

# 《医学细胞生物学》教学大纲(理论)

(授课对象：基础医学(朱宪彝班)专业)

## Preface

The medical cell biology is a subject concerned with life activities, its mechanisms and principles, focusing on cells, but also applying the experimental method of modern physics, chemistry and biology. It deals with the structure and functions or the interaction of cell components by using different approaches, namely at the whole cell, subcellular and molecular levels, it is concerned with the whole and dynamic functional activities of cells, and also deals with the molecular basis of these functions and interactions. Medical cell biology is a basic course in modern medical education, the task of which is to make medical students master the structure and functions of cellular components, as well as life regulation and mechanisms; and know the development and trends of the science and the application of new technology. This knowledge will provide a solid foundation for studying other related courses (basic and clinical).

Evaluation Methods: (1) The required course examination results include two parts: the test scores after the course ended (60%) and regular grades (40%). The grades depend on a comprehensive assessment of the experiments, assignments, reading report (review), class discussion, quizzes and independent studies. (2) The provisions of the course examination results: The test of theory class session, accounted for 60% of the total score, takes 100 points. The experimental results account for 28% and the remaining 8% covers the assignments, reading report (review), class discussion, quizzes and 4% covers the self-directed learning.

The teaching contents in this syllabus are arranged for students of basic medicine. The class hours are 45 in total (19 for theory and 2 for self-directed learning).

## Chapter 1 Introduction

### 1. OBJECTIVES

- (1) Know the concepts of cell biology and medical cell biology
- (2) Master the concept of cell
- (3) Familiar with the brief history of cell biology

### 2. COURSE CONTENT

- (1) The concepts of cell biology and medical cell biology
- (2) The study object of cell biology
  - ① The concept of cell
  - ② Prokaryotic cells and eukaryotic cells
- (3) The brief history of cell biology

### 3. TEACHING HOURS

1 class hour

### 4. TEACHING METHOD

Lecture with multimedia computer assisted instruction

## Chapter 2 Cell Membrane

### 1. OBJECTIVES

- (1) Familiar with the concept, chemical composition and molecular structure of cell membrane
- (2) Master the characteristics of cell membrane
- (3) Master transmembrane transport of small molecules, large molecule and granular materials

### 2. COURSE CONTENT

- (1) The chemical composition of cell membranes
- (2) The molecular structure of cell membranes
  - ① The unit membrane model
  - ② The fluid mosaic model
  - ③ The lipid raft model
- (3) The characteristics of cell membranes
  - ① Mobility
  - ② Asymmetry
- (4) The functions of cell membrane
  - ① Passive transport: simple diffusion, facilitated diffusion
  - ② Active transport:  $\text{Na}^+$ - $\text{K}^+$  pump
  - ③ endocytosis: phagocytosis, pinocytosis, receptor-mediated endocytosis
  - ④ exocytosis

### 3. TEACHING HOURS

2.5 class hours

### 4. TEACHING METHOD

Lecture with multimedia computer assisted instruction

## Chapter 3 Endomembrane System

## 1. OBJECTIVES

- (1) Know the shape and chemical composition of the endoplasmic reticulum, Golgi complex, lysosome and peroxisome
- (2) Familiar with the physical and chemical properties of ribosome
- (3) Master the structure of Golgi complex
- (4) Master the general characteristics of lysosome
- (5) Master the functions of the endoplasmic reticulum, Golgi complex, lysosome and peroxisome, the interrelation in structure and functions of them

## 2. COURSE CONTENT

### (1) Endoplasmic reticulum

- ① The shape, structure, types and chemical composition of the ER
- ② The characteristics of ribosomes
- ③ The main functions of the rER and sER

### (2) Golgi complex

- ① The structure and chemical composition
- ② The functions

### (3) Lysosomes

- ① The general characteristics
- ② The types
- ③ The functions

### (4) Peroxisome

- ① The structure
- ② The functions

## 3. TEACHING HOURS

3 class hours

## 4. TEACHING METHOD

Lecture with multimedia computer assisted instruction

## Chapter 4 Mitochondria

### 1. OBJECTIVES

- (1) Know the shape, size, number, and distribution of mitochondria
- (2) Familiar with the chemical composition of mitochondria
- (3) Master the ultrastructure of mitochondria
- (4) Master the function of mitochondria
- (5) Master the semiautonomy of mitochondria

