



Chapter 1 General Introduction of Physiology

Physiology (生理学)

A branch of biological sciences

Explains the functions of living organisms and
their regulating principles

Functional vs. Morphological



Relationship between physiology and clinical medicine

- **Compulsory basic medical subject**
- **Theoretical basis for understanding clinical diseases**
- **Clinical practice abundances physiology and promotes its development**



Historical review of Physiology

- Ancient scientific subject
- 17th century, William Harvey: “*The Motion Of The Heart And Blood In Animals*”——Cornerstone of physiology
- Experimental biological science



Three levels of physiological researches

Human being is multicellular organism:

- Cell (细胞)——basic structural and functional unit
- Organ (器官)——different types of cells
- System (系统)——functionally related organs
- Body (机体)——all systems within the body

3 different levels of physiological researches:

- Intact body
- Tissue and organ
- Molecular and cellular study



Classification of physiological studies

- **Objective**
 - **Human experiment (人体实验)**
 - **Animal experiment (动物实验)**

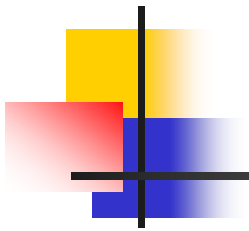
- ***In vivo* (在体实验) and *In vitro* (离体实验)**

- **Acute experiment (急性实验) and Chronic experiment (慢性实验)**



Two points need to be emphasized

- **From isolated tissues or organ to intact body**
- **From animal to human**



Internal environment **and** homeostasis

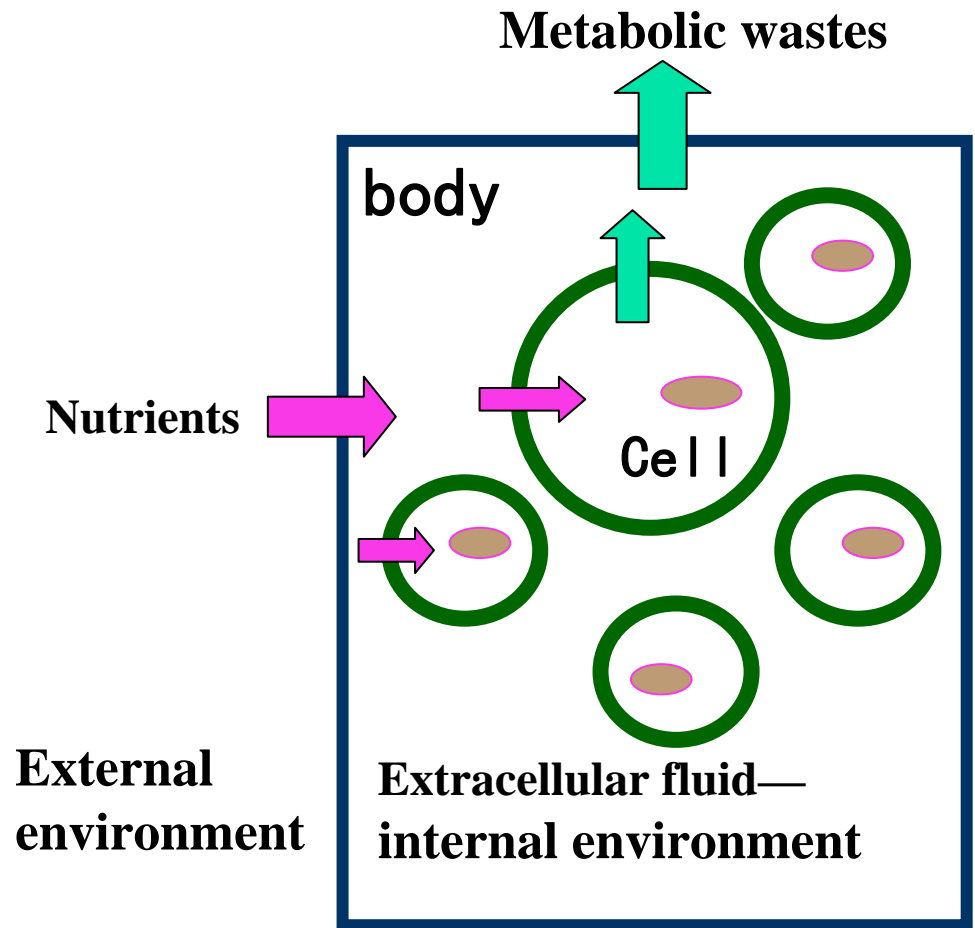


Body fluid (体液): 60 % of body weight

- **Intracellular fluid (细胞内液): 2/3**
- **Extracellular fluid (细胞外液): 1/3**
 - **Interstitial fluid (组织液): 4/5**
 - **Plasma (血浆) : 1/5**
 - **Cerebrospinal fluid(脑脊液)、lymphatic fluid (淋巴液),**
 - **Separate but communicate each other**
 - **Different in composition, but exchange each other**

