

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.

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| 1. | 课程名称 Course Title | 分子细胞生物学 Molecular Cell Biology |
| 2. | 授课院系 Originating Department | 生物医学工程系 Department of Biomedical Engineering |
| 3. | 课程编号 Course Code | BMEB218 |
| 4. | 课程学分 Credit Value | 3 |
| 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 Instructor(s), Affiliation & Contact (For team teaching, please list all instructors) | 姚明曦, 助理教授 Mingxi Yao, Assistant Professor, yaomx@sustech.edu.cn |
| 9. | 实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact | 待公布 To be announced |
| 10. | 选课人数限额(可不填) Maximum Enrolment (Optional) | |

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|---|----------------|-----------|---------------|------------------------|-------|
| 11. 授课方式 Delivery Method | 讲授 | 习题/辅导/讨论 | 实验/实习 | 其它(请具体注明) | 总学时 |
| | Lectures | Tutorials | Lab/Practical | Other (Please specify) | Total |
| 学时数 Credit Hours | 48 | | | | 48 |
| 12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements | 生物学原理 (BIO103) | | | | |
| 13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite | 无 | | | | |
| 14. 其它要求修读本课程的学系 Cross-listing Dept. | 无 | | | | |

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程的教学目标为：以细胞在生命活动中所遵循的工程原理为主线，讲解细胞结构和功能、基因表达、蛋白质合成、细胞运动、信号转导和细胞周期等方面的基础知识及调控机制。同时，本课程还将介绍分子生物学和细胞生物学的实验方法和技术，以及它们在生物医学工程等领域中的应用。

The objective of the course is to introduce the basic knowledge and engineering principles that underlie cellular life processes, such as cell structure and function, gene expression, protein synthesis, cell motility, signal transduction and cell cycle. It also covers the experimental methods and techniques used in molecular biology and cell biology, and how they can be applied to biomedical engineering and other disciplines.

16. 预达学习成果 Learning Outcomes

结合讲座，小组项目等多种教学手段本课程预期达到下列学习成果：

- 了解细胞的结构和功能，以及它们如何适应不同的环境和需求。
- 掌握细胞生物学的基本概念、原理和术语，以及它们在生命科学中的应用。
- 理解细胞生物学的主要实验方法和技术，以及它们在研究细胞现象中的作用。
- 了解工程学原理在一些细胞生理过程中的体现及作用。
- 培养学生的探究精神和创新思维，以及与他人合作交流的能力。

This course uses a variety of teaching methods, such as lectures and group projects, to help students achieve the following learning objectives:

- Learn about the structure and function of cells, and how they respond to different environmental and physiological challenges.
- Acquire the fundamental concepts, principles and terminology of cell biology, and how they are relevant to life sciences.
- Comprehend the major experimental methods and techniques in cell biology, and how they are used to investigate cellular phenomena.
- Appreciate how engineering principles can explain and manipulate some cellular processes.
- Cultivate students' curiosity and creativity, as well as their skills in collaboration and communication.

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.)

第 1 周：细胞生物学概述

- 课程介绍：课程目标、要求、评估方式等
- 细胞生物学的历史和发展
- 细胞的多样性和共同性
- 生命活动中的工程原理简介
- 细胞的组成和结构
- 细胞的观察和研究方法

Week 1: Introduction to Cell Biology

- Course overview: objectives, requirements, evaluation methods, etc.
- The history and evolution of cell biology
- The diversity and unity of cells
- Engineering principles in biological processes
- The components and structures of cells
- The techniques for observing and studying cells

第 2-3 周：细胞膜和运输

- 细胞膜的结构和性质
- 细胞膜上的蛋白质和功能
- 细胞膜的流动性和渗透性
- 细胞膜的运输机制

Week 2-3: The Cell Membrane and Transport

- The structure and properties of the cell membrane
- The proteins on the cell membrane and their functions
- The fluidity and permeability of the cell membrane
- The mechanisms for transporting substances across the cell membrane

第 4 周：细胞能量代谢

- 能量、酶和代谢途径
- 糖酵解和乳酸发酵
- 柠檬酸循环和电子传递链
- 氧化磷酸化和 ATP 合成

Week 4: Cellular Energy Metabolism

- Energy, enzymes, and metabolic pathways
- Glycolysis and lactic acid fermentation
- The citric acid cycle (Krebs cycle) and the electron transport chain
- Oxidative phosphorylation (OXPHOS) and ATP synthesis

第 5-6 周：细胞信号传导

- 细胞信号传导的概念和原理
- 细胞信号分子的种类和特征
- 细胞信号受体的类型和功能
- 细胞信号转导途径的组成和调控

Week 5-6: Cellular Signal Transduction

- The concept and principle of cellular signal transduction
- The types and features of cellular signaling molecules

