

## **TEACHING GUIDE OF PHYSIOLOGY**

**Title:** Physiology 生理学 I

**Code:** 50127950

**Classification:** Platform class at school level

**Lecture hours:** 80

**Credit points:** 5

**Textbook:**

1. 生理学(七年制) 姚泰主编 人民卫生出版社 2002.5
2. Textbook of Medical Physiology. Guyton AC. 人民卫生出版社

**Suitable major:**

**Clinical, Dental and Preclinical Medicine**

**Reference:**

1. Review of Medical Physiology. Ganong WF. 北京医科大学出版社
2. Costanzo LS: Physiology 3<sup>rd</sup> edition, Lippincott Williams & Wilkins in U.S.A.
3. 人体生理学（上、下册）姚泰主编 人民卫生出版社

**Achievement score:**

**Total score of 100 consists of 10 percent of midsemester test or general work and 90 percent of final examination.**

**Teaching aims and requirements:** see foreword

**Teaching contents:** see following each chapter

## Foreword

Physiology is one of the important basic medical sciences and the foundation of medical practice. It is a study of the normal functions of cells, organs and systems of the living body, the mechanisms by which they are achieved and the regulation of functional activities. A firm grasp of its principles is essential not only for the study of successive courses, but also for students' future professional career after graduation.

Selection of the teaching material should be in accordance with the necessity of medical education and should be laid emphasis on basic theories and knowledge of physiology as well as on the training of basic techniques. Attention should also be paid to promote the ability of scientific thinking of the students. In order to foster the students' ability of studying physiology, we conduct our teaching with several methods, such as self-study, instead of to be given only by lecture in the classroom. In this teaching guide, the three kinds of requirements for different contents are given, so that students can have a good command on them.

Physiology curriculum consists of 80 hrs lectures in one term.

### **Distribution of the lecture hours:**

Introduction	3 hrs
Basic Function of Cell	12 hrs
Blood	4 hrs
Blood Circulation	14 hrs
Respiration	8 hrs
Digestion & Absorption	6 hrs
Energy Metabolism & Body Temperature	4 hrs
Renal Excretion	8 hrs
Sensory Organs	5 hrs
Nervous System	13 hrs
Endocrine	3 hrs

## CHAPTER 1 INTRODUCTION

### Master (掌握) :

Internal environment and homeostasis. Control systems inside the body: autonomic control system, feedback.

### Understand (熟悉) :

Regulation of human functional activities: nervous regulation, humoral regulation (hormone and local humoral factor) and automatic regulation. Control systems inside the body: nonautonomic control system and feed-forward.

### Comprehend (了解) :

Human physiology is a science for studying the laws of functional activities of the human body. Relationship between medicine and physiology. Three levels and methods of physiological research.

## CHAPTER 2 BASIC FUNCTIONS OF CELL

### Master (掌握) :

Signal transduction mediated by ion channel, concepts of voltage-gated ion channel, chemically-gated ion channel, mechanically-gated ion channel.

Bioelectrical activities: excitability, concept of resting potential and action potential, genesis mechanism of the resting potential and action potential, conduction of action potential on a cell.

Muscle contraction: Transmission of excitation at neuromuscular junction, excitation-contraction coupling, and the role of calcium ion in the contraction.

### Understand (熟悉) :

Signal transduction mediated by G protein-linked receptor, G protein and G protein effectors. Muscle contraction: myofilament sliding theory, interaction between the two filaments and its regulation. Appearance and mechanic analysis of muscle contraction: isotonic contraction and isometric contraction. The preload, afterload and contractility affecting muscle work.

### Comprehend (了解) :

Unit membrane structure and its molecular composition, transport of substance across cell membrane; signal transduction mediated by tyrosine kinase receptor; research methods of the bioelectrical activity of cell; skeletal muscle twitch.

## CHAPTER 3 BLOOD

### Master (掌握) :

Physiological hemostasis mechanism: general process of physiological hemostasis, Clotting factors and basic processes of blood coagulation, two pathway of blood coagulation.

The ABO blood groups; principles of blood transfusion, cross-match test.

