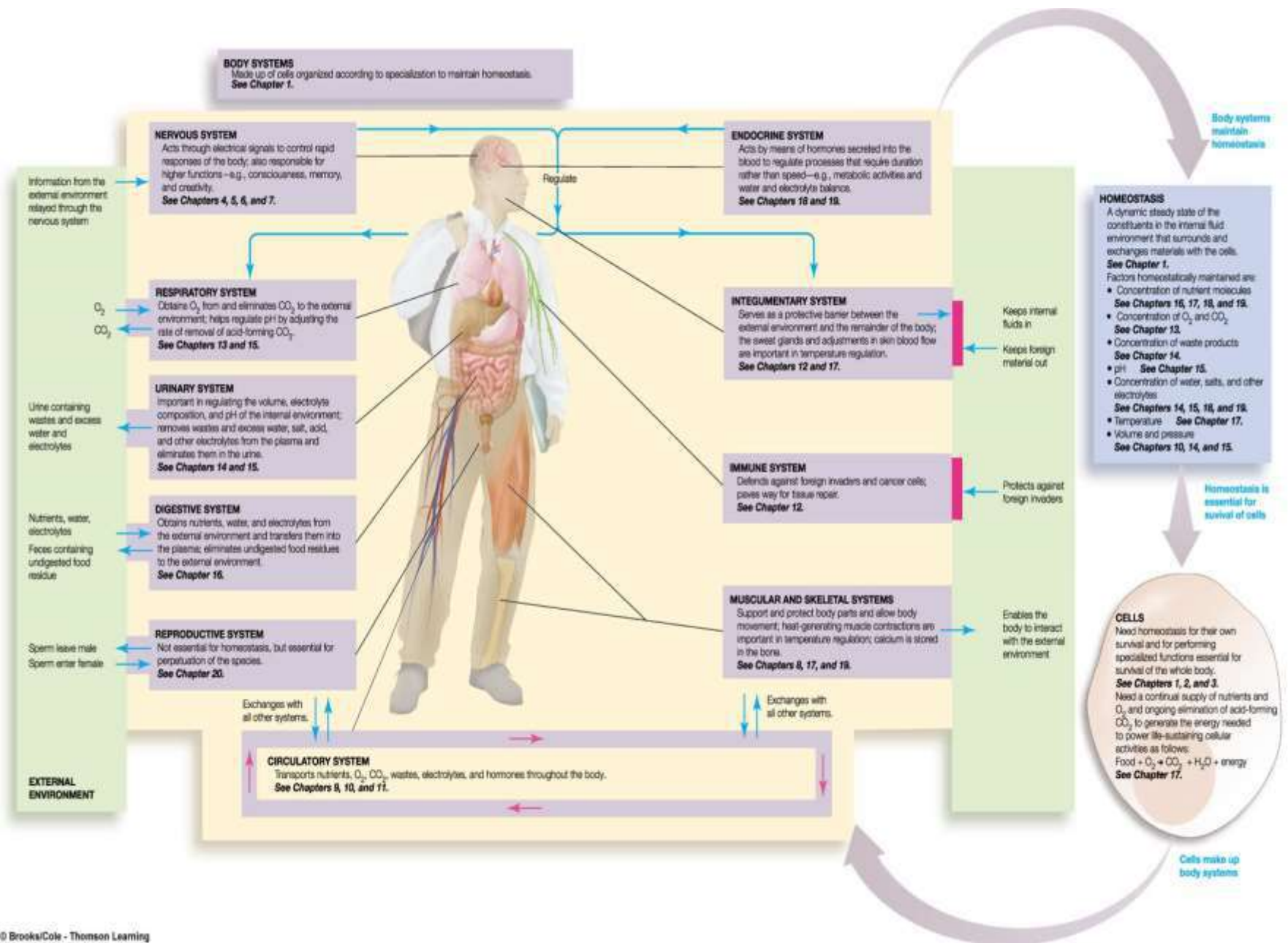
Factors Homeostatically Regulated

1. Concentration of nutrient molecules > amino acids / fats / glucose
2. Concentration of gases in blood (O_2 and CO_2)
3. Concentration of waste products > lactic acid
4. pH of blood plasma > normal range : 7.35 - 7.45.
It is very important and essential to maintain the pH bec all the enzymes activity
5. Concentration of water, salt, and other electrolytes
6. Volume of body fluids and vascular pressure > كل ما زاد حجم الدم كل ما زاد ال blood pressure.
7. Body Temperature

The Human Body Systems Contribute to Homeostasis

- ✓ **circulatory** - transports materials (e.g., nutrients, gases)
- ✓ **digestive** - breaks dietary food into small nutrient molecules
- ✓ **respiratory** - obtains oxygen and eliminates carbon dioxide
- ✓ **urinary** - removes and eliminates wastes from the plasma
- ✓ **skeletal** - provides support and protection for soft tissues
- ✓ **muscular** - moves the bones
- ✓ **integumentary** - serves as an outer protective barrier
- ✓ **immune** - defends against foreign invaders
- ✓ **nervous** - controls and coordinates activities rapidly
- ✓ **endocrine** - regulates activities that require duration
- ✓ **reproductive** - ??? perpetuation of the species

Role of Body Systems in Homeostasis



Homeostatic Control Systems

- **Intrinsic (local)** - inherent in an organ

↳ it means in the organ it self ..

