

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	生物医学基础实验 Basic Biomedical Laboratory
2.	授课院系 Originating Department	医学院 School of Medicine
3.	课程编号 Course Code	MED206
4.	课程学分 Credit Value	2
5.	课程类别 Course Type	专业基础课/ Major Foundational Courses
6.	授课学期 Semester	秋季/ Fall
7.	授课语言 Teaching Language	英文 English
8.	授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师） Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	刘依林, 医学院, liuy13@sustch.edu.cn Yilin Liu, School of Medicine, liuy13@sustch.edu.cn
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	王博, 医学院, wangb7@sustech.edu.cn Wang Bo, School of Medicine, wangb7@sustech.edu.cn
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
学时数 Credit Hours			64		64
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	待定/To be determined				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	待定/To be determined				
14. 其它要求修读本课程的学系 Cross-listing Dept.	待定/To be determined				

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本实验课依托于《医学生物化学》、《医学分子生物学》和《医学细胞生物学》等理论课程，内容包含生物化学、分子生物学和细胞生物学等领域的基础实验技术与技能，着眼于这些技术在生物医学研究领域的应用。本课程教授分子克隆，蛋白质定性、纯化、功能检测，细胞培养与检测等实验技术与方法，并将科研思维贯穿其中。通过实验课的动手操作和实验报告的撰写，培养学生认真观察、独立思考、辩证分析的能力，为学生今后医学综合实验及科研项目的设计与实施打下坚实的基础。

Based on the theories thought in <Medical Biochemistry>, <Medical Molecular Biology> and <Medical Cell Biology>, this laboratory course trains the students to master the fundamental experimental techniques and skills in biochemistry, molecular biology and cell biology, with a focus on the application of these techniques in biomedical research. This course involves molecular cloning techniques, protein determination, purification and functional assays, and cell culture and examination skills, along with the training of scientific thinking. Through hands-on practice and lab report writing, the students will acquire the abilities of observation, independent thinking and critical analysis of data. This course provides the students with a broad spectrum of basic biomedical research concepts and techniques that are the foundation for their integrated biomedical laboratory courses and research projects in the future.

16. 预达学习成果 Learning Outcomes

本实验课程完成后，学生应掌握 RNA 提取、逆转录、PCR 扩增、DNA 电泳、质粒酶切与连接、感受态细胞转化、克隆筛选与测序等一系列完整的分子克隆技术，蛋白提取与定量、蛋白电泳、Western blot、蛋白纯化、酶活性测定等对克隆蛋白产物定量、定性、功能检测的实验方法，以及细胞培养、细胞增殖、细胞周期、细胞凋亡等基础细胞生物学实验技术。同时培养学生独立发现科学问题、独立设计实验和分析结果的能力，规范和提高实验操作技能，并启发学生对生物医学研究的探索热情。

By completing this laboratory course, the students should be able to master a series of molecular cloning techniques including RNA extraction, reverse transcription, PCR amplification, DNA electrophoresis, restriction enzyme digestion and plasmid ligation, transformation of competent cells, and screening of positive clones. The students will also learn the techniques of protein extraction and quantification, SDS-PAGE, Western blot, protein purification and enzyme kinetics assay, for the determination and functional assessment of the cloning product. In addition, the students will know about the basic skills in cell culture and examination of cell proliferation, cell cycle and apoptosis. In the meanwhile, this course

trains the students with the capabilities of identifying scientific problems, designing experiments independently and analyzing data critically, and hopefully it can inspire the students with their enthusiasm in biomedical research.

17. 课程内容及教学日历（如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

1. 实验室安全教育与配置缓冲液（4 学时）

Lab 1: Lab Safety Education and Preparation of Buffer (4 hours)

生物医学基础实验课程介绍；实验室规章制度及操作安全培训。学习 pH 测定与滴定、练习溶液和缓冲液配置。

Introduction of Basic Biomedical Laboratory course, laboratory guidelines and lab safety training. To learn about pH determination and titration, and to practise preparation of solutions and buffers.

2. 核型分析（4 学时）

Lab 2: Karyotype Analysis (4 hours)

学习人源细胞的染色体制备与染色方法；了解人类体细胞染色体组型分析方法，以及染色体异常与疾病的关系。

To learn how to prepare chromosomes from human cells and chromosomal staining; To learn karyotype analysis of human somatic cells, and to know about the association of abnormal karyotype and disease.

3. 基因组 DNA 的提取与测定（4 学时）

Lab 3: Extraction of Genomic DNA and Determination of DNA (4 hours)

掌握从哺乳动物细胞中制备基因组 DNA 的方法并测定 DNA 的浓度和纯度。

To learn the method of preparation of genomic DNA from mammalian cells, and to determine the concentration and purity of extracted DNA.

