

Physiology Lecture 1

The scope of physiology
The internal environment and
Homeostasis

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Lecture Objectives:

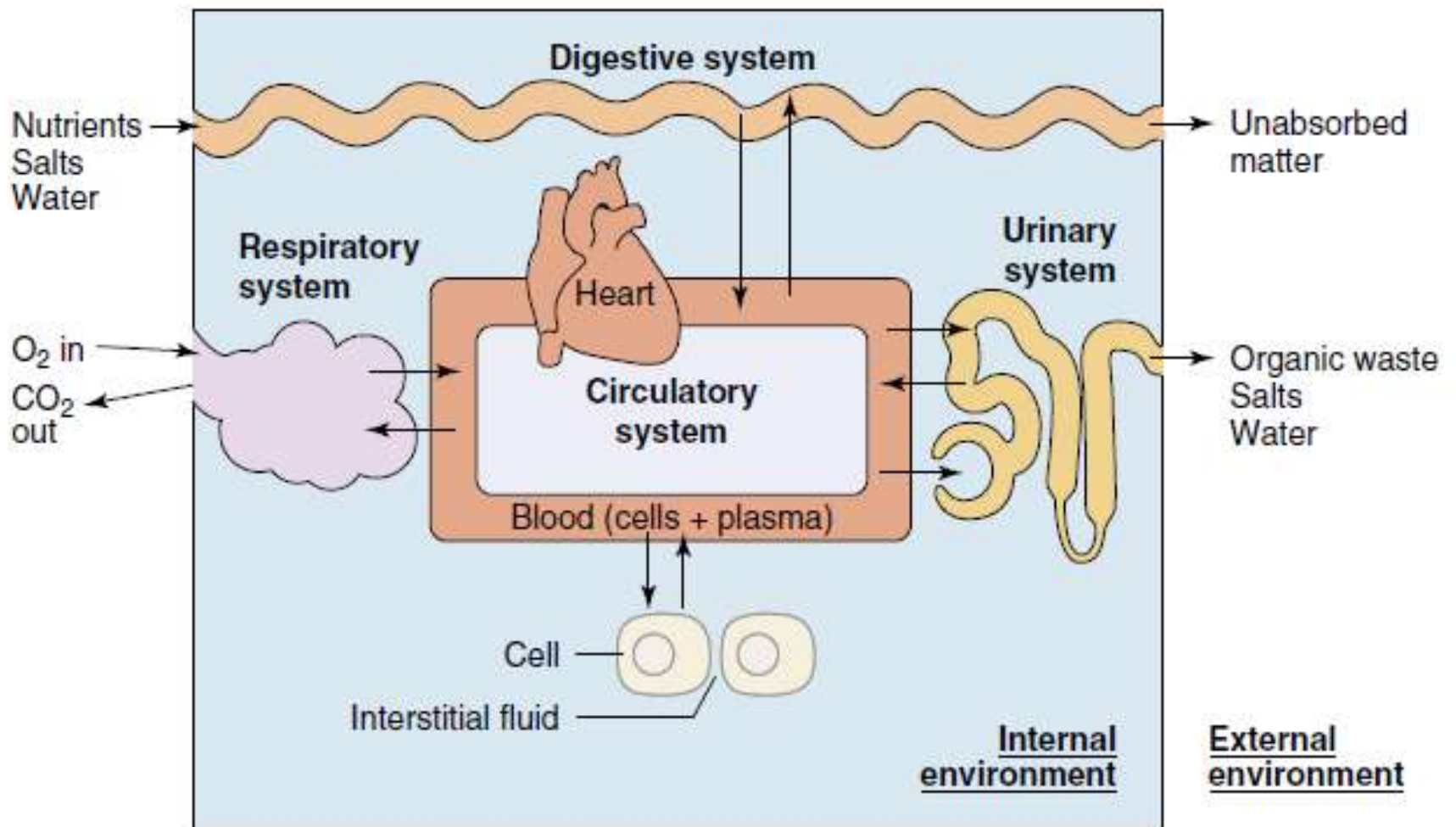
- Understand the concept of homeostasis, external and internal environments.
- Explain how organ systems contribute to the maintenance of the internal environment.
- Explain the difference between steady state and equilibrium.
- Describe how homeostatic mechanism monitors a particular aspect of the internal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

Physiology:

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

The internal environment (Extracellular fluid-ECF)

- 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.
- The ECF constitutes **one third** of body fluid. ECF consists of the blood plasma and interstitial fluid.
- 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.
- The composition of the ECF is maintained by **body systems**
- It contains the ions and nutrients needed by the cells for maintenance of cellular life. It also contains CO_2 plus other cellular waste products



The internal environment (Cont.)

- 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, growing, and performing 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)
- 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**

Homeostasis

- 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.
- 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.
- Maintenance of a steady-state occurs when water and a number of important solutes **input** into the body equals **output** from the body.
- Disease or death is often the result of dysfunction of homeostatic mechanisms.
- The discipline of **pathophysiology** explains how the various physiological processes are altered in diseases or injury.
- The effectiveness of homeostatic mechanisms varies over a person's lifetime.

Contributions of the Body Systems to Homeostasis

- Role of CVS in homeostasis (mixing the plasma and extracellular fluid, thereby it maintains complete homogeneity of these fluids throughout the body).
- Role of respiratory system in homeostasis (supply of O_2 and removal of CO_2).
- Role of GIT in homeostasis (absorption of carbohydrates, fatty acids, and amino acids into the extracellular fluid).
- Role of liver and other organs in homeostasis (metabolic function, e.g. changing chemical composition, modifying the absorbed substances, and storing).
- 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.)

- 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).
- 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.
- 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.

Contributions of the Body Systems to Homeostasis (cont.)

- 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**.
- 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.
- 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.
- C. The body's compensatory mechanisms often lead to deviations from the normal range in some of the body's functions.
- D. Disease is generally considered to be a state of disrupted homeostasis.
- E. The concept of homeostasis includes the concept of an error signal.