**《分子生物学D》**

**（供六年制临床医学专业来华留学生使用）**

**教**

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**基础医学院生物化学与分子生物学教研室**

**2021年10月**

**Preface**

1. **Basic informtion**

Name: Molecular Biology

Class hours: 36 total class hours including 27 teaching hours and 9 experimental hours. 2 total credit hours.

Speciality: six-year term clinical medicine specialty (foreign students)

The prerequisite courses: Biology, Chemistry, Organic Chemistry and Biochemistry.

1. **Introduction**

In a broad viewpoint, Molecular Biology concerns the understanding of biological phenomena in molecular terms. More restrictively, Molecular Biology refers to the study of gene structure and function at the molecular level. Just like Biochemistry, Molecular Biology has also become the basic language of all life sciences. A thorough comprehension of Molecular Biology will enable students to best understand the molecular basis of disease.

Molecular Biology is an important and foundamental preclinical course for advanced medial education. Molecular Biology lays the foundation for other basic and clinical medical sciences.

1. **Objecttives**

The Molecular Biology course is taught at the fourth semester for international students majoring clinical medicine. This course introduces the foundations of molecular biology and provides medical perspectives. Through this ourse, students could understand the central dogma and the common molecular technologies and methods. Through this course study, students will understand the basis of disease developement and try to explore the molecular mechnism of some diseases.

1. **Requiments**

The recommended textbook is Lippincott's Illustrated Reviews: Biochemistry (6th edition). This teaching outline is mainly constituted based on China National Medical Licensing Examination (CNMLE) and United States Medical Licensing Examination (USMLE). The teaching aims and requirements for each chapter are mainly set up at three different levels (Understand > Be familiar with > Be aware of).

1. **Methods**

This course will be taught mainly by Lecture with Multimedia. Students can learn part of chapter by self-study or group discussion.

1. **Evaluation**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Item | Weight | Evaluation  indicator | Evaluation ability | Evaluation standards |
| **Formative evaluation**  （E-learning and tests）  （30%）  UMOOC | **E-learning**  (100 points)  1. Online length  2 Number of videos/PPTs of course | 33.3% | Prepare lession by watching videos and PPTs | Self-study ability,  Analyzing-problem ability,  Solving-problem ability | Online learning activity in Umooc：  1. Online length (5%) (100 points): ≥100 minutes, 100 points; <100, 1 points per time  2. Number of videos/PPTs of course (5%) (100 points) : ≥10 times, 100 points; <10, 0 points |
| Online tests/quizzes  (100 points ) | 33.4% | Master and use of knowledge | Analyzing and solving problem ability | Tests/quizzes in Umooc.  Average of these tests scores. |
| Experiments and homeworks  (100 points ) | 33.3% | Correct experimental operation and serious experimental report,  Master and use of knowledge | Analyzing and solving problem ability,  experimental operation skills. | Experiments and homeworks in Umooc:  Two experimental reports, and 1~2 homeworks. Average of these scores. |
| Bonus  (6 points) |  | Post and reply questions in the course discussion area | Analyzing and solving problem ability | Take part in the course discussion area in Umooc:  Number of posts ≥10 times, 3 points; 1~9 times, 2 points  Number of replies ≥10 times, 3 points; 1~9 times, 2 points |
| **Summarized evaluation**  （Final exam）  （70%）  Exam online | Final exam  (100 points ) | 100% | Master and use of knowledge | Analyzing and solving problem ability | Final exam online |

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**Textbook, Teaching auxiliary books and Bibliography**

This teaching outline is mainly constituted based on China National Medical Licensing Examination (CNMLE) and United States Medical Licensing Examination (USMLE). So we choose Lippincott's Illustrated Reviews: Biochemistry (6th edition), a classic common book as the textbook.

1. **Textbook**

Denise R. Ferrier. Lippincott's Illustrated Reviews: Biochemistry (6th). Baltimore: Wolters Kluwer, Lippincott Williams &Wilkins, 2014.

1. **Teaching auxiliary books**

Youquan Bu. Molecular Biology, Learning Guidelines & Self-Tests. (unpublished book)

1. **Bibliography**
2. Michael A. Lieberman, Rick Ricer. Lippincott’s illustrated Q & A review of biochemistry, 1st ed. Baltimore: Lippincott Williams & Wilkins. 2010.
3. Michael A. Lieberman, Rick Ricer. BRS Biochemistry, Molecular Biology, and Genetics. Sixth Edition. Baltimore: Lippincott Williams & Wilkins. 2014.
4. David L. Nelson, Michael M. Cox. Lehninger Principles of Biochemistry. 6th ed. New York: W. H. Freeman and Company, 2013.
5. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick. Molecular Biology of the Gene. 7th ed. New York: Cold Spring Harbor Laboratory Press, 2013.
6. Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil. Harper's illustrated biochemistry. 30th ed. 2015. New York. McGraw-Hill Companies.
7. Robert F. Weaver. Molecular Biology, fifth edition. 2012. New York. McGraw-Hill Companies.

