

Lec-1-

Introduction to Physiology

Third Stage

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Section I **What is Physiology?**

- **Physiology:** biological sciences
 - dealing with the normal life phenomena exhibited by all living organisms.
- **Human physiology:** basic sciences
 - dealing with normal life phenomena of the human body.
- **Goal of physiology:**
 - explain the physical and chemical factors that are responsible for the origin, development and progression of **life**.

Human Physiology

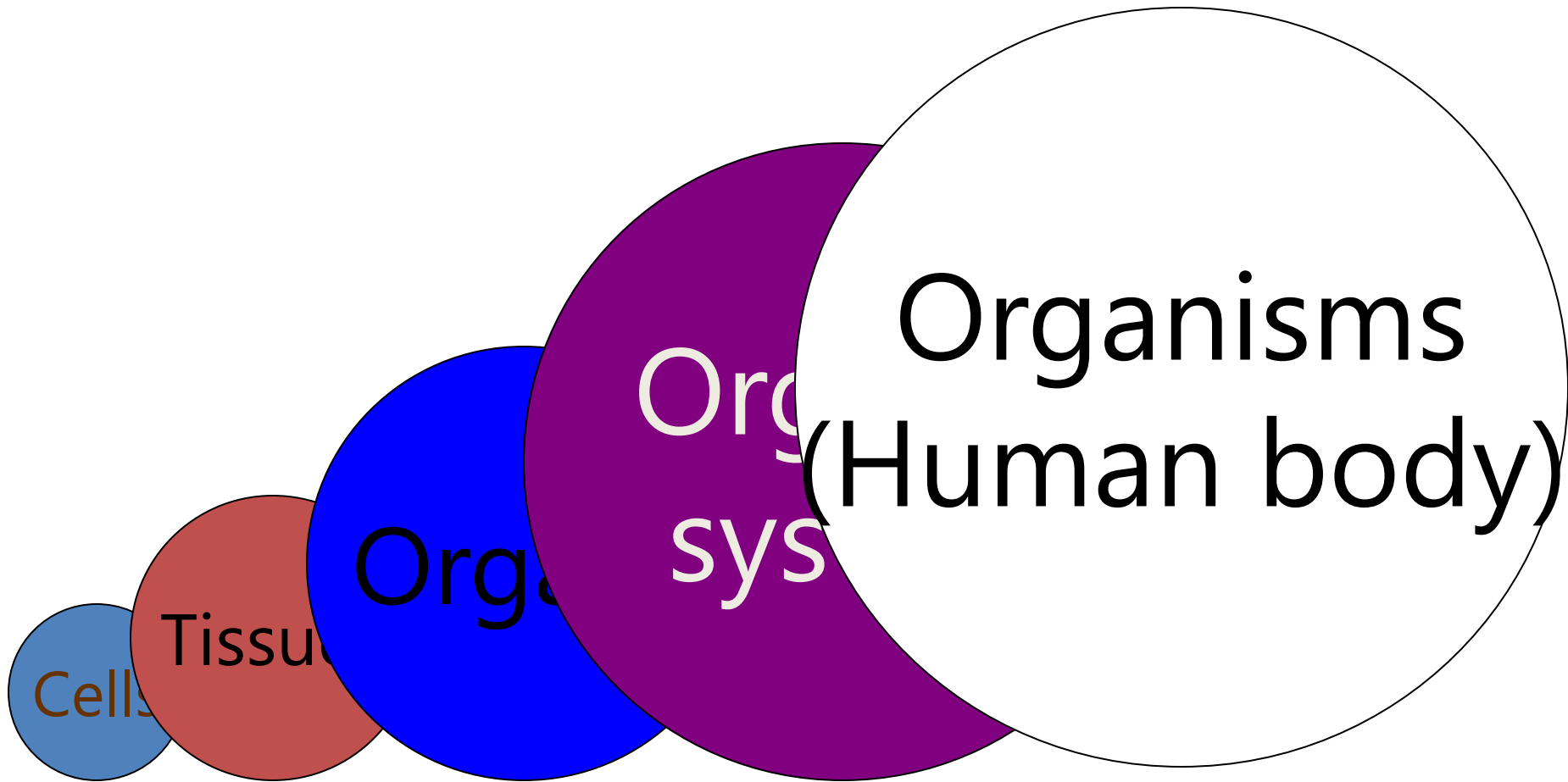
- **Physiology: (Greek) The study of nature, the involvement of Physics and Chemistry.**
- **The basis for**
 - **Pathophysiology**
 - **Pharmacology**
 - **Immunology**
 - **Biochemistry**
 - **Microbiology**

Why do we study Physiology?