من خارج

- **Extrinsic (body-wide)** - outside the organ to alter the activity of the organ

* mostly the hormones are Extrinsic.

1. Nervous system

2. Endocrine system

Homeostatic Control Systems

- Control systems are grouped into two classes
 - **Intrinsic (within) controls** : Local controls that are inherent in an organ
 - Example exercising skeletal muscle consumes more oxygen leading to fall in oxygen concentration in the skeletal muscle (local). This local decrease in oxygen acts directly on smooth muscle of blood vessels of skeletal muscle causing dilatation of these blood vessels (more blood flow means more oxygen supply and thus maintain oxygen level in exercising skeletal muscle.
 - **Extrinsic (outside) controls**: Regulatory mechanisms initiated outside an organ
 - Accomplished by **nervous and endocrine systems**
 - Example: when blood pressure falls, the nervous system acts on heart (increases heart rate and contractility) and on blood vessels (vasoconstriction). Both effects can increase blood pressure to normal.

Mechanisms to maintain homeostasis

- All our homeostatic mechanisms they have feedback systems

1. *Negative Feedback*

2. *Positive Feedback*

3. *Feedforward*

- What Feedback system means?

That the body have receptors which control the homeostatic mechanisms to perform its function and then stopped

Homeostatic Control Systems

↳ 2 types of systems: \neq negative feedback system.
 \neq positive feedback system.

- **Negative feedback system**

- Primary type of homeostatic control

- Opposes initial change

- Components
 - The components of the

- 1 • **Sensor**

- **Monitors** magnitude of a controlled variable

- 2 • **Control center** } → usually it is in the brain .

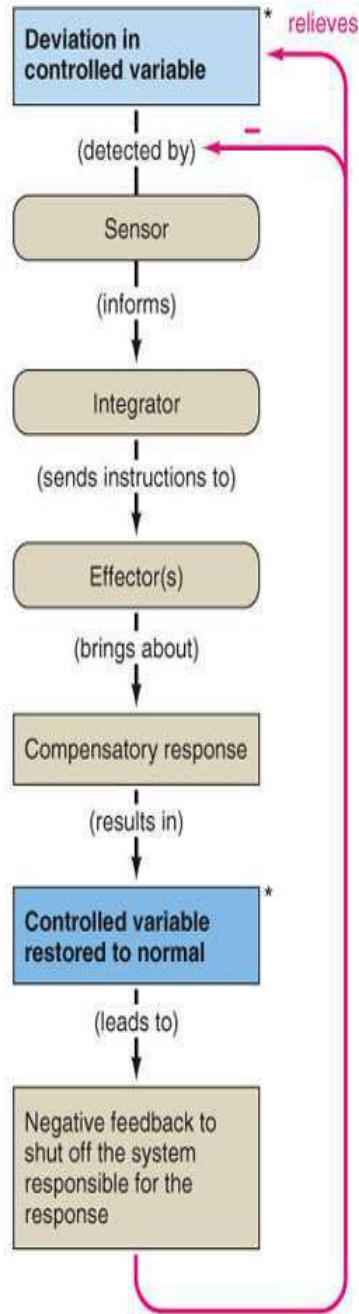
- **Compares** sensor's **input** with a set point

- 3 • **Effector**

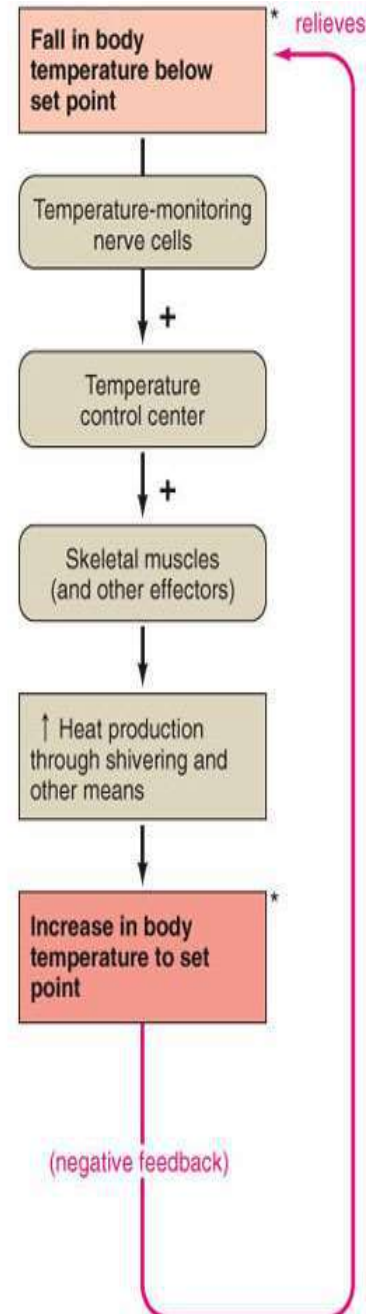
- The control center will effect the effectors which enable you to response what is required