- The types and functions of cellular signaling receptors
- The components and regulation of cellular signal transduction pathways

第 7 周：细胞周期和分裂

- 细胞周期的阶段和检查点
- DNA 复制的过程和机制
- 有丝分裂的过程和机制
- 减数分裂的过程和机制

Week 7: The Cell Cycle And Division

- The stages and checkpoints of the cell cycle
- The process and mechanism of DNA replication
- The process and mechanism of mitosis
- The process and mechanism of meiosis

第 8-9 周：细胞骨架和运动

- 微丝、微管、中间丝的结构和功能
- 肌肉收缩的分子基础
- 绒毛、纤毛、假足等细胞运动形式
- 细胞内运输的机制

Week 8-9: The Cytoskeleton And Movement

- The structure (organization) and function (role) of microfilaments (actin filaments), microtubules (tubulin polymers), intermediate filaments (IFs)
- The molecular basis (mechanism) of muscle contraction
- Cilia (hair-like structures), flagella (tail-like structures), pseudopodia (false feet), etc. as forms (modes) of cellular movement
- The mechanism for transporting materials within cells

第 10 周：细胞间连接和通讯

- 紧密连接、粘着连接、间隙连接等细胞连接类型及其功能
- 胶原纤维、弹性纤维、纤连蛋白等细胞外基质成分及其功能
- 整合素、纤连蛋白受体等细胞外基质受体及其功能
- G 蛋白偶联受体、酪氨酸激酶受体、离子通道受体等细胞间通讯受体及其功能
- 细胞间通讯的调节和失调

Week 10: Cell-Cell Interactions And Communications

- The types (categories) and functions (roles) of cell junctions such as tight junctions (occluding junctions), adherens junctions (anchoring junctions), gap junctions (communicating junctions), etc.
- The components (elements) and functions (roles) of the extracellular matrix (ECM) such as collagen fibers (structural proteins), elastic fibers (elastic proteins), fibronectin (adhesive glycoproteins), etc.
- Integrins (transmembrane proteins), fibronectin receptors (cell adhesion molecules) and other ECM receptors and their functions (roles)
- G protein-coupled receptors (GPCRs), tyrosine kinase receptors (RTKs), ion channel receptors (ICRs) and other cell-cell communication receptors and their functions (roles)

第 11 周：细胞分化和发育

- 细胞分化的概念和类型
- 基因表达的调控机制
- 转录因子、表观遗传、非编码 RNA 等基因表达的调控因素
- 细胞命运的决定和改变

Week 11: Cell Differentiation And Development

- Concept and types of cell differentiation
- Regulation mechanisms of gene expression
- Transcription factors, epigenetics, non-coding RNA and other regulatory factors of gene expression
- Determination and change of cell fate

第 12 周：干细胞和再生

- 干细胞的定义和分类
- 干细胞的来源和分离
- 干细胞的培养和诱导分化
- 干细胞的应用和伦理问题

Week 12: Stem Cells And Regeneration

- Definition and classification of stem cells
- Source and isolation of stem cells
- Culture and induced differentiation of stem cells
- Application and ethical issues of stem cells

第 13 周：细胞死亡和疾病

- 细胞死亡的类型和机制
- 凋亡、坏死、自噬等细胞死亡途径及其调控
- 细胞死亡在生理和病理过程中的作用
- 细胞死亡与癌症、神经退行性疾病、免疫系统等相关疾病

Week 13: Cell Death And Disease

- Types and mechanisms of cell death
- Apoptosis, necrosis, autophagy and other cell death pathways and their regulation
- Role of cell death in physiological and pathological processes
- Cell death and related diseases such as cancer, neurodegenerative diseases, immune system, etc.

第 14 周：小组项目展示和讨论

Week 14: Group project presentation and discussion

第 15 周：小组项目展示和讨论

Week 15: Group project presentation and discussion

第 16 周：复习

Week 16: Review

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

Alberts B, et al. Molecular Biology of the Cell. 6th ed. Garland Science, 2014.
Sheetz M & Yu H. Cell as a Machine. Cambridge University Press, 2018

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 | | 10 | | |
| 课堂表现 Class Performance | | | | |
| 小测验 Quiz | | | | |
| 课程项目 Projects | | 30 | | 以小组汇报的形式完成课程项目，目的培养学生小组合作能力； Finish a team project via presentation and help students to learn about teamwork. |
| 平时作业 Assignments | | 20 | | 通过布置作业，让学生复习和使用课堂学习的内容以及学习收获； Students learn to apply the theory and algorithms in the homework, to summarize what they learned in the class. |
| 期中考试 Mid-Term Test | | | | |
| 期末考试 Final Exam | | 40 | | 通过期末考试的形式，考察学生对课程知识理解程度； Help students to summarize and digest what they learning during the course in the 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) | | | | |

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

生物医学工程系教学委员会