### Understand (熟悉) :

Physiological hemostasis mechanism: The role of platelets in hemostasis, anticoagulative system (heparin, antithrombin III and TFPI), fibrinolysis. Blood groups and agglutination: Rh blood groups.

### Comprehend (了解) :

Body fluid compartments: two basic elements of extracellular fluid. The components, properties, and functions of the blood.

## CHAPTER 4 BLOOD CIRCULATION

### Master (掌握) :

Physiological features and bioelectrical activities of cardiac muscle: Transmembrane potential of the working cells; comparison of transmembrane potentials in autorhythmic and nonautorhythmic cells; genesis mechanism of autorhythmicity of fast response cells and slow response cells; characteristics of cardiac conduction.

Heart pumping function: Process of heart pumping: changes of intraventricular and intraatrial pressure and volume, movement of cardiac valves in a cardiac cycle. Indexes for measuring heart pumping function: cardiac output, cardiac index, ejection fraction. Factors affecting cardiac output.

Physiology of blood vessel: Blood pressure, formation and normal values of arterial blood pressure, factors affecting arterial blood pressure; central venous pressure, function of microcirculation; production and drainage of interstitial fluid and affecting factors.

Regulation of cardiovascular activity:

Neural regulation: Innervation of heart, the actions and transmitters of sympathetic and vagal parasympathetic nerves, and their receptors on cardiac muscle. The actions, transmitters of sympathetic vasoconstrictors, and their receptors on vascular smooth muscle. Cardiovascular reflexes: depressor reflex.

Humoral regulation: The general functions of adrenaline, noradrenaline, angiotensin, and vasopressin on heart and blood vessel.

### Understand (熟悉) :

Bioelectrical activities of cardiac muscle: Excitability, the change of excitability of cardiac muscle, premature systole and compensatory pause; factors affecting cardiac autorhythmicity and cardiac conduction.

Heart pumping function: Concept of cardiac cycle, heart work, cardiac reserve, heart sound.

Physiology of blood vessel: Concepts of blood flow, resistance of blood flow, venous flow and affecting factors, venous pressure, structure of microcirculation; production and drainage of lymph.

Regulation of cardiovascular activity:

Neural regulation: Peptidergic nerves, innervation of blood vessels. Cardiovascular reflexes: carotid and aortic body chemoreceptive reflex.

Humoral regulation: The general functions of vasoactive products of endometrium, kinin, atrial natriuretic peptide, histamine, and tissue metabolic products. Long-term regulation of blood pressure.

Autoregulation.

Regional circulation: Blood flow characteristics and regulation of coronary circulation.

### Comprehend (了解) :

Types of cardiac muscle: working cells and autorhythmic cells, fast response cells and slow response cells; electrocardiogram, hemodynamics, structural and functional features of various types of blood vessels. Cardiovascular center, reflex of cardiopulmonary receptor.

## CHAPTER 5 RESPIRATION

### Master (掌握) :

Pulmonary ventilation: Motive force of pulmonary ventilation: respiratory movement; formation,

changes, and significance of intrapleural pressure. Respiratory resistance: Elastic resistance and compliance of the lung, pulmonary surfactant and its significance. Primary lung volumes and lung capacities: Tidal volume, vital capacity and forced expiratory volume; functional residual capacity, minute ventilation volume, alveolar ventilation.

Gas exchange: Factors affecting gas exchange; pulmonary diffusion capacity.

Gas transport in the blood: Oxygen capacity, content and saturation, oxygen hemoglobin dissociation curve and factors affecting it; CO<sub>2</sub> transport carried in HCO<sub>3</sub><sup>-</sup> form and in combination with amino groups of Hb.

Regulation of respiratory movement: Concept, process and significance of pulmonary stretch reflex; the influences, pathways and significances of arterial CO<sub>2</sub> and O<sub>2</sub> and the concentration of H<sup>+</sup> on respiration.

**Understand (熟悉) :**

Pulmonary ventilation: Changes of intrapulmonary pressure during respiration; elastic resistance and compliance of the thorax; non-elastic resistance (changes of airway resistance during respiration). Primary lung volumes and lung capacities: residual volume, functional residual capacity; maximal voluntary ventilation, dead spaces and their effects.