- **Makes a response** to produce a desired effect

Example of negative feedback mechanism



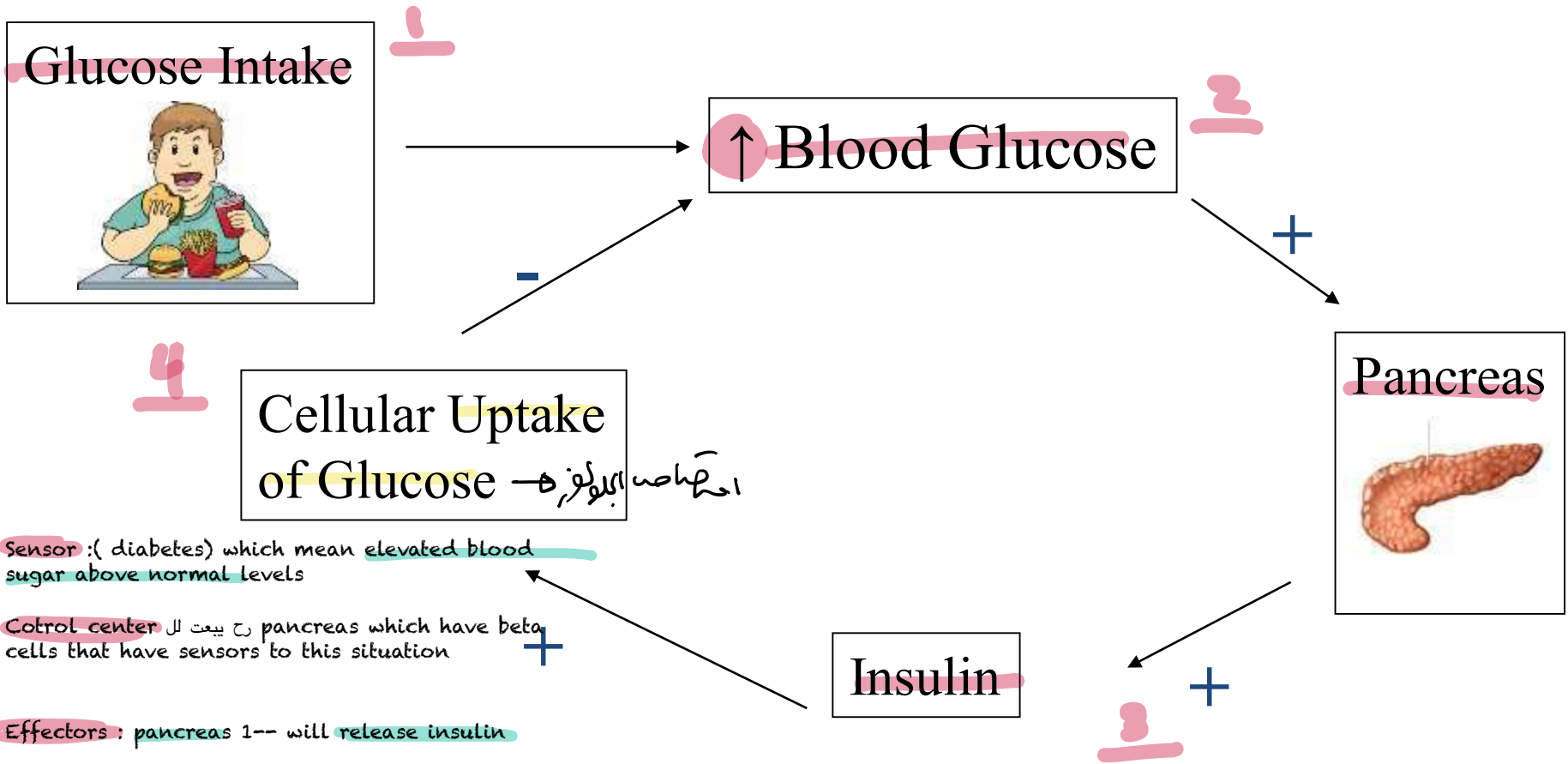
(a)



(c)

— شرح جزئياً
36

Negative Feedback



Sensor: (diabetes) which mean elevated blood sugar above normal levels

Control center: pancreas which have beta cells that have sensors to this situation

Effectors: pancreas 1-- will release insulin

2-- insulin will force the glucose to enter the cells especially the skeletal muscles cells so this will decrease glucose to normal levels (increasing the uptake)

