

PHYSIOLOGY



Lec: The internal environment and homeostasis

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* Physiology Lecture 1

The scope of physiology
The internal environment and
Homeostasis

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Lecture Objectives:

- 1 ■ Understand the concept of homeostasis, external and internal environments.
- 2 ■ Explain how organ systems contribute to the maintenance of the internal environment.
- 3 ■ Explain the difference between steady state and equilibrium.
- 4 ■ Describe how homeostatic mechanism ^{control systems.} monitors a particular aspect of the internal environment.
- 5 ■ Be familiar with the coordination of body systems in regulation of body functions

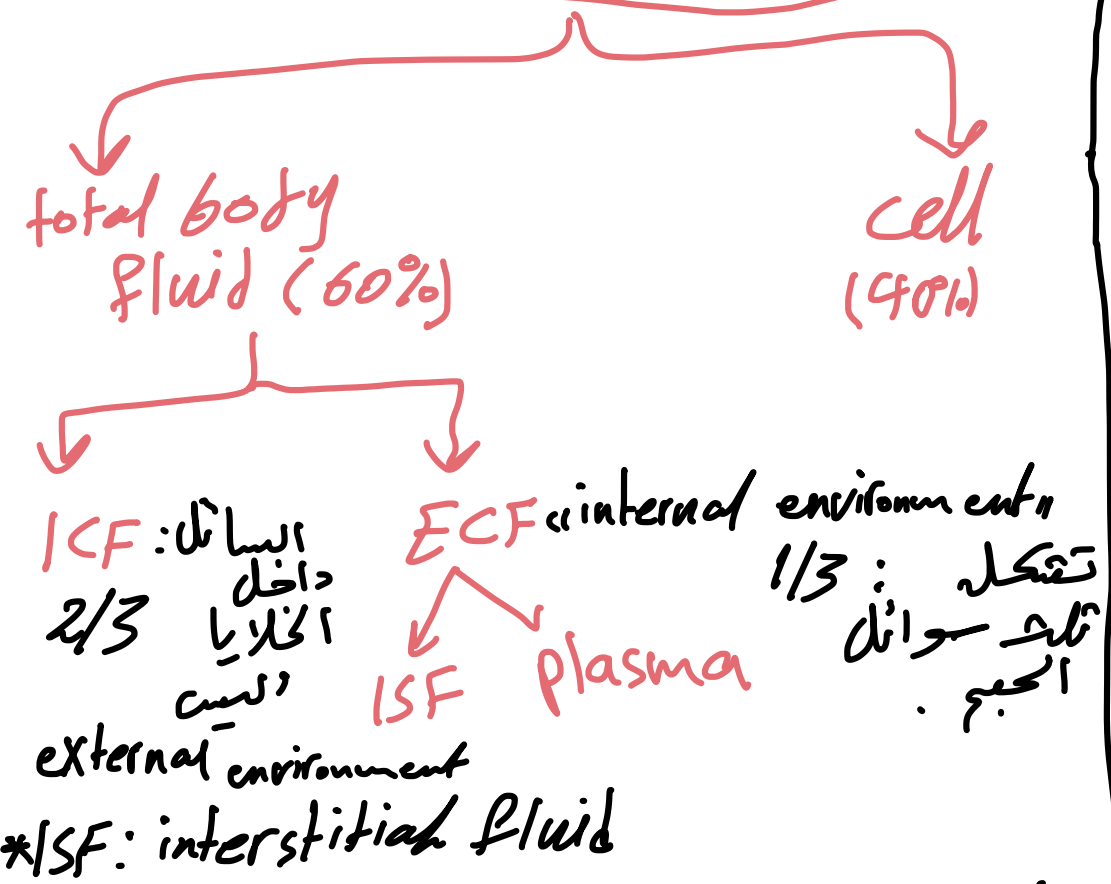
علم الفسيولوجيا يهتم بدراسة وظائف مستويات التنظيم في جميع الأنسجة (الخلايا، الأنسجة، والأعضاء) وكيف تتلائم وتعمل عند أجل المحافظة على المستوى الأقل من الصحة ومنع حدوث الأمراض

*Physiology:

The science that ^① explains the function of ^② cells, ^③ tissues, and ^④ organs; and how they are ^⑤ integrated to maintain body optimal health and survival.

level of ←
body regulation

Human body



عبارة عن السائل التي تتواجد فيه خلايا الجسم.