4. RNA 提取、逆转录与聚合酶链反应（4 学时）

Lab 4: RNA Extraction, Reverse Transcription and PCR (4 hours)

掌握从哺乳动物细胞中提取 RNA，RNA 逆转录至 cDNA；设计引物，将需要克隆的基因片段利用 PCR 法进行扩增。

To extract total RNA from mammalian cells and to reversely transcribe RNA to cDNA; To amplify the gene fragment of interest by polymerase chain reaction (PCR) using pre-designed primers.

5. 限制性内切酶酶切、DNA 电泳与胶回收（4 学时）

Lab 5: Restriction Endonuclease Digestion, DNA Electrophoresis, and Gel Extraction (4 hours)

了解限制性内切酶，利用限制性内切酶对表达载体和上节课的 PCR 产物进行酶切；制备琼脂糖凝胶，对酶切产物进行电泳分离；使用胶回收试剂盒回收酶切后目的 DNA 片段。

To learn about restriction endonuclease, and to digest the vector plasmid and PCR product (from last laboratory) with restriction enzymes; To prepare an agarose gel and to separate the digested fragments by electrophoresis; To obtain the desired DNA fragments from the agarose gel using a gel extraction kit.

6. 质粒连接与感受态细胞转化（4 学时）

Lab 6: Plasmid Ligation and Transformation of Competent Cells (4 hours)

将上节课胶回收产物（目的片段及载体）进行连接；将连接产物转化至感受态细胞，转化后涂板培养过夜。

To ligate the target fragment and the vector (extracted from agarose gel from last laboratory); To transform competent cells with the ligated plasmid and plate the cells for overnight culture.

7. PCR 法筛选阳性克隆及测序 (4 学时)

Lab 7: Colony Screening PCR and Sequencing (4 hours)

挑选若干上节课转化后培养生长出的菌落，利用 PCR 法对克隆片段进行扩增，筛选阳性克隆；了解基因测序的基本原理，学习测序结果分析的基本方法；制备测序品，对克隆片段进行测序分析。

To select several colonies grown from last laboratory, and to amplify the target fragment by PCR for the selection of positive clones; To understand the principle of gene sequencing and to learn how to analyze sequencing results; To prepare sequencing samples, and to sequence and analyze the cloned fragment.

8. 蛋白的提取与定量 (4 学时)

Lab 8: Protein Extraction and Quantitation (4 hours)

学习蛋白的提取方法，从上节课获得的阳性克隆菌株扩增产物中提取全蛋白；学习蛋白定量的原理，比较紫外光吸收法和 BCA 法两种蛋白定量方法。

To learn basic methods of protein extraction, and to extract total proteins from the propagated cells derived from the positive clone identified in the last laboratory; To understand the principles of protein quantitation, and to compared two protein quantitation methods: UV spectroscopy and BCA methods.

9. SDS-聚丙烯酰胺凝胶电泳及考马斯亮蓝染色 (4 学时)

Lab 9: SDS-PAGE and Coomassie Blue Staining (4 hours)

掌握 SDS-聚丙烯酰胺凝胶电泳分离蛋白质的原理及方法，将上节课提取的蛋白质进行电泳分离；对凝胶进行考马斯亮蓝染色，对染色的蛋白条带进行观察。

To learn the principle and method of protein separation by SDS-polyacrylamide gel electrophoresis (SDS-PAGE), and to run a SDS-PAGE to separate the proteins obtained in the last laboratory; To stain the gel with Coomassie blue stain and to observe the stained protein bands.

10. 蛋白印迹 (4 学时)

Lab 10: Western Blot (4 hours)

了解蛋白免疫印迹法的原理与方法，将 SDS-PAGE 分离的蛋白转印至 PVDF 膜上，而后进行封闭、抗体孵育、显色等步骤，观察外源表达所克隆基因（实验四~七）蛋白产物的表达量。

To understand the principle and method of Western blot; To transfer the proteins that are separated by SDS-PAGE to a PVDF membrane, followed by blocking, incubation with antibodies, and chemiluminescent detection of exogenous expression of the protein of the cloned gene (Lab 4~7).

11. 亲和层析法蛋白纯化 (4 学时)

Lab 11: Affinity Chromatography for Protein Purification (4 hours)

学习亲和层析法进行蛋白纯化的原理，利用 Ni-NTA 柱从实验八中提取的蛋白中纯化克隆的 His-Tag 融合蛋白。

To learn the principle of affinity chromatography, and to purify the cloned His-Tag fusion protein from total proteins extracted in Lab 8.