Negative Feedback



Exposure to cold

Normal Body Temperature

↓ Body Temperature



↑ Body Temperature

Brain

Shivering

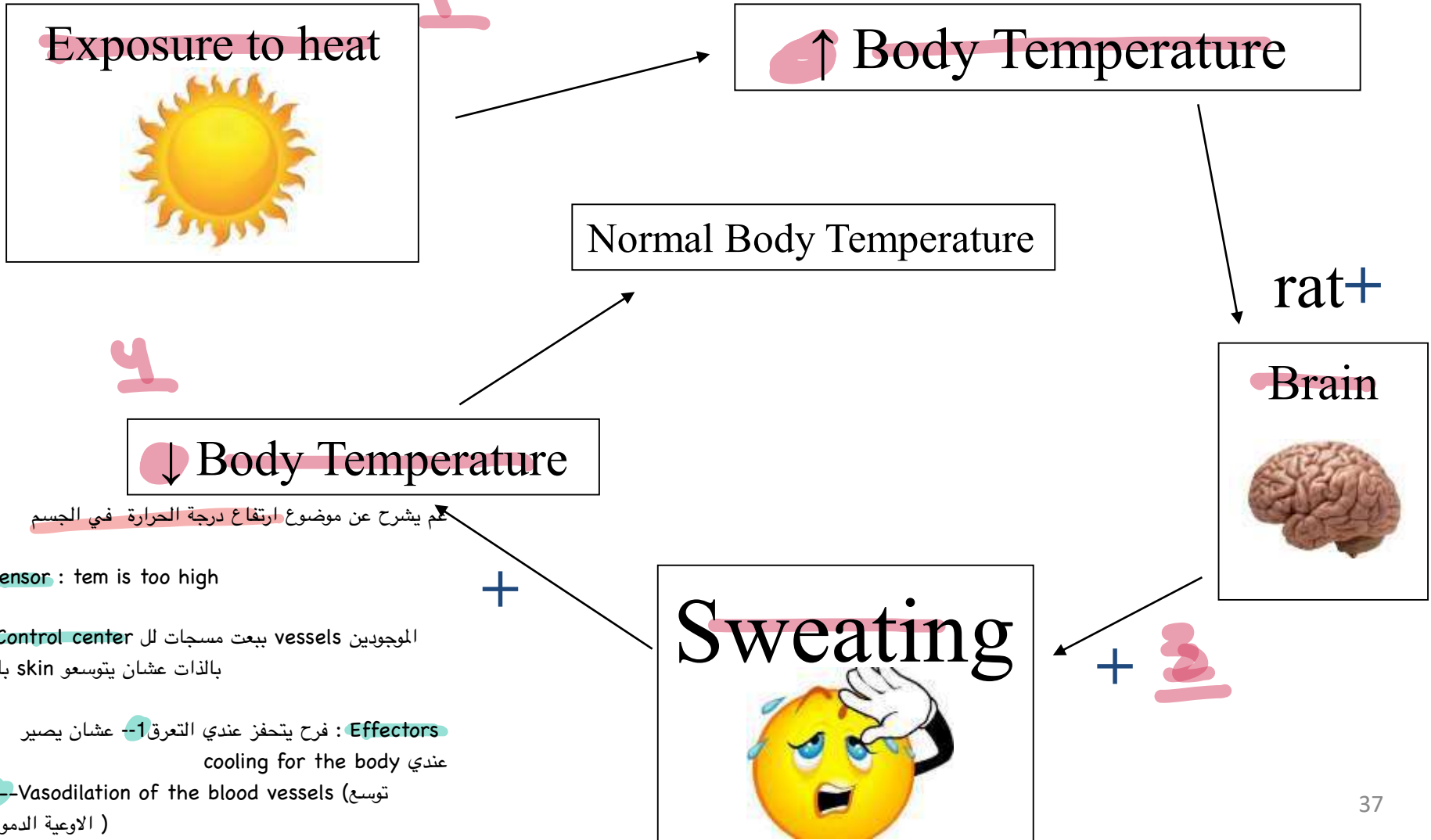
Sensor : decrease in the body temperature

Control center is the brain , ووصله انى لازم تعمل على انتاج الطاقة لرفع درجة حرارة الجسم ,

Effectors : mechanisms to prduce energy : the effectors are the skeletal muscels the cells starting to burn the sugars , fats . So (metabolic activity) --1 this increase the metabolism which increases the body temprature

2-- shivering (القشعريره) thats shivering generates energy و هذا يؤدي الى رفع حرارة الجسم

Negative Feedback



Maintaining constant body temperature by negative feedback mechanism

Controlling the body temperature ↗

Thermoregulation center in brain is activated.



Sweat glands secrete sweat that evaporates, cooling the body.