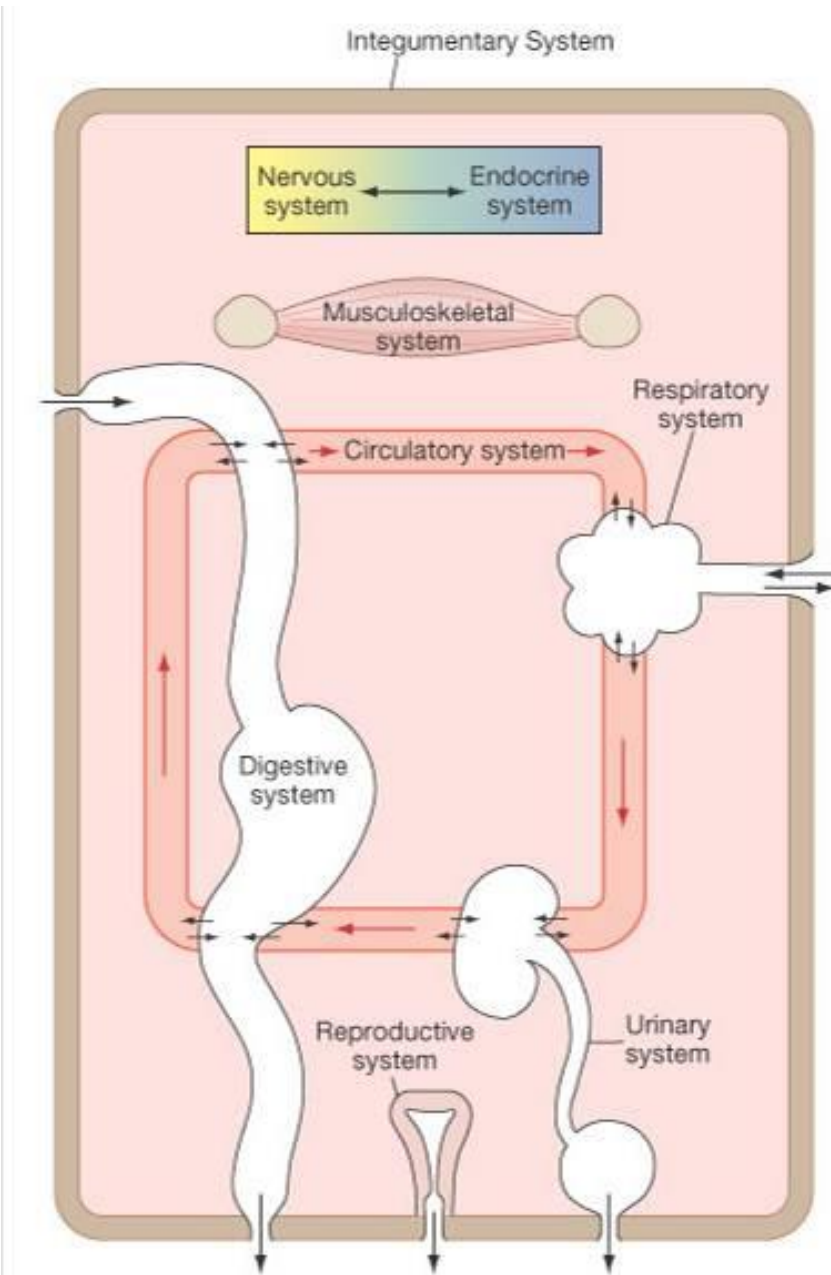
- Understand the physical and chemical principle underlie normal function in order to cure the impairments.