Internal environment of the body and homeostasis

- Internal environment
- Homeostasis





Consistency of internal environment

- **Essential for normal life activity**
- **Maintenance of homeostasis——
regulation (调节)**
 - **Neuroregulation**
 - **Humoral regulation**
 - **Autoregulation**



Regulation of physiological function —— neuroregulation (神经调节)

Definition: the response to the changes of environment is achieved by the participation of central nervous system.

- **Process of neuroregulation ——Reflex**
- **Structural basis for reflex: reflex arc (反射弧)**
 - **Receptor**
 - **Afferent nerve fiber**
 - **Reflex center**
 - **Efferent nerve fiber**
 - **Effector**



Types and characteristics of reflex

- **Types:**

- **Unconditioned reflex (非条件反射)**

- Pupillary light reflex; trigeminal reflex, sucking reflex

- **Conditioned reflex (条件反射)**

- Food: salivary glands secretion

- **Characteristics:**

- **Rapid, local, precise**



Humoral regulation(体液调节)

- **Definition:**

- Endocrine glands or cells

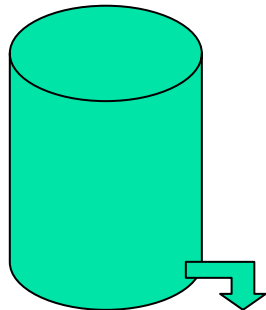
- Secret chemicals having biological activities
 - Target cells or organs
 - Changes in physiological functions

Cold → Thyroxin secretion → Metabolic rate

Hormone (激素)

Autoregulation (自身调节)

- **Definition: regulating the activities without participating of external nervous or humoral factors.**



80-180 mmHg



Control system in the body

- **Cybernetics(控制论)——concept from engineering**
- **Control system:**
 - **Consists of controlling part and controlled part**
 - **Non-automatic control system (非自动控制系统)**
 - **Feedback control system (自动控制系统, 反馈控制系统)**
 - **Positive feedback control system(正反馈)**
 - **Negative feedback control system(负反馈)**
 - **Feed-forward control system(前馈系统)**



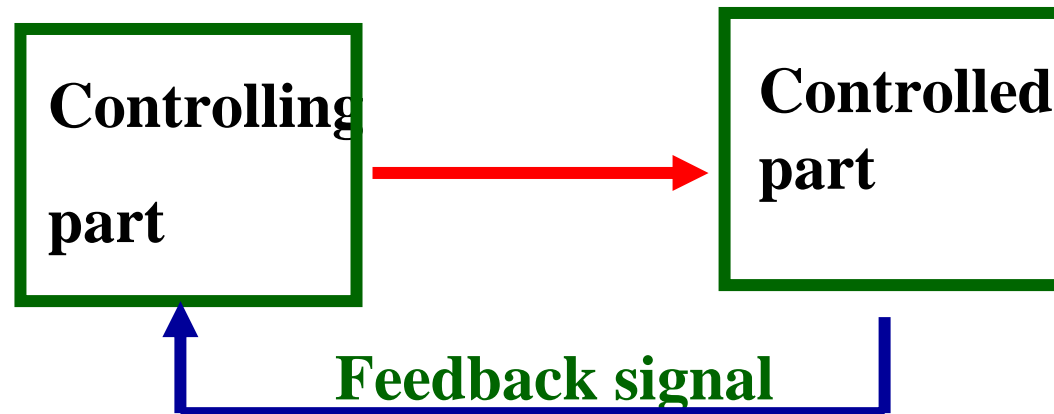
Non-automatic control system

- **Open loop system**
- **Not common:**
 - **Stressed condition: increased blood pressure and heart rate**

Closed-loop system

Closed-loop system: controlling part keeps receiving feedback signal from controlled part.

Feedback control





Negative Feedback Control System

- **Output of the system is controlled to resist the original change**
 - **Body temperature regulation**
 - **Blood pressure regulation**
- **Set Point**
- **Significance: maintaining homeostasis**



Positive Feedback Control System

- **Original change initiates greater change in the same direction.**
- **For example: generation of action potential, baby delivery.**
- **Significance: accelerate a physiological process**
- **Pathological condition**



Feed-forward Control System

- **A response in anticipation of change**
- **For example: Ingested food in the tract——
Secretion of insulin**
- **Significance: prepared to the change in
advance**