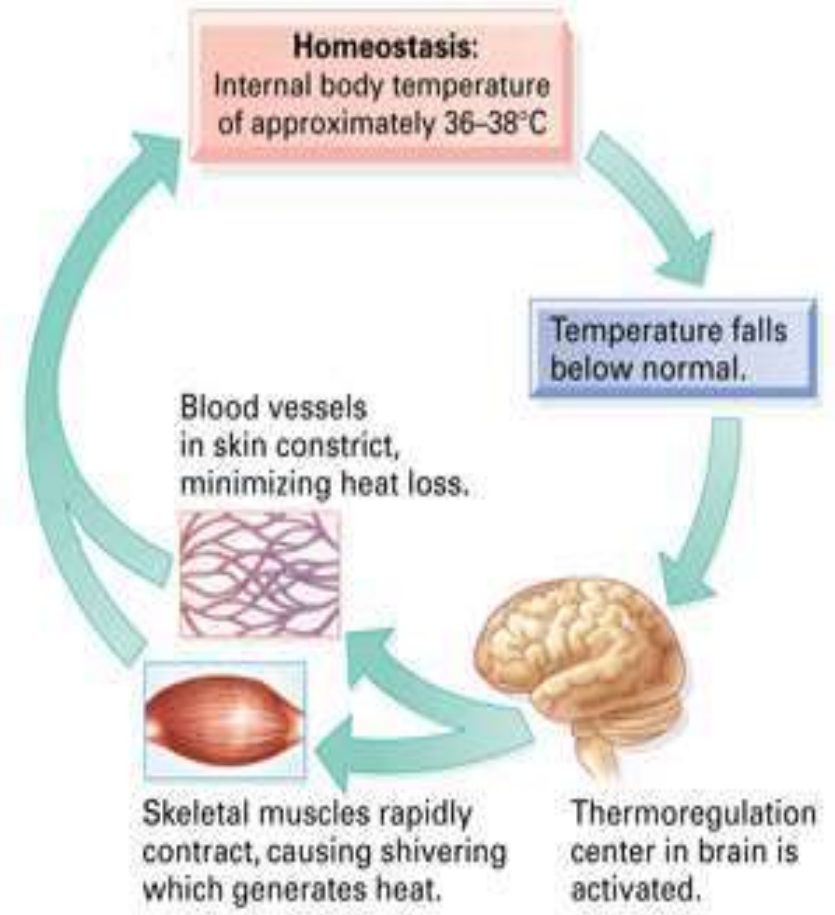


Blood vessels in skin dilate and heat escapes.



Temperature rises above normal.

Homeostasis:
Internal body temperature of approximately 36–38°C



Homeostatic Control

Systems

Positive feedback means a response which will enhance its activity to increase more and

- **Positive feedback system**

Exampels of positive feedback system :

1--Uterine contraction during the birth

2-- the stimulation of the cells

3-- blood clotting

- **Amplifies an initial change.**

- **Do not occur as often as negative feedback system.**

- **Example**

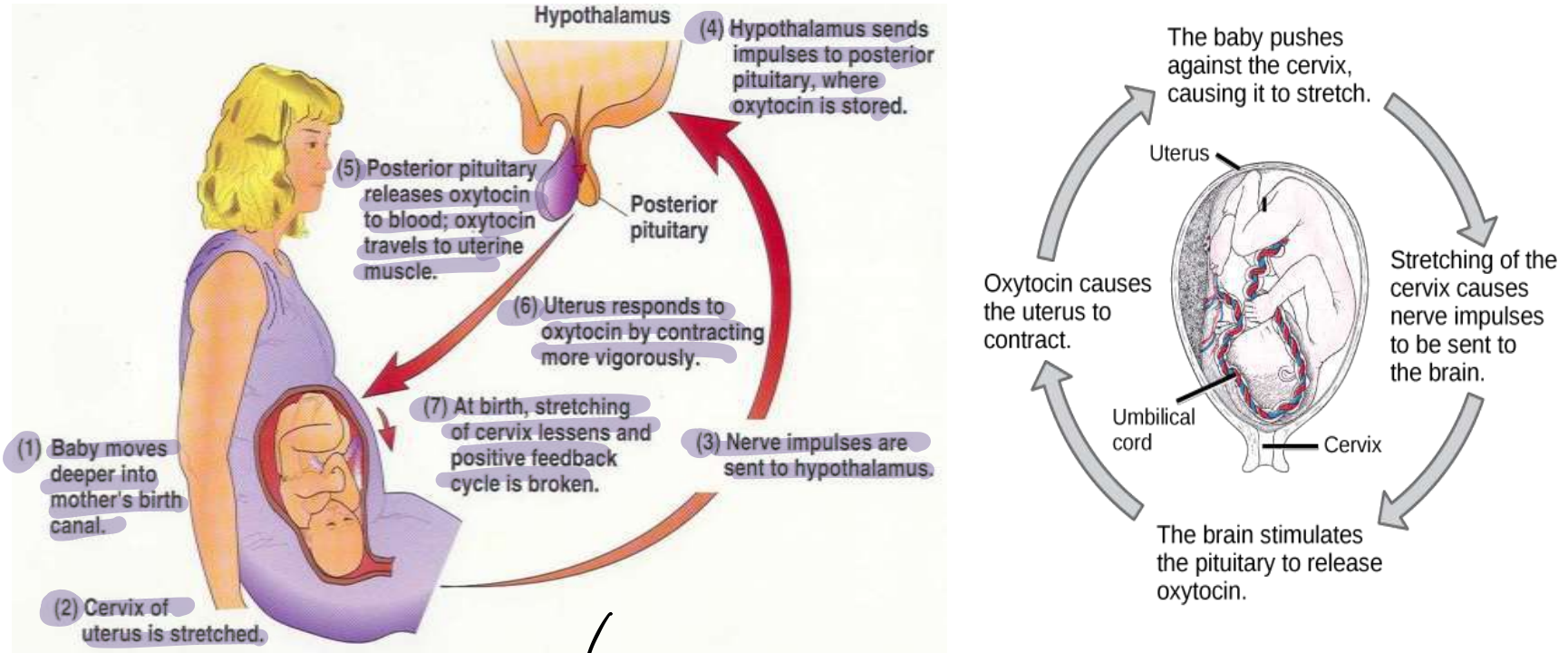
- **Uterine contractions become increasingly stronger until the birth of the baby**