### 2. COURSE CONTENT

- (1) The shape, size, number and distribution of mitochondria
- (2) The ultrastructure of mitochondria
- (3) The chemical composition and enzyme distribution of mitochondria
- (4) The function of mitochondria
- (5) Relative independent genetic system of mitochondria

### 3. TEACHING HOURS

1.5 class hours

### 4. TEACHING METHOD

Lecture with multimedia computer assisted instruction

## Chapter 5 Cytoskeleton

### 1. OBJECTIVES

- (1) Know the shape, distribution and relationship of cytoskeleton components
- (2) Know the basic chemical composition and functions of intermediate filament
- (3) Master the chemical composition, structure and functions of microtubules and microfilaments

### 2. COURSE CONTENT

#### (1) Microtubule

- ① The shape, functions and ultrastructure
- ② The types
- ③ The functions

(2) Microfilaments

- ① The shape, structure and distribution
- ② Actin and actin-associated protein
- ③ The functions

(3) Intermediate filament

- ① The types
- ② The molecular structure
- ③ The functions

3. TEACHING HOURS

1 class hour

4. TEACHING METHOD

Lecture with multimedia computer assisted instruction

## Chapter 6 The Interaction Between Cells and Extracellular Environment

1. OBJECTIVES

- (1) Master the structure and functions of cell junction
- (2) Master the types and functions of cell adhesion molecules
- (3) Master the chemical composition and main function of extracellular matrix
- (4) Familiar with the biological effect of extracellular matrix

2. COURSE CONTENT

(1) Cell junction and cell adhesion

- ① Cell junction
- ② Cell adhesion

(2) Extracellular matrix and cell-extracellular matrix interaction

- ① The chemical composition of extracellular matrix
- ② Basement membrane and integrin
- ③ The biological effect of extracellular matrix

3. TEACHING HOURS

1 class hour

#### 4. TEACHING METHOD

Lecture with multimedia computer assisted instruction

## Chapter 7 Nucleus

### 1. OBJECTIVES

- (1) Know the nature of nuclear matrix
- (2) Master the structure of the nucleus, nuclear envelope, chromatin, and nucleolus
- (3) Master the functions of nuclear envelope and the nucleolus
- (4) Master the chemical composition and types of chromatin

### 2. COURSE CONTENT

#### (1) Nuclear envelope

- ① The structure of nuclear envelope
- ② The main functions of the nuclear envelope

#### (2) Chromatin and chromosome

- ① Chromosome are condensed chromatin during the mitosis
- ② The chemical composition of chromatin
- ③ The structure of chromatin
- ④ Euchromatin and heterochromatin
- ⑤ X-chromatin and Y-chromatin

#### (3) Nucleolus

- ① The ultrastructure of nucleolus
- ② The chemical composition of nucleolus
- ③ The functions of nucleolus

#### (4) Nuclear matrix

- ① The concept of nuclear matrix
- ② The shape, structure and chemical composition of nuclear matrix
- ③ The functions of nuclear matrix

(5) The functions of nucleus

### 3. TEACHING HOURS

3 class hours

### 4. TEACHING METHOD

Lecture with multimedia computer assisted instruction

## Chapter 8 Cell Proliferation

### 1. OBJECTIVES

- (1) Master the concept and types of cell proliferation
- (2) Master the concept cell cycle and the characteristics of each phase
- (3) Master the functions of cdk and cyclin on cell cycle regulation
- (4) Master the functions of cell cycle checkpoints, growth factors and their receptors on cell cycle regulation

### 2. COURSE CONTENT

- (1) The concept and types of cell proliferation
- (2) Cell cycle and its progress
  - ① The concept
  - ② The activities of each phase
- (3) The regulation of cell cycle
  - ① The functions of cdk and cyclin
  - ② The functions of cell cycle checkpoints
  - ③ The functions of growth factors and their receptors

