1. DEFINITION OF PHYSIOLOGY

Study of the functions of the healthy human body.
How the body works.
Focus on mechanisms of action.

Anatomy & Physiology: inseparable & complementary

They are complementary with each other. Structure determines function and function determines certain structure.
Ex: The structure of lung cannot secrete urine, like kidneys.

2. DEFINITION OF HOMEOSTASIS

Maintenance of the relative stable “internal environment” in an ever changing world.

Balance or equilibrium of all functions.
It is a dynamic steady state.
Dynamic: parameters do change
Steady state: parameters change ins very narrow limits.
Ex: Normal pH = 7.35- 7.45
3. DEFINITION OF INTERNAL ENVIRONMENT

Fig. 1-4. Page 11.

Internal environment IS THE SAME AS Extracellular Fluid (ECF):

Definition: The environment, where the cells live. It is “salty water”.
Components:
1. Plasma
2. Interstitial Fluid (ISF):

Intracellular Fluid (ICF): cytoplasm

Unicellular Organism

The cell has direct contact with the external environment.
The cell cannot change the exterior.

Multicellular Organism

The cell does not have direct contact with the external environment.
The cell have direct contact with the INTERNAL ENVIRONMENT.(= extracellular fluid)

Therefore, who has the contact with external environment???

Some of the organ systems!!!

The order of contact is:

External environment → some organ/ body system → Internal environment → cells
Ex: respiratory system
digestive system
urinary system
reproductive system

Body systems are involved in maintenance of homeostasis. Fig. 1-5. Page 12.
EXAMPLES, homeostatically regulated:

- Concentration of nutrient molecules
- Concentration of $O_2$ & $CO_2$
- Concentration of waste Products
- $pH$
- Concentration of water, salt & electrolytes
- Temperature
- Volume & pressure

4. HOMEOSTATIC CONTROL SYSTEM: controls the “variable”.

Ex: normal body temperature

Components of control system:

Set Point: the level or range at which a variable is to be maintained.
Determined by control center.

Sensor: receptors or receptor organs that monitor variable.

\[\downarrow\]

Integrator = control center: compares variable to set point
makes adjustment of variable to keep set point
sends command out to effector

\[\downarrow\]

Effector: brings about the adjustment to set point
5. CLASSIFICATION OF CONTROL MECHANISM

Based on location:
Intrinsic or local control:
Regulatory mechanism is initiated inside an organ. (= inherent to an organ)
Ex: local vasodilation
    movement of cilia

Extrinsic: Regulatory mechanism is initiated outside the organ.
    Two major regulatory control systems:
    • endocrine
    • nervous system

Based on kinds of response:
Negative feedback: Main form of regulation.
Stimulus triggers a response that opposes the stimulus.
Driving the variable in the opposite direction of the initial change.

Ex: when you feel cold, you start shivering to raise body temperature.

Positive feedback: Less frequent form of regulation.
Stimulus triggers a response that is continually enhanced.
Driving the variable in the same direction of the initial change.

Ex: blood clotting
    action potential
    child labor

Feedforward: Less frequent form of regulation.
Stimulus triggers a response in anticipation of a change in a variable.
Ex: smell of food triggers digestive juice secretion.
Two major regulatory systems:

1. Nervous

2. Endocrine

- circulatory

- digestive

- respiratory

- urinary

- immune

- integumentary

- skeletal

- muscular

- reproductive
7. DISRUPTION IN HOMEOSTASIS:

Mechanism:
- components of the feedback break down
- abnormal positive feedback = “circulus vitiosus”

→ illness

→ death

Pathophysiology: Study of mechanisms involved in disruption in homeostasis.

Critical thinking questions of homeostasis:

1. exercise p. 13. What is exercise physiology?

2. stem cell research p. 8.

3. pH balance in the blood p. buffers

4. Glucose control p. diabetes

5. Vomiting/diarrhea
   - vomiting = losing acid → metabolic alkalosis
   - diarrhea = losing base → metabolic acidosis

6. AIDS disruption in immune homeostasis
   - helper T cells do not work

Anikó Szabó Hill MD, PhD