→ الرجوع

Useful positive feedback

Childbirth

Uterine contraction pushes head to stretch cervix muscle → signals through the uterine muscle, causing even more contraction. This action is repeated until the baby is born.



↓ الترحح للرسمة واللايدرة كاعلة

sharp drop.

ببلش الطفل يطلع لما يصير عندي drop بهرمون يسمى بروسجترون

This will integer the contractions of the uterine wall.

This contraction will push the baby out , the surface will start stretching this stretching is the mechanical response will send a message to the brain (to the hypothalamus) so the hypothalamus will send a message to pituitary gland to release oxytocin (oxytocin is a hormone which increase the contraction of uterine wall) that contraction will push the baby out , more stretch will be more released of oxytocin , the more release of oxytocin which means stronger contraction in the uterine wall , more stretch will send back messages back to the brain to release more and more oxytocin and the oxytocin will further increase the force of contraction of the uterine wall until the baby is born

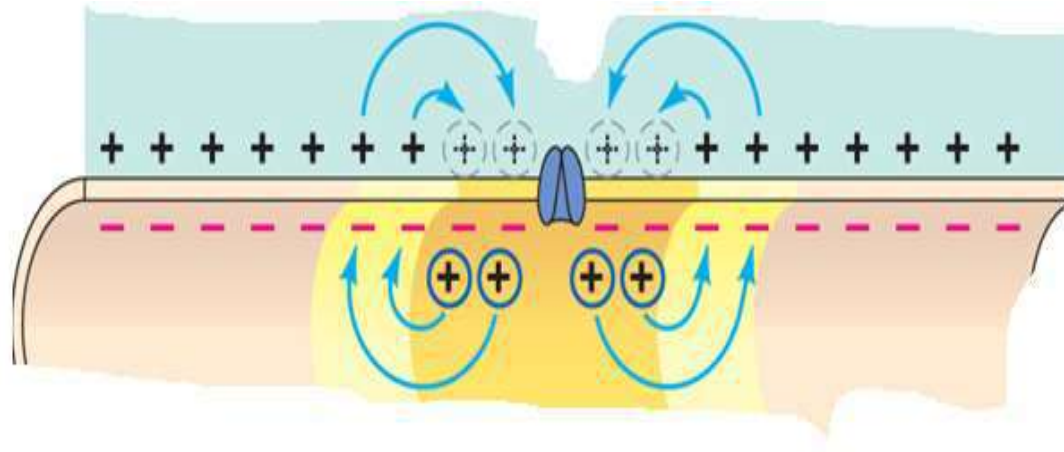
Useful positive feedback

VERY IMPORTANT NOTE :

All cells have negative resting membrane potential

Generation of nerve signals:

Stimulation nerve fiber → causes slight leakage of sodium ions
→ more sodium move in causes change in membrane potential
→ that will cause more & more sodium channels to open and producing Na influx → more change in membrane potential → more opening → until action potential is created and spread all the way to the end of fiber.



The stimulus (حرارة ، ضوء) سواء كان بغض النظر شو كان a touch your skin , or a physical stimulus

These stimulus open sodium gates in the membrane of the cells whether it is muscle , endocrine , nervous system whatever the cell is .

Because the membrane has alot of sodium channels ((those sodium channels are normally closed i open it by stimulas (بغض النظر عن نوعه)))

The stimulus therefor will open the sodium gate a little bit , some sodium will enter the cell from high concentration outside the cell to the low concentration inside the cell ((the concentration of Na^+ outside the cell is 140 , inside the cell about 10))

So this moving of the Na^+ we call it depolarization in the membrane (يعني مثلا كانت الخلية -60 بتصير -50 بتزيد و بتطلع ل فوق شوي)