### 3. TEACHING HOURS

2 class hours

### 4. TEACHING METHOD

Lecture with multimedia computer assisted instruction

## Chapter 9 Cell Differentiation

## 1. OBJECTIVES

- (1) Know the relationship between cell differentiation and cancer
- (2) Know how to get stem cell
- (3) Master the concept and characteristics of cell differentiation
- (4) Master cell differentiation and the regulation of gene expression
- (5) Master the biology characters of stem cell

## 2. COURSE CONTENT

### (1) Cell differentiation

- ① The concept
- ② The characteristics

### (2) Cell differentiation and gene expression

- ① Differentiated cells are totipotent
- ② The genes concerned with cell differentiation
- ③ The characteristics of gene expression in the process of cell differentiation
- ④ The regulation of gene expression in the process of cell differentiation

### (3) Types and the biology characters of stem cell

## 3. TEACHING HOURS

2 class hours

## 4. TEACHING METHOD

Lecture with multimedia computer assisted instruction

# Chapter 10 Cell Aging and Death

## 1. OBJECTIVES

- (1) Know the concepts and biological significance of cell aging and death
- (2) Master the mechanisms of cell aging
- (3) Master the concepts and characteristics of cell apoptosis

## 2. COURSE CONTENT

### (1) Cell aging



① The life-span of cells

② Cell aging mechanism

(2) Cell death

① The concepts and characteristics

② The ways

(3) Cell apoptosis

① The process of

② The shape and chemical characteristics

③ The regulatory mechanism

3. TEACHING HOURS

2 class hours

4. TEACHING METHOD

Lecture with multimedia computer assisted instruction

## Self-Directed Learning

### 1. CONTENTS

Analyze relation of diseases and the structural or functional changes of certain organelles based on the available knowledge of cell biology.

### 2. PURPOSES

- (1) Properly understand the unity of cell structures and functions.
- (2) Further grasp the correlation of disease occurrence and changes of cellular structure or function.
- (3) Exactly comprehend the unity and correlation of cells and body health.

### 3. FORMS

A natural class including about 20-30 students will be as a unit directed by one teacher.

- (1) The theory class teacher should arrange the learning content in the class of the course.
- (2) Students finish the summary reports after consulting the books and references (no less than 5 papers in the last 3 years).
- (3) Divide the students into 5-6 groups on ID.
- (4) Representatives of each group report PPT for 1 hour.
- (5) Students and the teacher discuss for 1 hour.

### 4. SCHEDULES

2 class hours

### 5. REQUIREMENTS

Each group of students should write a report (PPT) around the structural or functional changes of cells according to the searched references and make comprehensive analysis and discussion about the relation of such abnormality and certain disease occurrence.

### 6. ASSESSMENTS

The performance of independent study will occupy a certain proportion in the final examination scores.

# 《医学细胞生物学》教学大纲(实验)

(授课对象：基础医学(朱宪彝班)专业)

## Preface

The experiment teaching is an important part of the course of medical cell biology. This syllabus contains main theory and basic technique, which should be mastered in each class. These contents can help students to master biological methods and techniques, and are the base of learning following course as well. This syllabus also serves as an accordance of preparing class, assessing experiment teaching level and experiment exam.

The teaching contents in this syllabus are arranged for students of basic medicine. The class hours are 45 in total (24 for laboratory).

## Experiment 1 An introduction of Light Microscope

### 1. OBJECTIVES

- (1) Know the basic construction of light microscope
- (2) Master the correct usage of low and high power magnification
- (3) Master preliminarily the use of oil lens

### 2. COURSE CONTENTS

- (1) The main construction of light microscope
- (2) The operation of light microscope
- (3) The matters needing attention in the process of using light microscope
- (4) Observe prepared slides

### 3. TEACHING HOURS

1 class hour

### 4. TEACHING METHOD

Teacher demonstration method, students operation method

## Experiment 2 Basic Conformation of Cell

### 1. OBJECTIVES

- (1) Learn the method of making temporary specimens
- (2) Master the conformation of cells under light microscope
- (3) Familiarize with the use of light microscope

## 2. COURSE CONTENTS

- (1) The method of making temporary specimens
- (2) Observe the conformation of several kinds of cells