ISF و plasma في حركة مستمرة للتخلص من الفضلات وتوفير بيئة ملائمة للخلايا ولهذا يحدث عن طريق الشعيرات الدموية.

مجموع: * عنصر البناء الأساسي في الكائنات الحية هو الخلية.

* الأحياء: كائن حي يعيش في المادة مكونة من خلية واحدة فقط.

* البيئة الداخلية لهذا الكائن الحي تكون داخل الغشاء البلازمي والبيئة الخارجية هي الماء وهي المسؤولة عن توفير البيئة المناسبة لبقاء الكائن الحي على قيد الحياة.

* تشمل البيئة المناسبة على O₂ nutrition, waste disposal.

* جسم الإنسان يحوي على البيئة الداخلية internal environment وهي الموجودة بين حاجر الخلية والخلايا، ويحوي external environment «خارج الخلية»

* ECF: هي المسؤولة عن توفير البيئة المناسبة للأعضاء والخلايا عن توفير O₂ و مواد غذائية والتخلص من الفضلات وهي السائل الذي تقيس فيه الخلايا

* The internal environment (Extracellular fluid-ECF)

اسم آخر للـ ECF باللغة الفرنسية هو

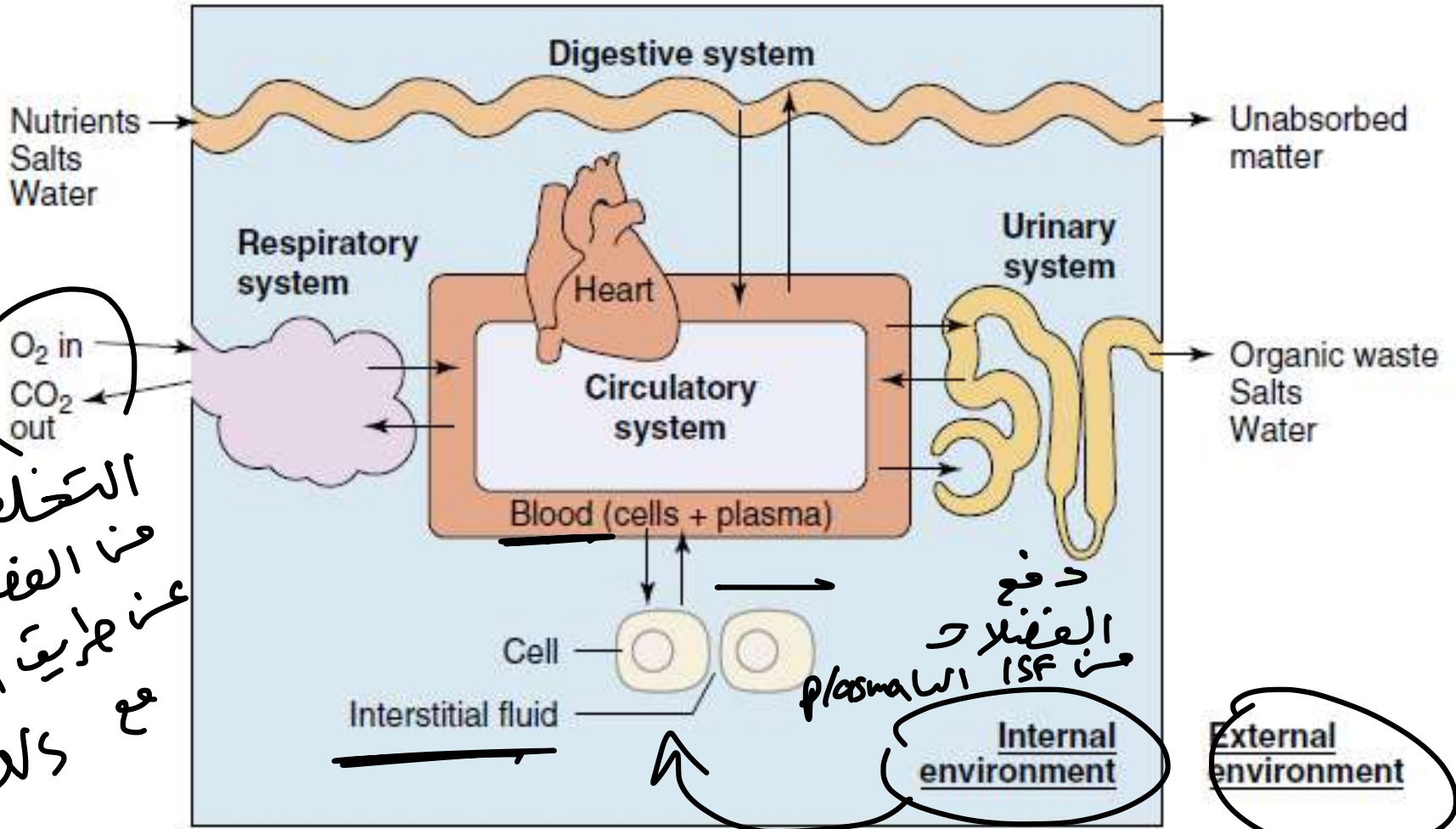
① ■ Also called milieu interieur by the French physiologist Claude Bernard (1813-1878). The **internal environment** is the fluid environment in which the cells live. Note that the external environment is outside the body. → خارج حاجر الحبله.