Gas exchange: Principles of gas exchange (concepts of partial pressure and tension); gas exchange process in the lung and in the tissue.

Gas transport in the blood: Oxygen in reversible chemical combination with hemoglobin. CO<sub>2</sub> dissociation curve, the effect of hemoglobin oxygen saturation on CO<sub>2</sub> transport. Medullary centers and pneumotaxic centers of respiratory regulation.

Regulation of respiratory movement: Hypothesis about the genesis of respiratory rhythmicity. Reflex regulation of respiration: Respiratory muscles proprioceptive receptor reflex and its significance.

**Comprehend (了解) :**

Functions of respiratory tract; Gas transport in the blood: Physically dissolved gas, concept of respiratory centers.

## CHAPTER 6 DIGESTION AND ABSORPTION

**Master (掌握) :**

Concepts of digestion and absorption; innervation of the digestive tract; the main functions of gastrointestinal hormones.

The main functions of saliva; regulatory characteristics of salivary secretion.

The main functions of gastric juice; mucus-bicarbonate barrier; regulation of gastric secretion: cephalic, gastric and intestinal phase of gastric secretion.

The main functions of pancreatic juice; regulation of pancreatic secretion; the main functions of bile and small intestinal juice.

Gastric motility and its function: receptive relaxation, gastric peristalsis, gastric emptying and its regulation.

The types of small bowel motility.

**Understand (熟悉) :**

The general compositions of saliva, gastric juice, pancreatic juice, bile and intestinal juice. Mechanism of HCl secretion; regulation of bile secretion, regulation of intestinal secretion.

Absorption: Pathways and locations of absorption.

**Comprehend (了解) :**

The characteristics of the smooth muscle of digestive tract. Large bowel motility and its control, defecation reflex. Basic mechanism of absorption.

## **CHAPTER 7 ENERGY METABOLISM AND BODY TEMPERATURE**

**Master (掌握) :**

Concept of energy metabolism, principles of measuring energy metabolism: indirect calorimetry (concept of thermal equivalent of food, thermal equivalent of oxygen, and respiratory quotient). Main factors affecting energy metabolism: muscular activity, mental activity, food specific dynamic effect, environmental temperature. Concept of basal metabolism and basal metabolism rate.

Concept of body temperature. The balance between heat production and heat loss in the body: main organs of heat production and ways of heat production; ways of heat loss. Thermoregulation: the key position of the integration of thermotaxic and “set point”.

**Understand (熟悉) :**

Normal body temperature and its main physiological variation. Method and locations of the body temperature measurement in clinical practice. Concept of radiation, conduction, convection, and evaporation; insensible perspiration and sweating; “set point” theory.

**Comprehend (了解) :**

The sources of energy utilized by organisms, the process of energy liberation, storage, transformation and expenditure. Principles of measuring energy metabolism: direct calorimetry. Temperature receptor and thermotaxic center.

## **CHAPTER 8 URINE FORMATION BY THE KIDNEYS**

**Master (掌握) :**

Concept of excretion, pathways for excretion, functions of kidneys. Characteristics of glomerular filtration membrane Concept of glomerular filtration rate and filtration fraction, effective filtration pressure, factors affecting glomerular filtration.

Concept of renal clearance.

Transport function of tubule and collecting duct: Concepts of reabsorption and secretion; the methods, pathways and sites of reabsorption in renal tubule and collecting duct.

Concentration and dilution of urine: Mechanism for establishment of high osmotic gradient of renal medulla. Mechanism for conserving the medullary osmotic gradient.

Regulation of urine formation: concentration of solute in the tubule; neural and humoral regulation: the main functions and secretion regulation of renin-angiotensin-aldosterone system, antidiuretic hormone (vasopressin).

Micturation reflex.

**Understand (熟悉) :**

Glomerular filtration membrane and its permeability.

Transport function of tubule and collecting duct: Characteristics of reabsorption of NaCl, K<sup>+</sup>, HCO<sub>3</sub><sup>-</sup>, glucose, amino acid and water; Characteristics of reabsorption in distal tubule and collecting duct; secretion of K<sup>+</sup>, H<sup>+</sup>, NH<sub>3</sub>.