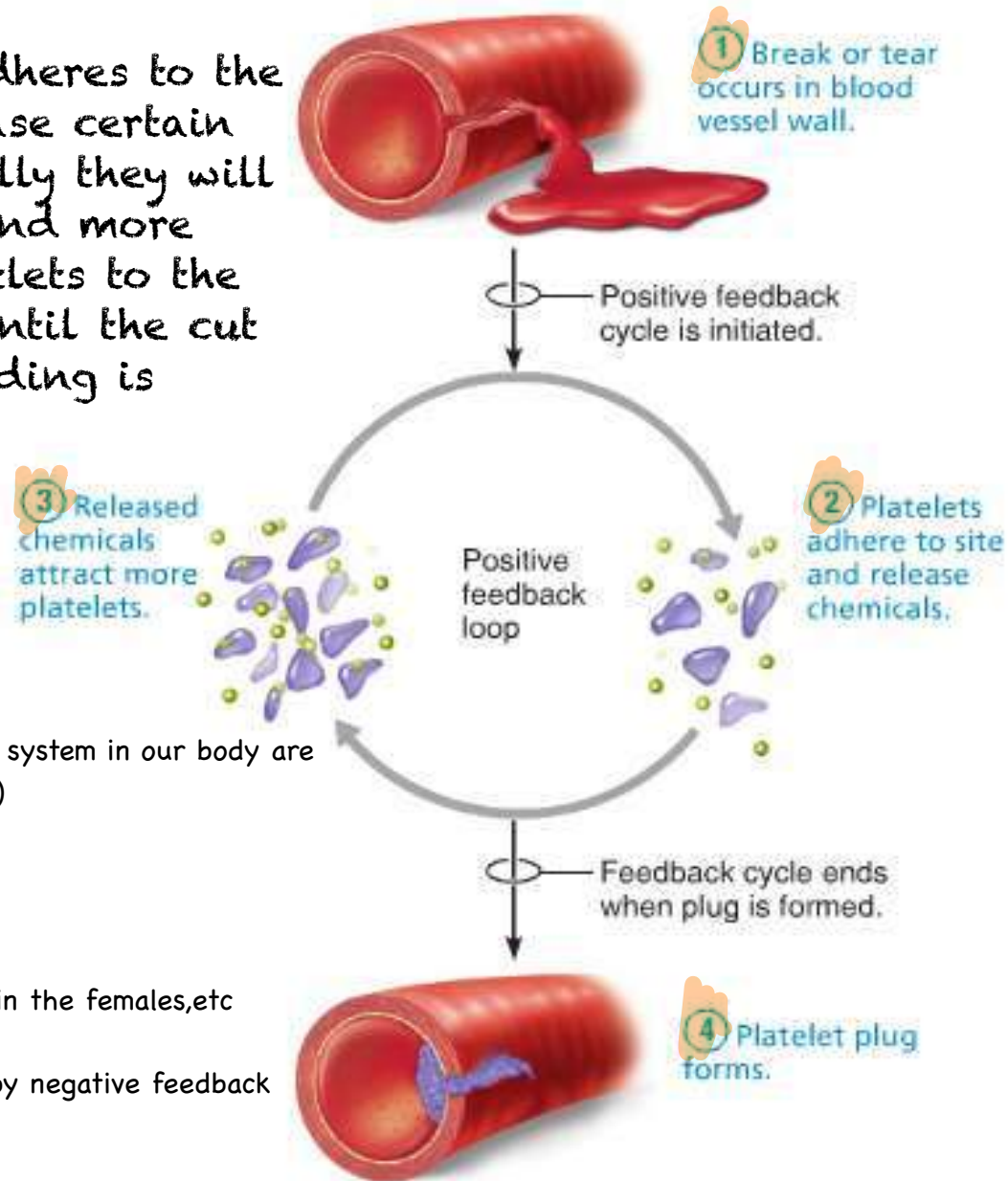
That small amount of sodium entering will enhance more and more soduim channel will open , sodium will more and more enter into the cell until full depolarization is produced

Summary :

The entry of small amount of sodium initially by the stimulation , will enhance (يعزز) further and further amount of sodium to enter into the cell to produce full excitation (اثارة كاملة) that occurs in all excitable cells of our body

Positive feed back mechanism of blood clotting

Small platelets adheres to the injury will release certain chemicals, locally they will increase more and more adhesion of platelets to the side of injury until the cut is shut and bleeding is