② ■ The ECF constitutes **one third** of body fluid. ECF consists of the blood plasma and interstitial fluid.

③ ■ The ECF is in **constant motion**. It is rapidly transported in the circulating blood and then mixing between the blood and tissue fluids occurs by diffusion through the capillary walls.

④ ■ The composition of the ECF is maintained by **body systems**. يتم ضبط البيئة الداخلية بواسطة body system أو system أو cell أو organ.

⑤ ■ It contains the ions and nutrients needed by the cells for maintenance of cellular life. It also contains CO₂ plus other cellular waste products. ← يتم التخلص منها عن طريق CVS system.



ICF	ECF
PO_4^{3-}	HCO_3^-
K^+	Cl^-
Mg^{+2}	Na^+
	Ca^{+2}

* تركيز بعض الأيونات والمواد.

⑧ يختلف تركيز المواد والأيونات فيما بين ECF و ICF وهذا التركيز relatively constant يعني يوجد ضمن range معين وليس برقم محدد قليلاً pH في الجسم (7,35 - 7,45) ولهذا يمكن الخلايا من العيش بسلام والنمو والتكاثر 😊

* يتم الحفاظ على تركيز المواد في حالة steady state وليس equilibrium
 * طبيب أيش الفرق؟؟؟
 بكل بساطة حالة equilibrium يتحلل على توزيع التركيز بشكل عشوائي بين ECF و ICF أما steady state يتحلل على توزيع التركيز ضمن الـ range المطلوب والحد.

* The internal environment (Cont.)

"rangen"

✓ The level and concentrations of O_2 , glucose, different ions, water, pH, amino acids, fatty substances, and other constituents are **held relatively constant** in this internal environment so as cells are capable of living, ¹ growing, and performing ² their special functions

✓ The concentration of ions and other substances in the extracellular fluid may differ from that of the intracellular fluid (e.g. high Na^+ , Cl^- , and HCO_3^- ions extracellularly)

T in ECF

✓ Intracellular fluid (ICF) has higher concentration of K^+ , Mg^{2+} , and phosphate ions. The composition of the ICF is maintained by the cell membrane which has special mechanisms for transporting of ions and molecules through it by **diffusion, osmosis, active transport, and vesicular transport**

PO_4^{3-}

عناصر
لا حقا

يتم الحفاظ على تركيز المواد في حالة steady state عن طريق mechanisms or controls system