Different Level of Physiological Research

Organization of the human body

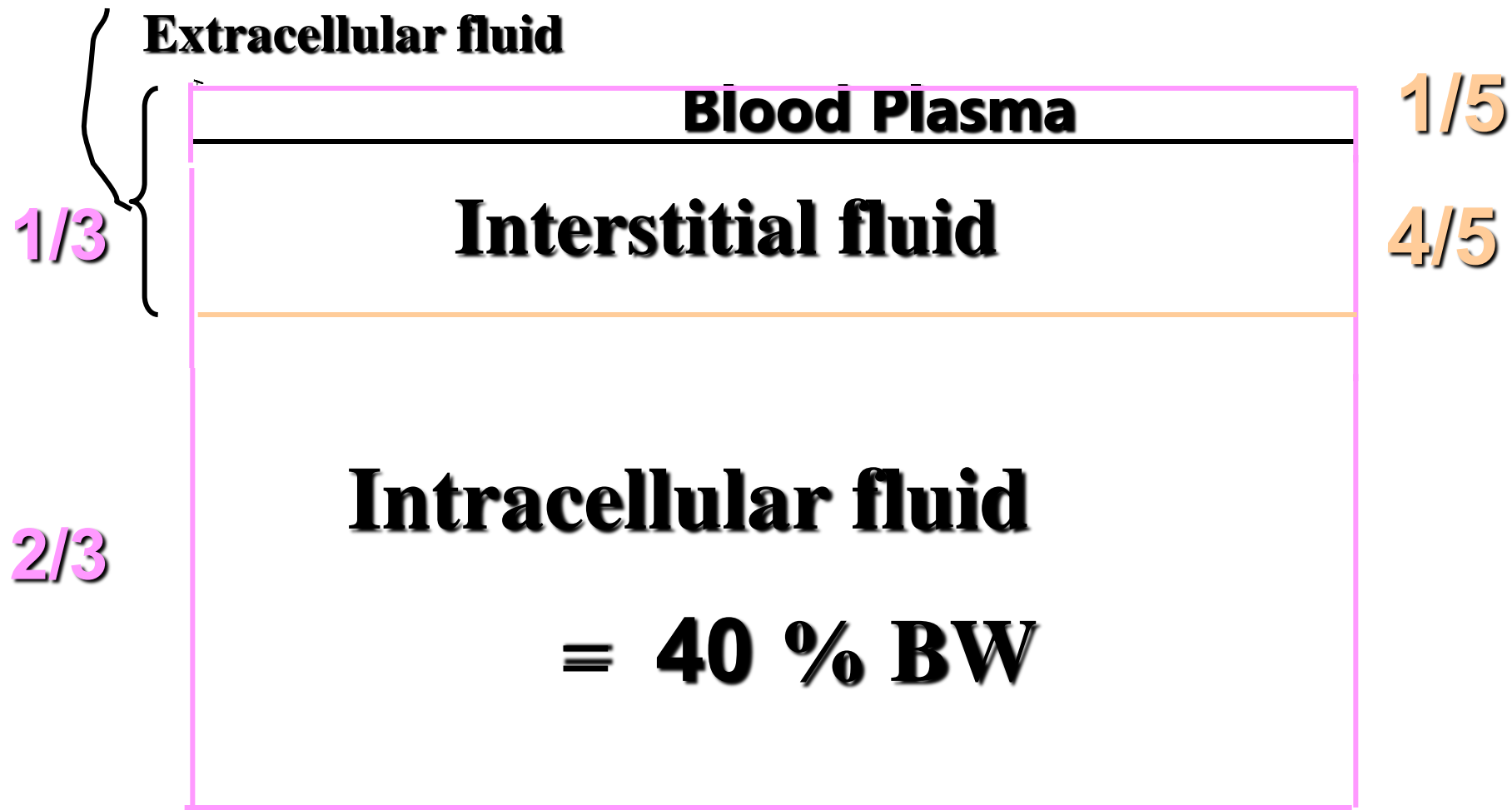


The integration between systems of the body

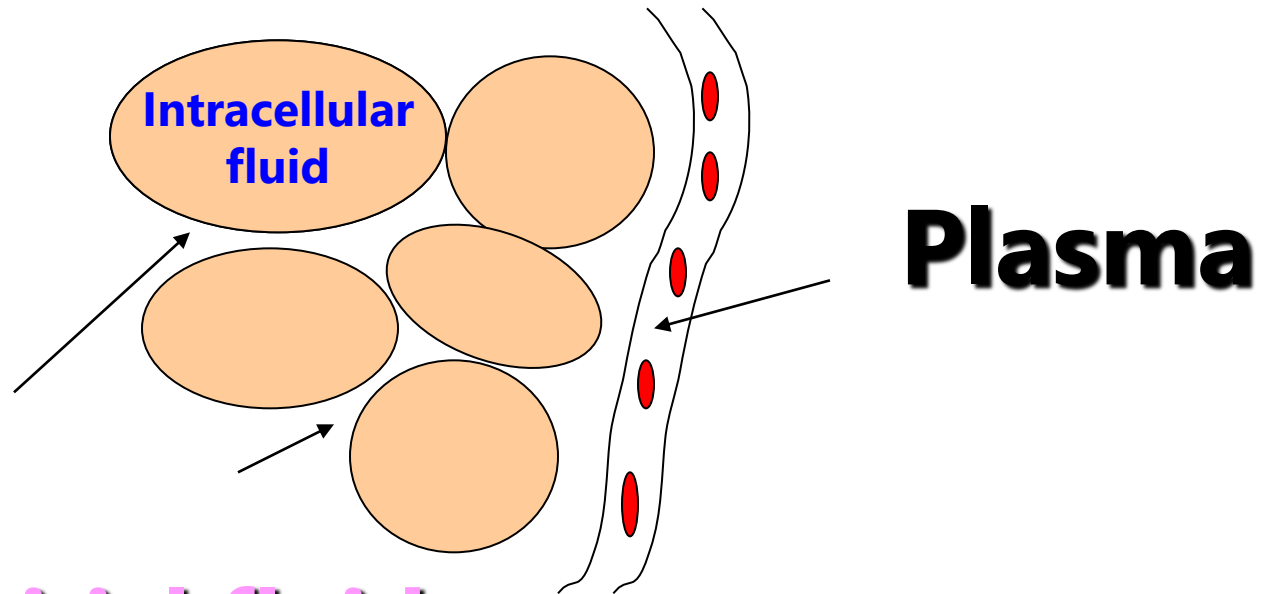


Section II Internal Environment and Homeostasis

Total body water = 60 % BW



Internal environment

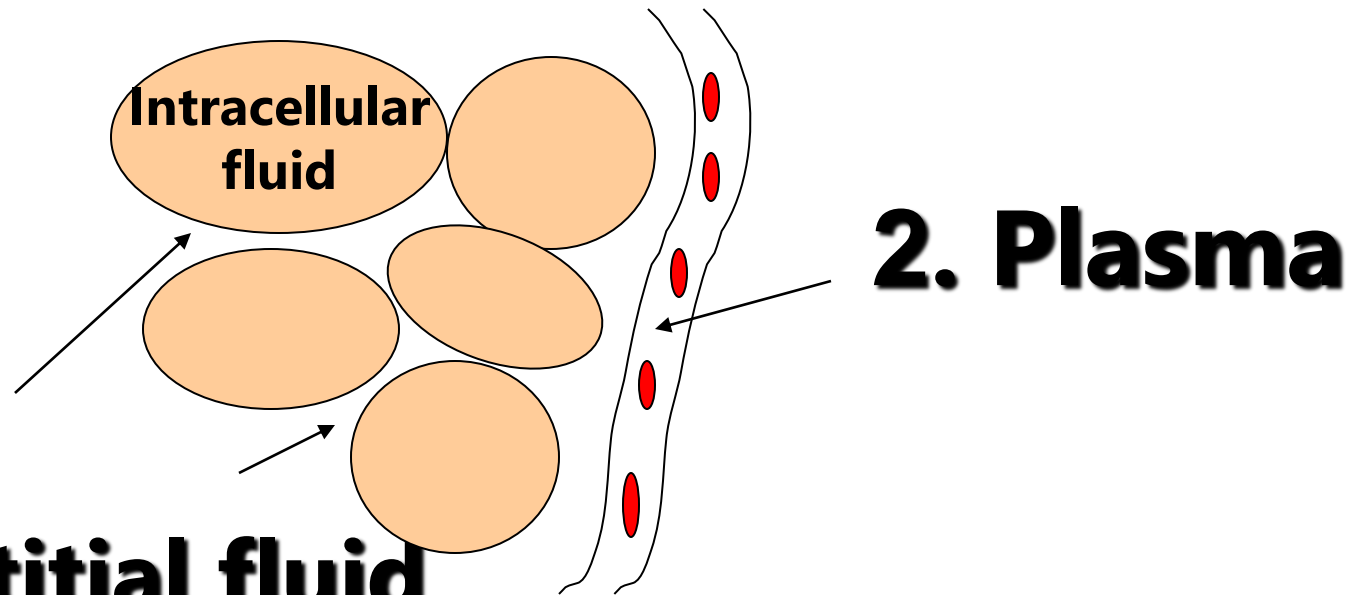


Interstitial fluid

Extracellular fluid directly bathes body cells

Internal environment = Extracellular fluid

Extracellular fluids



1. Interstitial fluid

**3. Fluid of special compartments:
pericardial fluid, pleural fluid, cerebrospinal fluid**

Homeostasis

- Maintenance of Relatively Constant Chemical/Physical Conditions **of the internal environment.**



Homeostasis

- **Walter Bradford Cannon, (1871– 1945),**
- **The concept of Homeostasis**



- **stable \neq rigidity, can vary within narrow limit (normal physiological range)**
- **The golden goal of every organ :**
 - **to maintain homeostasis**
 - **(concept of REGULATION)**