**Outlines**

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# Teaching Arrangements (36 class hours)

|  |  |  |
| --- | --- | --- |
| **Teaching Contents** | **Teaching**  **Hours** | **Experiment**  **Hours** |
| Introduction | 1 |  |
| Chapter 1 DNA Structure, Replication, and Repair | 5 |  |
| Chapter 2 RNA Structure, Synthesis, and Processing | 3 |  |
| Chapter 3 Protein Synthesis | 6 |  |
| Chapter 4 Regulation of Gene Expression | 6 |  |
| Chapter 5 Biotechnology and Human Disease | 6 |  |
| Experiment 1 Plasmid Extraction |  | 4 |
| Experiment 2 PCR |  | 5 |
| **In total** | **27** | **9** |

# Introduction

1. **Objectives & Requirements**
2. Understand the definition and the significance of the central dogma.
3. Be familiar with the definition of molecular biology, gene, genome, and proteomics.
4. Be aware of the history and application of molecular biology.
5. **Main Contents**
6. Definition of Molecular Biology
7. Brief history of Molecular Biology
8. Application of Molecular Biology
9. **Arrangement**

1 class hour (1 teaching hour)

1. **Teaching Methods**

Lecture with Multimedia

1. **Key Points and Difficult Points**

**Key Points**: the central dogma

**Difficult Points**:genome and proteomics

1. **Language**

English

# Chapter 1 DNA Structure, Replication, and Repair

**1. Objectives & Requirements**

1. Through this chapter study, students should know the molecular mechanism of inheritance and the molecular mechanism of some diseases.
2. Understand the structure of DNA.
3. Be familiar with the process of prokaryotic DNA Synthesis, the names and functions of proteins and enzymes involved in prokaryotic DNA Synthesis, the process of eukaryotic DNA Synthesis, the names and functions of proteins and enzymes involved in eukaryotic DNA Synthesis, the organization of eukaryotic DNA, and the types and mechanisms of DNA repair
4. Be aware of reverse transcription.

**2. Main Contents**

1. Overview
2. Structure of DNA
3. Steps in prokaryotic DNA Synthesis
4. Eukaryotic DNA replication
5. Organization of eukaryotic DNA
6. DNA Repair

**3. Arrangement**

5 class hours (5 teaching hours)

**4. Teaching Methods**

1. Lecture with Multimedia
2. Group discussion

**5. Key Points and Difficult Points**

**Key points:**

1. The process of prokaryotic DNA Synthesis
2. The names and functions of proteins and enzymes involved in prokaryotic DNA Synthesis

**Difficult points:**

1. The process of prokaryotic DNA Synthesis
2. The names and functions of proteins and enzymes involved in prokaryotic DNA Synthesis

**6.Language**

English.

# Chapter 2 RNA Structure, Synthesis, and Processing

**1.Objectives & Requirements**

1. Students should know the significance of gene expression.
2. Understand the concepts of transcription, polycistronic, monocistronic, TATA box, holoenzyme, general transcription factor, exon, intron, splicing.
3. Be familiar with RNA Structure, the transcription of Prokaryotic gene, the transcription of Eukaryotic gene, the characteristics of post-transcriptional Modification of RNA
4. Be aware of the methods of RNA measurement.

**2.Main Contents**

* 1. Overview of RNA Structure
  2. Transcription of Prokaryotic gene
  3. Transcription of Eukaryotic gene
  4. Post-transcriptional Modification of RNA

**3.Arrangement**

3 class hours ( 3 teaching hours)

**4.Teaching Methods**

* 1. Lecture with Multimedia
  2. Group discussion

**5.Key Points and Difficult Points**

**Key Points:**

* 1. Steps in RNA synthesis
  2. Sigma factor (σ) and -35 sequence in prokaryotes
  3. Promoter for RNA pol II in eukaryotes
  4. Splicing

**Difficult Points:**

* 1. Functions of ρ factor and rho-dependent termination
  2. Mechanism of splicing

**6.Language**

English

# Chapter 3 Protein Synthesis

**1.Objectives & Requirements**

* 1. Understand the concepts of translation, genetic code, degeneracy, anticodon, SD sequence, Protein targeting. Understand the covalent attachments during posttranslational processing
  2. Be familiar with the genetic code (61 sense codons, 3 termination codons.), the characteristics of the genetic code, the components required for translation, the wobble hypothesis, the steps in protein synthesis.