Concentration and dilution of urine: Concentration and dilution of urine, maintenance of high osmolality of the renal medulla.

Regulation of urine formation: Glomerulotubular balance; the function of renal sympathetic nerve and atrial natriuretic peptide.

**Comprehend (了解) :**

Functional anatomy of kidney and characteristics of renal circulation, innervation of kidney; Research methods of kidney function. Regulation of urine formation: the main function of kinin, endothelin, NO, PG.

## **CHAPTER 9      SENSORY ORGAN**

**Master (掌握) :**

Physiological Characteristics of receptors: adequate stimulus, transduction, signal coding and adaptation.

Visual function of the eyes: Accommodation of eye, visual acuity, characteristics of two types of retinal phototransduction systems; general transduction mechanism of the scotopic vision.

Auditory function of ear: Conduction ways of sound into inner ear, theory of traveling wave.

**Understand (熟悉) :**

Concept of receptor and sensory organ.

Visual function of the eyes: Near point and the reduced eye, trichromacy theory of color vision and color blindness, characteristics of information process in retina, light adaptation and dark adaptation, visual field.

Auditory function of ear: **Function of external and middle ear**; vibration of basilar membrane of cochlea, bioelectrical phenomena of cochlea.

**Comprehend (了解) :**

Refractive system of the eyes, abnormality of the refractive function and accommodation of eye, binocular vision. Hearing threshold and hearing range; the function of vestibular apparatus.

## **CHAPTER 10      FUNCTIONS OF THE NERVOUS SYSTEM**

**Master (掌握) :**

Basic structures and functions of neuron: Characteristics of nerve fiber conduction.

Transmission of synapse and junction: Process of classic synaptic transmission, electrical activities of postsynaptic neuron (concept and genesis mechanism of EPSP and IPSP), properties of synaptic transmission, synaptic inhibition, main neurotransmitter-receptor systems.

Sensory transduction in the nervous system: Sensory projection systems, pain.

Motor function of nervous system: Function of  $\alpha$  neuron and  $\gamma$  neuron, motor unit of spinal cord, stretch reflex (concept, receptor, process, types and properties), the regulatory effect of brain stem on skeletal muscle tone and posture.

Function of autonomic system: main functions and properties of activities of the sympathetic and parasympathetic nervous system.

**Understand (熟悉) :**

Basic structures and functions of neuron: axoplasmic transport, trophic action of nervous system and trophic factors supporting the nervous system.

Transmission of synapse and junction: Classification and fundamental structures of synapse, non-synaptic chemical transmission and electrical synaptic transmission.

General principles of reflex activities: communications among central neurons, feedback regulation of reflex.

Sensory transduction in the nervous system: nucleus of thalamus.

Evoked cortical potential, electroencephalogram, sleep and awareness.

Motor function of nervous system: Spinal shock, the regulatory function of basal ganglia on movement, decerebrate rigidity.

Function of autonomic system: Structural properties of the sympathetic and parasympathetic nervous system.

Higher integration in brain: Neural basis of instinctual behavior and emotions, learning and memory, language center of cerebrum and laterality of cerebral dominance.

**Comprehend (了解) :**

Classification of nerve fibers, velocity of nerve fiber conduction, functions of neuroglia; neurotransmitter and receptor; synaptic facilitation, plasticity of synapse; brain areas concerned with somatic sensation, touch, proprioception of muscles etc; flexor reflex and crossed extensor reflex, intersegmental reflex, cerebral motor cortex associated with voluntary movement.

Function of autonomic system: regulation of spinal cord, lower portion of brain stem, hypothalamus, and cerebrum on visceral functions.

## **CHAPTER 11      ENDOCRINE**

**Master (掌握) :**

Common characteristics of their functions of the hormones.

Endocrine function of hypothalamus, functional relationship between hypothalamus and adenophysis.

Regulation of the hormone secretion.

**Understand (熟悉) :**

Releasing hormones and release-inhibiting hormones secreted by hypothalamus.

**Comprehend (了解) :**

Classification of hormones