12. 磷酸甘油醛脱氢酶动力学检测 (4 学时)

Lab 12: GAPDH Kinetics Assay (4 hours)

学习酶动力学特性；运用分光光度计法检测上节课纯化出的磷酸甘油醛脱氢酶的 K_M 及 V_{max} 。

To be familiar with the characteristics of enzyme kinetics, and to determine the values of K_M and V_{max} of glyceraldehyde-3-phosphate dehydrogenase (GAPDH) purified in last laboratory by spectrophotometry.

13. 细胞培养与转染（4 学时）

Lab 13: Cell Culture and Transfection (4 hours)

掌握贴壁细胞传代的培养方法，练习在生物安全柜内进行无菌操作；观察传代细胞贴壁生长和消化过程中细胞形态变化；讲解细胞转染的原理并演示操作方法。

To learn aseptic techniques of culture and passage of adherent cells, and to practice the techniques in a biosafety cabinet; To observe the morphology change of cell during adherent growth and trypsinization; To demonstrate cell transfection.

14. 细胞增殖与细胞周期检测（4 学时）

Lab 14: Cell Proliferation and Cell Cycle Analysis (4 hours)

学习细胞增殖的检测原理，利用 CCK-8 法检测细胞增殖情况；了解细胞周期的检测原理，利用流式细胞仪检测细胞周期。

To learn the principle of cell proliferation assay, and to examine cell proliferation using CCK-8 assay; To understand the principle of cell cycle analysis, and to analyze cell cycle by flow cytometry.

15. 细胞凋亡检测（4 学时）

Lab 15: Assessment of Cell Apoptosis (4 hours)

熟悉凋亡细胞的形态学特征，利用 Hoechst 染色结合荧光显微镜法鉴别凋亡细胞；利用 Annexin V/PI 染色结合流式细胞仪法鉴别凋亡细胞并计数。

To be familiar with the morphology of apoptotic cells, and to identify apoptotic cells by Hoechst staining and fluorescent microscopy; To identify and quantify apoptotic cells by Annexin V/PI staining followed by flow cytometry.

16. 实验回顾与总结（4 学时）

Lab 16: Review and Presentation (4 hours)

学生根据课程内容对实验原理、步骤、实验结果进行回顾，并对实验相关内容进展扩展，以小组演讲形式讲解。

The students will present the experiment principle, work flow and data interpretation in groups.

Section	Topic	Hours
1	实验室安全教育与配置缓冲液/ Lab Safety Education and Preparation of Buffer	4
2	核型分析/ Karyotype Analysis	4
3	基因组DNA的提取与测定/ Extraction of Genomic DNA and Determination of DNA	4
4	RNA提取、逆转录与聚合酶链反应/ RNA Extraction, Reverse Transcription and PCR	4
5	限制性内切酶酶切、DNA电泳与胶回收/ Restriction Endonuclease Digestion, DNA Electrophoresis, and Gel Extraction	4
6	质粒连接与感受态细胞转化/ Plasmid Ligation and Transformation of Competent Cells	4
7	PCR 法筛选阳性克隆及测序/ Colony Screening PCR and Sequencing	4

8	蛋白的提取与定量/ Protein Extraction and Quantitation	4
9	SDS-聚丙烯酰胺凝胶电泳及考马斯亮蓝染色/ SDS-PAGE and Coomassie Blue Staining	4
10	蛋白印迹/ Western Blot	4
11	亲和层析法蛋白纯化/ Affinity Chromatography for Protein Purification	4
12	磷酸甘油醛脱氢酶动力学检测 / GAPDH Kinetics Assay	4
13	细胞培养与转染/ Cell Culture and Transfection	4
14	细胞增殖与细胞周期检测/ Cell Proliferation and Cell Cycle Analysis	4
15	细胞凋亡检测/ Assessment of Cell Apoptosis	4
16	实验回顾与总结/ Review and Presentation	4

教材及其它参考资料 Textbook and Supplementary Readings

教材:

1. Essential Experiments for Molecular Biology: A Student's Guide, Zhang Shuping & Li Peng, 高等教育出版社, 2015
2. 生物医学实验, 王进科, 科学出版社, 2013

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance				
课堂表现 Class Performance		15		
小测验 Quiz				
课程项目 Projects		20		Lab Notebook
平时作业 Assignments		35		Lab Report
期中考试 Mid-Term Test				
期末考试 Final Exam				

期末报告 Final Presentation 其它（可根据需要 改写以上评估方 式） Others (The above may be modified as necessary)	30		Group Oral Presentation

20. 记分方式 **GRADING SYSTEM**

A. 十三级等级制 **Letter Grading**
 B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority

本课程已经医学院教学副院长张文勇教授审核通过。