**2.Main Contents**

* 1. Protein Biosynthesis System
  2. Activation of Amino Acids
  3. Protein Biosynthesis Steps ( Initiation, Elongation,Termination)
  4. Protein Folding and Posttranslational Processing

**3.Arrangement**

6 class hours (6 teaching hours)

**4.Teaching Methods**

* 1. Lecture with Multimedia
  2. Group discussion

**5.Key Points and Difficult Points**

**Key Points:**

1. Steps in protein synthesis

2. The three-base codon determined one amino acid.

3. Steps in amino-acylation

**Difficult Points:**

1. The amino acylation reaction

2. Functions of A, P, and E sites on the ribosome

3. Polypeptide covalently modification

**6.Language**

English

# Chapter 4 Regulation of Gene Expression

**1.Objectives & Requirements**

* 1. Understand the characteristics of the tryptophan (trp) operon, the concepts of transcription, housekeeping genes, cis-acting element, trans-acting factor, operon, stringent response, mRNA editing, RNA interference.
  2. Be familiar with the concept and product of gene expression, the regulatory sequences and molecules, the mechanism of lactose operon.

**2.Main Contents**

* 1. Oerview of Gene Expression Regulation
  2. Regulation of Gene Expression in Prokaryote
  3. Regulation of Gene Expression in Eukaryote

**3.Arrangement**

6 class hours (6 teaching hours)

**4.Teaching Methods**

* 1. Lecture with Multimedia
  2. Group discussion

**5.Key Points and Difficult Points**

**Key Points:**

* 1. The regulatory sequences and molecules
  2. The mechanism of lactose operon
  3. Regulation by processing of messenger RNA (splice-site choice, RNA interference, mRNA editing)

**Difficult Points:**

* 1. The mechanism of lactose operon
  2. Splice-site choice, RNA interference, mRNA editing
  3. Mechanism of the trp operon

**6.Language**

English

# Chapter 5 Biotechnology and Human Disease

**1.Objectives & Requirements**

* 1. Students will know which methods can be used to explore the molecular mechanism of some disease.
  2. Understand the process of DNA cloning.
  3. Be familiar with the characteristics of restriction endonucleases, the kinds of vector, the method of labeling probes and the procedure of southern-blotting, the concept and applications of restriction fragment length polymorphism, the mechanism and process of polymerase chain reaction, the method of analysis of gene expression, the names and content of gene therapy and transgenic animals.

**2.Main Contents**

* 1. Overview
  2. Restriction endonucleases
  3. DNA cloning
  4. Probes
  5. Southern-blotting
  6. Restriction fragment length polymorphism
  7. Polymerase chain reaction
  8. Analysis of gene expression
  9. Gene therapy

(10)Transgenic animals

**3.Arrangement**

6 class hours (6 teaching hours)

**4.Teaching Methods]**

1. Lecture with Multimedia
2. Group discussion

**5.Key Points and Difficult Points**

**Key Points:**

* 1. The steps and applications of polymerase chain reaction.
  2. The content of DNA cloning.
  3. The mechanism of restriction fragment length polymorphism.

**Difficult Points:**

* 1. The steps and applications of polymerase chain reaction.
  2. The content of DNA cloning.
  3. The mechanism of restriction fragment length polymorphism.

**6.Language**

English

# Experiment 1 Plasmid Extraction

**1.Experiment Type**

Comprehensive experiment

**2.Objectives & Requirements**

1. Be familiar with the properties of vectors and plasmids, the method and principle of plasmid extraction, and the usage of spectrophotometer.
2. Be aware of the other methods of plasmmid extraction.

**3.Class Hours**

Four class hours

**4.Contents**

1. Culture and collection of bacteria
2. Extraction and purification of plasmids
3. Determination of plasmid concentration

**5.Group**

Two students/group.

# Experiment 2 PCR

**1.Experiment Type**

Comprehensive experiment

**2.Objectives & Requirements**

* 1. Understand the concept of PCR.
  2. Be familiar with the principle reaction system of PCR, the application of PCR in medicine, and the usage of PCR equipment.

**3.ClassHours**

Five classs hours

**4.Contents**

1. Preparation of PCR reaction system

2. Amplificaion by PCR equipment

3. Determination of amplified DNA by agarose electrophoresis

**5.Group**

Two studenys/group

# Appendix: Clinical Case study

**1. INTEGRATIVE CASES**

**Severe Fasting Hypoglycemia**

Glucose 6-phosphatase deficiency (glycogen storage disease [GSD] type Ia, von Gierke disease), VitD, purine-urate, triglyceride, membrane protein biosynthesis

**2.FOCUSED CASES**

1. **icrocytic Anemia**

allele-specific oligonucleotide (ASO) hybridization in the diagnosis

1. **Skin Rash**

Skin Rash with Lyme Disease, Lyme disease caused by the bacterium Borrelia byrgdorfert, Antibiotics in the tetracycline class inhibit protein synthesis (translation)

1. **2.3 Sun Sensitivity**

Sun Sensitivity with Xeroderma Pigmentosum

1. **2.4 No Bowel Movement**

No Bowel Movement with Cystic Fibrosis (CF), CFTR