Normal Physiological ranges

■ In fasting blood

Arterial pH **7.35-7.45**

Bicarbonate **24-28 mEq/L**

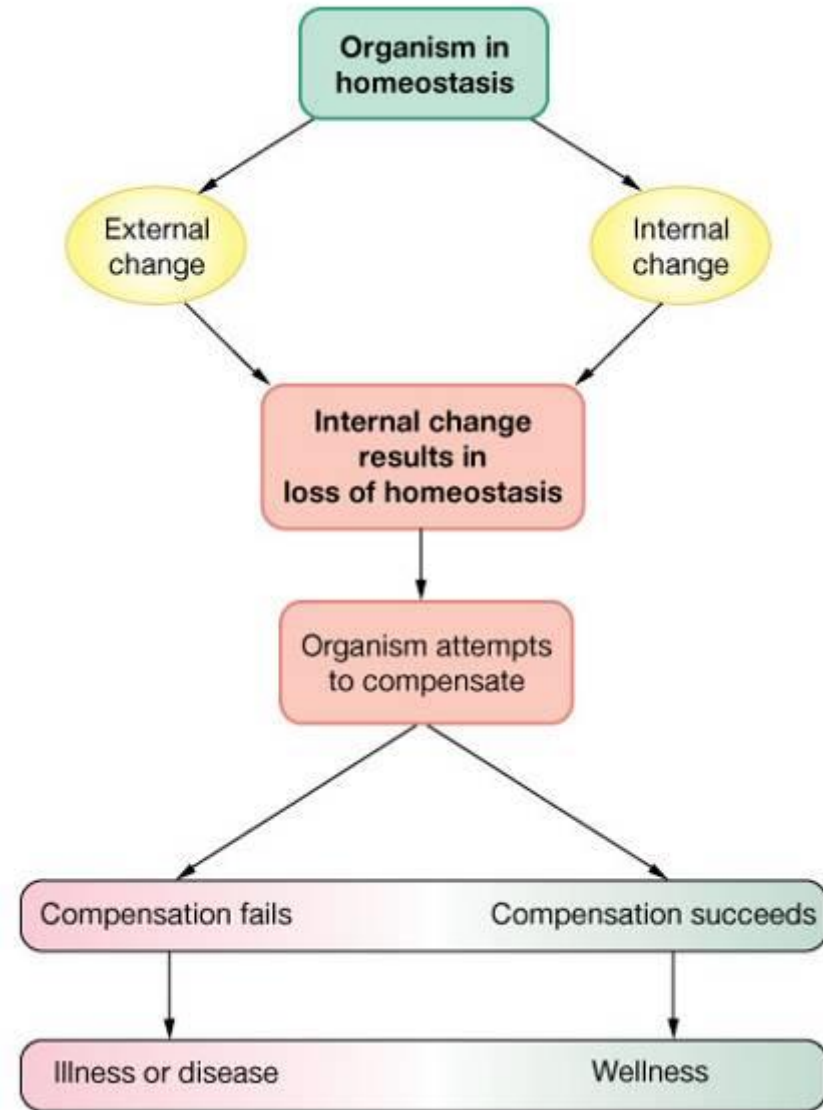
O₂ content **17.2-22.0 ml/100 ml**

Total lipid **400-800 mg/100 ml**

Glucose **75-110 mg/100 ml**

Homeostasis & Controls

- Successful compensation
 - Homeostasis reestablished
- Failure to compensate
 - Pathophysiology
 - Illness
 - Death

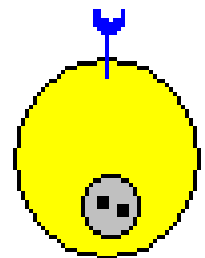
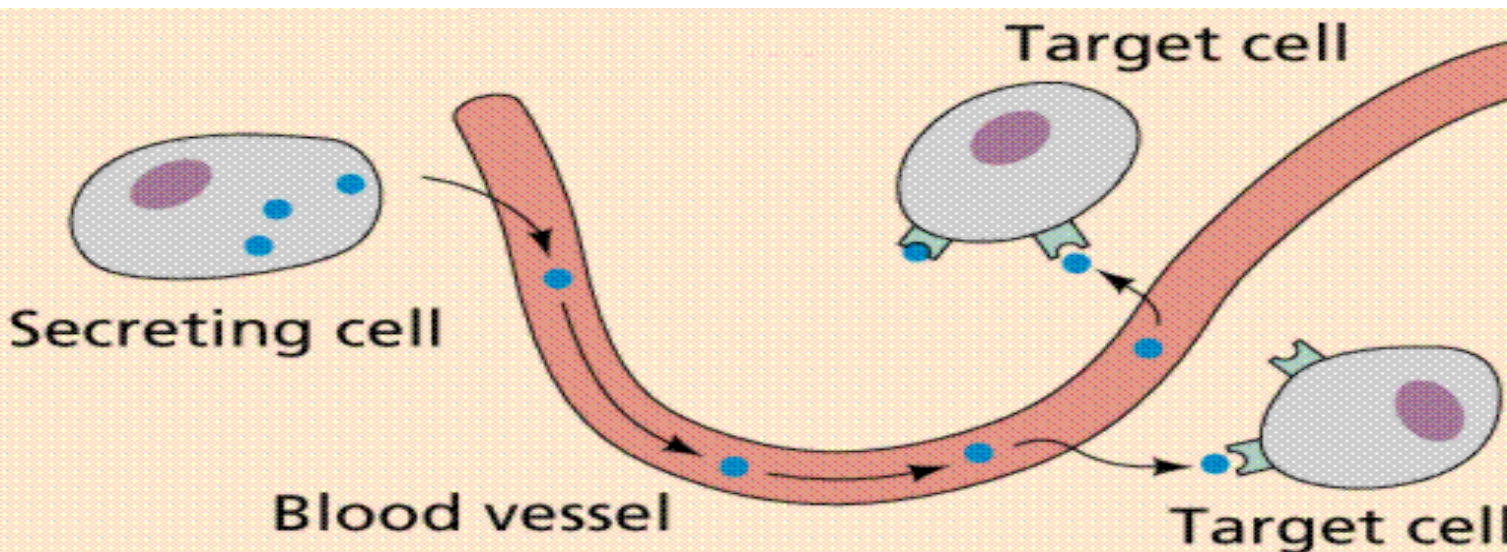
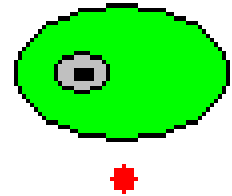