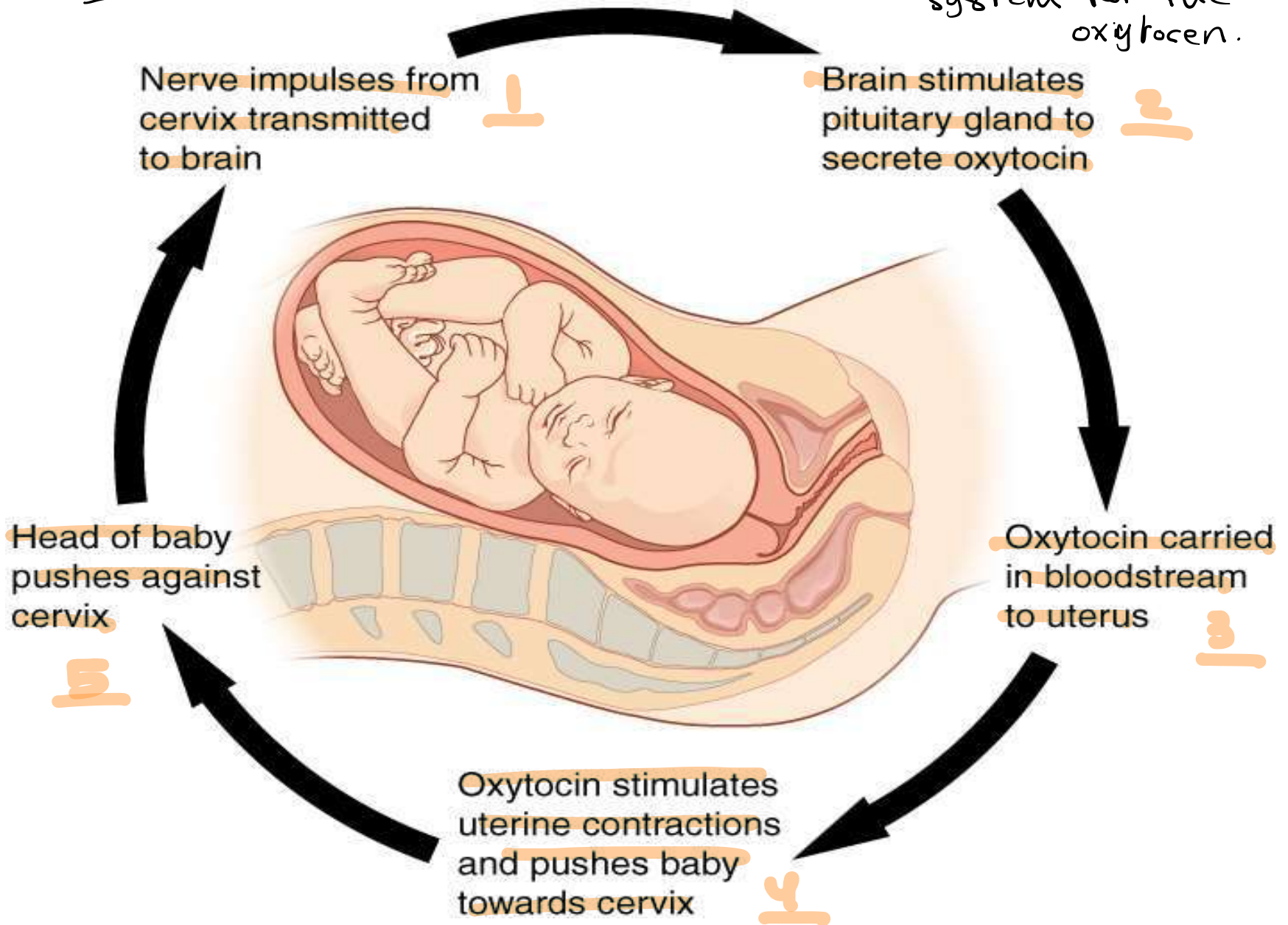


The majority of the control system in our body are ((negative feedback system))

- 1.hormones levels
- 2.calcium levels
- 3.sodium levels
- 4.blood presure , 5. Period in the females,etc

All of these are controled by negative feedback system

* positive feedback system for the oxytocin.



Disruption in Homeostasis

can lead to illness and death

Is the subject which looks into the abnormalities
in the control systems of all our body

Pathophysiology 

*the abnormal functioning of the body
during disease*

The disease is abnormality in the
homeostatic mechanisms

End of lecture 1

Contributions of Body Systems to Homeostasis (cont.)

- Nervous system
 - Controls and coordinates bodily activities that require rapid responses.
 - Detects and initiates reactions to changes in external environment.
- Endocrine system
 - Secreting glands of endocrine regulate activities that require duration rather than speed
 - Controls concentration of nutrients and, by adjusting kidney function, controls internal environment's volume and electrolyte composition
- Reproductive system
 - Not essential for homeostasis (not essential for survival of individual)
 - Is essential for perpetuating the species

Contributions of Body Systems to Homeostasis

- Circulatory system
 - Carries materials from one part of the body to another.
- Digestive system
 - Breaks down dietary food into smaller molecules that can be distributed to body cells.
 - Transfers water and electrolytes from external environment to internal environment.
 - Eliminates undigested food residues to external environment in the feces.

Contributions of Body Systems to Homeostasis (cont.)

- Respiratory system
 - Gets O₂ from and eliminates CO₂ to the external environment
 - Important in maintenance of proper pH of internal environment
- Urinary system
- Removes excess water, salt, acid, and other electrolytes from plasma and eliminates them in urine.

- Skeletal system
 - Provides support and protection for soft tissues and organs
 - Serves as storage reservoir for calcium
 - Along with muscular system enables movement of body and its parts
 - Bone marrow is ultimate source of all blood cells

Contributions of Body Systems to Homeostasis (cont.)

- Muscular system
 - Moves the bones
- Integumentary system
 - Serves as outer protective barrier
 - Important in regulating body temperature
- Immune system
 - Defends against foreign invaders and against body cells that have become cancerous
 - Paves way for repairing or replacing injured or worn-out cells