عناصرها

تعني الحفاظ على ECF من حيث تركيز الأيونات والمواد الغذائية من أجل الحفاظ على صحة الخلية ومنع الأمراض وهذا **Homeostasis** يتم عن طريق *control systems*

- 1 ■ Is the maintenance of the ECF and the ICF composition (and their temperature) relatively stable in a **steady-state** condition, distinct from **equilibrium**, by a variety of regulatory processes called homeostatic mechanisms.
- 2 ■ Homeo means "the same"; stasis means "to stand or stay". Homeostasis is not a rigid, fixed state but a dynamic steady-state in which the changes that do occur are minimized by the homeostatic mechanisms. *لا يوجد اتزان في جسم الإنسان*
- 3 ■ Maintenance of a steady-state occurs when water and a number of important solutes **input** into the body equals **output** from the body. *Body control system*
- 4 ■ Disease or death is often the result of dysfunction of homeostatic mechanisms. *وليس not function سواد*
- 5 ■ The discipline of **pathophysiology** explains how the various physiological processes are altered in diseases or injury.
- 6 ■ The effectiveness of homeostatic mechanisms varies over a person's lifetime. *الحفاظ على homeostatic تختلف باختلاف العمر*
"نقل" يعني عمل وظائف الخلية بـ adult يتكون أعم من elderly

* Contributions of the **Body Systems** to Homeostasis

- 1 ■ Role of **CVS** in homeostasis (mixing the plasma and extracellular fluid, thereby it maintains complete homogeneity of these fluids throughout the body).
- 2 ■ Role of **respiratory system** in homeostasis (supply of O₂ and removal of CO₂).
- 3 ■ Role of **GIT** in homeostasis (absorption of carbohydrates, fatty acids, and amino acids into the extracellular fluid).
- 4 ■ Role of **liver** and other organs in homeostasis (metabolic function, e.g. changing chemical composition, modifying the absorbed substances, and storing).
- 5 ■ Role of **kidneys** in homeostasis (excretion of waste products such as urea, uric acid, excesses of ions and water).

Contributions of the Body Systems to Homeostasis (cont.)

- 6 ■ Role of **musculoskeletal system** in homeostasis (provides **support** and protection for the soft tissues and organs; and enables **movement** toward food or away from threats).
- 7 ■ Role of **nervous system** in homeostasis (instant regulatory functions by its sensory part, central nervous system or integrative part, and the motor part). The autonomic system operates at a **subconscious** level to control many organs such as the heart pumping, GIT movement, glandular secretion, etc. The nervous system controls mainly the muscular and secretory activities.
- 8 ■ Role of **endocrine system** (hormonal system) in homeostasis (delayed and prolonged regulatory function; e.g. thyroid hormones, insulin hormone, parathyroid hormone, etc.). This system regulates mainly metabolic functions.

تنظيم

Contributions of the Body Systems to Homeostasis (cont.)

- 9 ■ Role of **the immune system** (white blood cells, the thymus, and lymph nodes) in homeostasis is the protection from pathogens. This function is achieved by distinguishing body own cells from harmful foreign cells and substances; and by destroying the invader by **phagocytosis** or by **antibodies**.
- 10 ■ The role of the **integumentary system** (skin and its various appendages) is to cover, cushion, and protect the deeper tissues and organs. This system is also important for **temperature regulation** and excretion of wastes, and it provides a sensory interface between the body and the external environment.
- 11 ■ Role of **reproductive system** is to maintain homeostasis (maintains continuity of life by generating new beings to replace those that are dying).

Test Question:

Q. Which statement regarding homeostasis is incorrect?

A. The term "homeostasis" describes the maintenance of nearly constant conditions in the body. ✓

B. In most diseases, homeostatic mechanisms are no longer operating in the body. *dysfunction* ✗

C. The body's compensatory mechanisms often lead to deviations from the normal range in some of the body's functions. *ممکنه که در سطح و لیکن تغییرات طبیعی در محدوده طبیعی*

D. Disease is generally considered to be a state of disrupted homeostasis. *که او تغییرات طبیعی*

E. The concept of homeostasis includes the concept of an error signal.