Regulation of the Body Functions

- Regulation- the ability of an organism to maintain a stable internal conditions in a constantly changing environment
 - Three types:
 - 1. Chemical (hormonal) Regulation
 - 2. Nervous Regulation
 - 3. Autoregulation

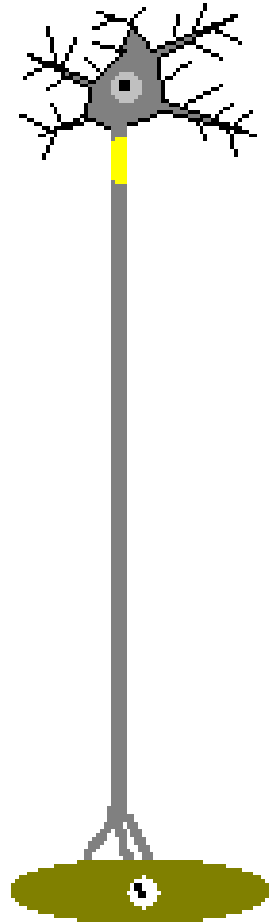
Chemical (hormonal) Regulation

- a regulatory process performed by **hormone** or **active chemical substance** in blood or tissue.
 - response slowly
 - acts extensively
 - lasts for a long time.



Nervous Regulation

- a process in which body functions are controlled by nerve system
 - Pathway: nerve reflex
 - Types: unconditioned reflex and conditioned reflex
 - Example: baroreceptor reflex of arterial blood pressure
- Characteristics:
 - response fast
 - acts exactly or locally
 - last for a short time



Autoregulation

- a tissue or an organ can directly respond to environmental changes
 - independent of nervous and hormonal control
 - Characteristics:
 - Amplitude of the regulation is smaller than other two types.
 - Extension of the effects is smaller than other two types.

Regulation of the Body Functions

- The three regulations have coordinated and acts as one system, “feedback control system”.

Section 4 Control System in the Human Body

- Feedback Control
- Feed-forward control

Section 4 Control System in the Human Body

- Feedback Control
 - **Feedback: Output** (feedback signal) from **controlled organ** returns to affect or modify the action of the **control system**.
 - Feedback control mechanism consists of two forms:
 - **Negative** feedback control.
 - **Positive** feedback control