## 3. TEACHING HOURS

3 class hours

## 4. TEACHING METHOD

Teacher demonstration method, students operation method

# Experiment 3 Cell Chemistry

## 1. OBJECTIVES

- (1) Know several cellular chemical reactions, as well as the principles and methods of showing some chemical components in cells
- (2) Familiarize with the distribution of carbohydrates, proteins and nucleic acids in cells

## 2. COURSE CONTENTS

- (1) Observe the carbohydrates (amylum-iodine reaction) in cells
- (2) Observe acid proteins and basic proteins in cells
- (3) Observe peroxidases in cells
- (4) Observe fats in cells
- (5) Observe nucleic acids (Brachet reaction and Feulgen reaction) in cells

## 3. TEACHING HOURS

4 class hours

## 4. TEACHING METHOD

Teacher demonstration method, students operation method

# Experiment 4 Fractionation of Cellular Components

## 1. OBJECTIVES

- (1) Know the principles and the main process of fractionation of cellular components
- (2) Master the methods of homogenate and differential centrifugation

## 2. COURSE CONTENTS

- (1) Principles
- (2) Experimental procedure: homogenate, fractionation, analysis and identification
  - ① The separation of nuclei
  - ② The separation of mitochondria
- (3) Analysis of the result: The components isolated by fractionation can be identified with the techniques of cytochemistry and biochemistry

## 3. TEACHING HOURS

4 class hours

## 4. TEACHING METHOD

Teacher demonstration method, students operation method

# Experiment 5 Basic Shape and Ultrastructure of Organelles

## 1. OBJECTIVES

- (1) Observe several kinds of organelle about their shape and distribution under light microscope
- (2) Know the principles of dyeing living cells
- (3) Master the use of oil lens and drawing picture under light microscope
- (4) Know the ultrastructure of cells by watching electronic photographs

## 2. COURSE CONTENTS

- (1) Dye and observe living mitochondria
- (2) Observe Golgi complex and draw picture
- (3) Observe mitochondria
- (4) Observe centrosomes
- (5) The ultrastructure of cells (electronic photographs)

## 3. TEACHING HOURS

1.5 class hours

#### 4. TEACHING METHOD

Teacher demonstration method, students operation method

### Experiment 6 Cell Physiology

#### 1. OBJECTIVES

Know the permeability of cell membrane

#### 2. COURSE CONTENTS

Hemolysis and permeability of erythrocytes

#### 3. TEACHING HOURS

1 class hour

#### 4. TEACHING METHOD

Teacher demonstration method, students operation method

### Experiment 7 Cell Division

#### 1. OBJECTIVES

(1) Know the manners of cell division

(2) Master the main characteristics of each phase in animal mitosis

(3) Master the main characteristics of each phase in plant mitosis

#### 2. COURSE CONTENTS

(1) Observe the mitosis of animal cells (the slides of ascaris equorum uterus)

(2) Observe the mitosis of plant cells (the slides of root tip of onion)

#### 3. TEACHING HOURS

1.5 class hours

#### 4. TEACHING METHOD

Teacher demonstration method, students operation method

### Experiment 8 Preparation and Observation of Chromosome Specimens of

## Mouse Bone Marrow Cells

### 1. OBJECTIVES

- (1) Know the functions of each main step in this experiment
- (2) Master the preparation method of chromosome specimens of animal marrow cells
- (3) Master the methods of recognizing dividing phase and counting chromosomes under light microscope

### 2. COURSE CONTENTS

- (1) Principles
- (2) Make the chromosome specimens of mouse marrow cells
- (3) Stain and observe the specimens

### 3. TEACHING HOURS

4 class hours

### 4. TEACHING METHOD

Teacher demonstration method, students operation method

## Experiment 9 Cytoskeleton

### 1. OBJECTIVES

- (1) Know the basic shape and distribution of cytoskeleton
- (2) Master the method of preparation of cytoskeleton specimens
- (3) Master the method of dyeing cytoskeleton of plant cells with Coomassie blue

### 2. COURSE CONTENTS

Make and observe the cytoskeleton specimens of plant cells

### 3. TEACHING HOURS

4 class hours

### 4. TEACHING METHOD

Teacher demonstration method, students operation method