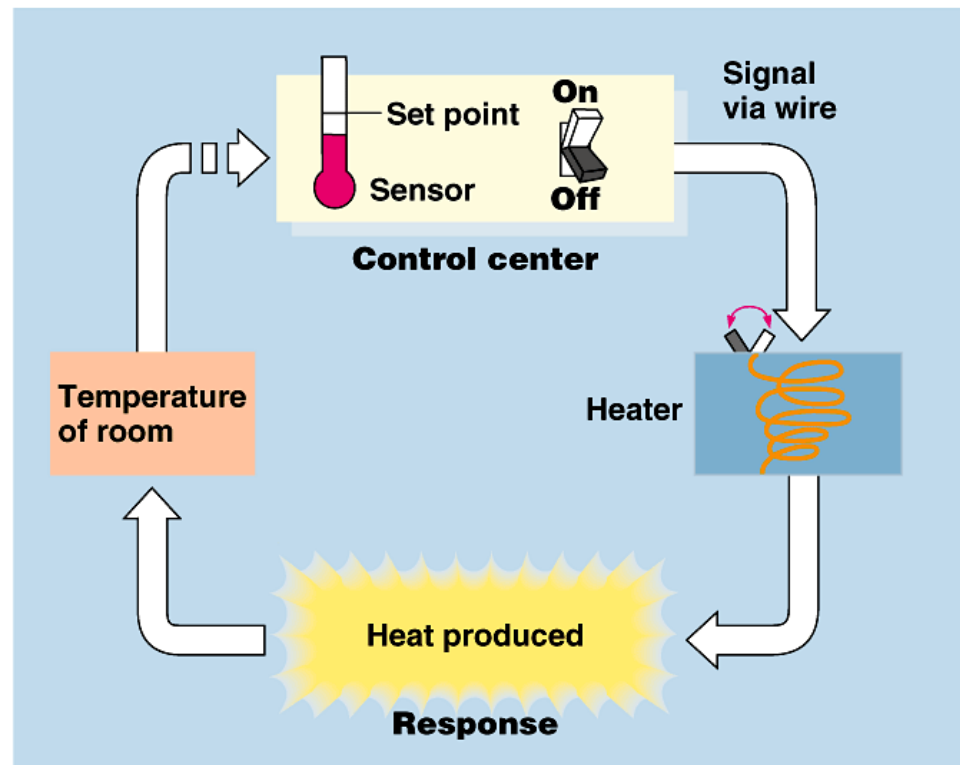
Negative feedback

- The feedback signals from controlled system produces effect **opposite** to the action of the control system.
- The opposite effect is mainly “inhibitory action”.

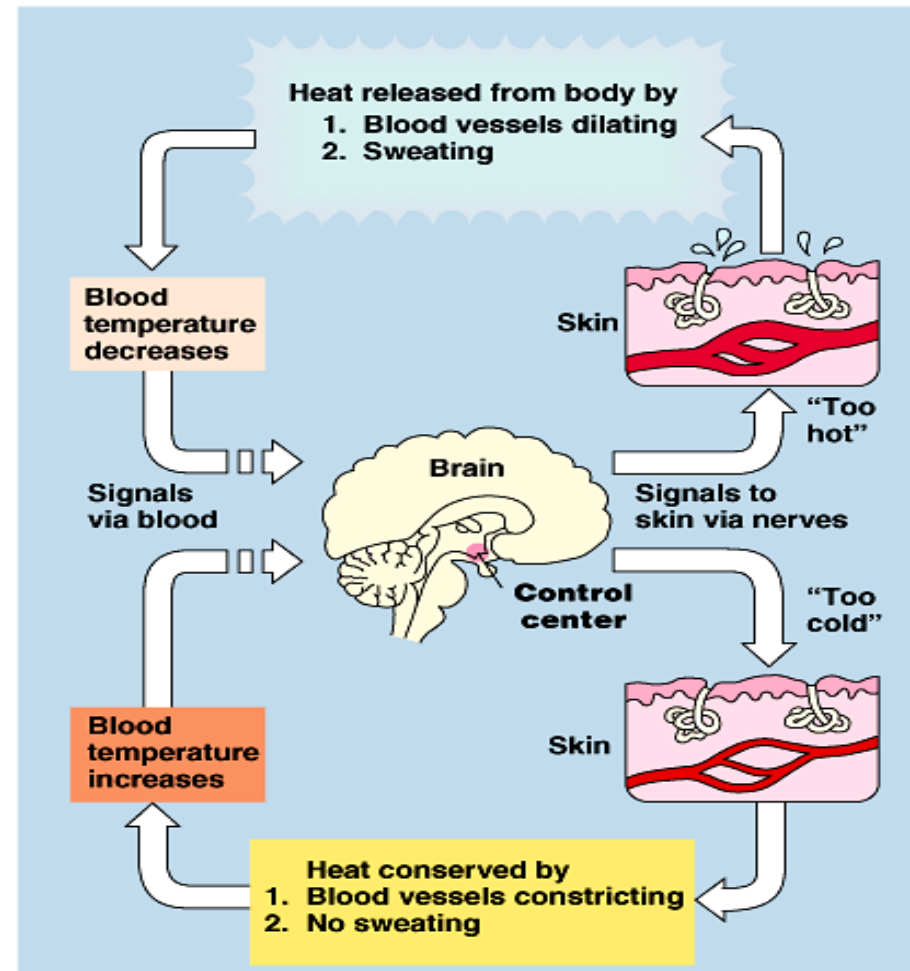
Negative Feedback: Inhibitory.

Stimulus triggers response to counteract further change in the same direction.

Negative-feedback mechanisms prevent small changes from becoming too large.



(a) Control of room temperature



(b) Control of body temperature

Importance:

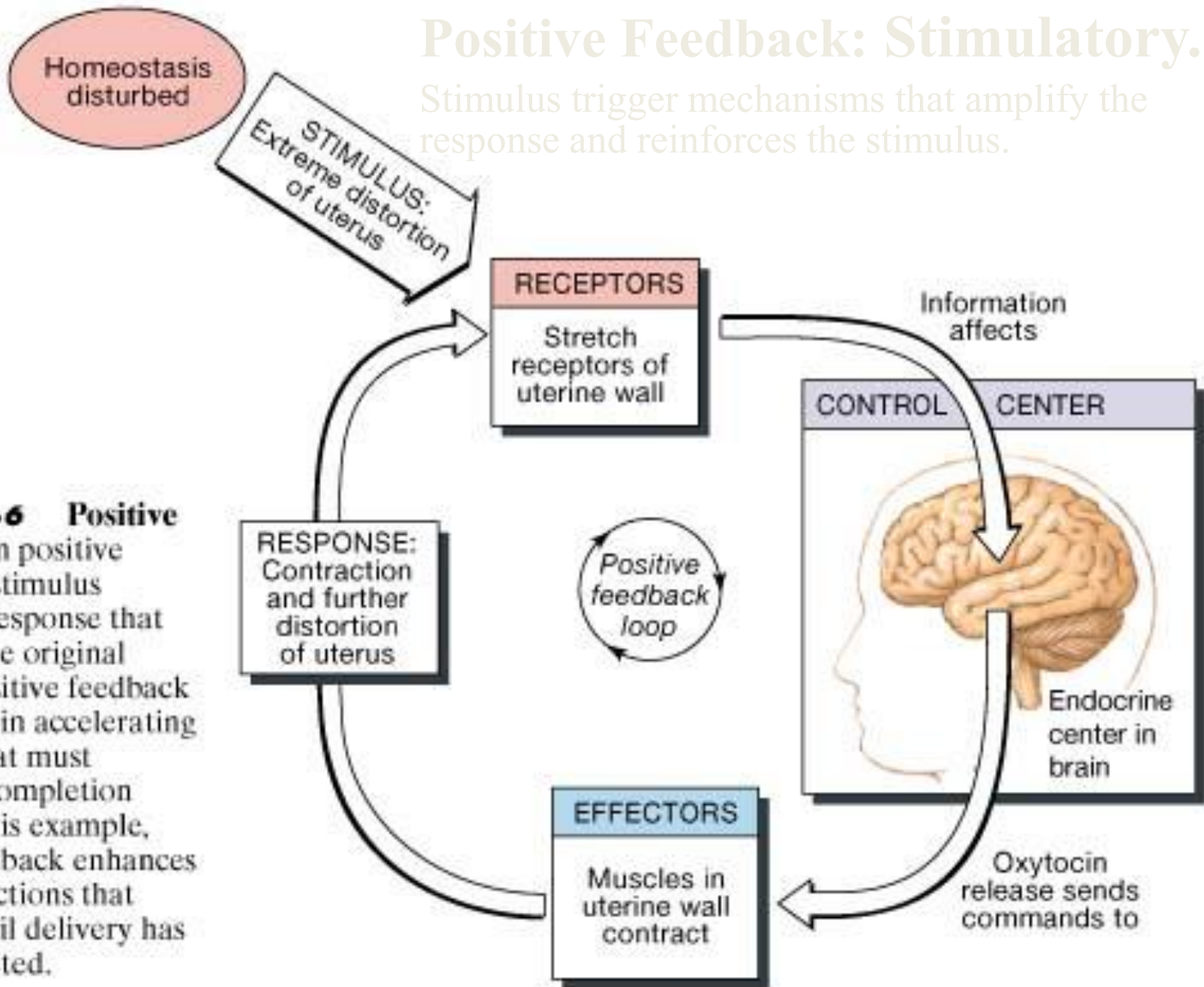
Maintenance of the homeostasis

Positive feedback

- The feedback signal or output from the controlled system increases the action of the control system
- Examples:
 - Blood clotting
 - Micturition (排尿)
 - Defecation (排便)
 - Na^+ inflow in genesis of nerve signals
 - Contraction of the uterus during childbirth (parturition) (分娩)

Positive Feedback: Stimulatory.

Stimulus trigger mechanisms that amplify the response and reinforces the stimulus.



• **FIGURE 1-6 Positive Feedback.** In positive feedback, a stimulus produces a response that reinforces the original stimulus. Positive feedback is important in accelerating processes that must proceed to completion rapidly. In this example, positive feedback enhances labor contractions that continue until delivery has been completed.

Importance:

- Enhance the action of original stimulus or amplify or reinforce change
 - promote an activity to finish
- Vicious circle - can lead to instability or even death

Feed-forward control

- Concept: Direct effect of stimulus on the control system **before** the action of feedback signal occurs.
 - **Disturb signal or interfere signal.**
- Example: Shivering before diving into the cold water

Feed-forward control

- Significance of **Feedback-forward** :
 - adaptive feedback control.
 - makes the human body to **foresee** and **adapt** the environment promptly and exactly
 - (prepare the body for the change).

- Thank you