

课程大纲
COURSE SYLLABUS

1.	课程代码/名称 Course Code/Title	干细胞生物学 The Biology of Stem Cells
2.	课程性质 Compulsory/Elective	选修 Elective
3.	开课单位 Offering Dept.	医学院 School of Medicine
4.	课程学分/学时 Course Credit/Hours	3 学分 (48 学时) 3 Credits (48 Hours)
5.	授课语言 Teaching Language	中英文 Chinese and English
6.	授课教师 Instructor(s)	覃刚健 QIN GANGJIAN
7.	开课学期 Semester	2023 春 2023 Spring
8.	是否面向本科生开放 Open to undergraduates or not	否 No
9.	先修要求 Pre-requisites	无 No

10. 教学目标
Course Objectives

通过本课程教学，使学生全面了解干细胞研究的发展，掌握干细胞的基本生物学特性，熟悉干细胞研究的相关技术，了解干细胞领域的前沿进展及发展方向。重点聚焦在干细胞的核心基本概念，分子生物学与发育学基础，分化、转分化与逆分化，干性与重编程，胚胎干细胞、诱导的多能干细胞、以及成体干细胞基本技术，干细胞的治疗与非治疗性应用，以及相关的伦理、规范、和知识产权内容。

此外，进一步强化学生对生物学研究的重要基本概念的理解，包括必需与充分原则，生物模型系统，核心信号通路，用胚胎学机制和原理模拟体外分化过程，疾病建模，再生医学等。

最后，使学生了解干细胞知识的获取过程，学会如何批判性地评估实验证据。结合目前应用干细胞进行临床实践的原理，技术思路，和亟待解决的难点，独立思考，把握学科的发展方向，为未来的科学研究打下坚实的基础。

Through the course study, the students will gain comprehensive understanding of stem cell research, master basic biological characteristics of different stem cells, acquire relevant stem cell technologies, and grasp the cutting-edge progress in the field. The emphasis will be on core concepts of stem cells; the molecular and developmental basis; differentiation, dedifferentiation, and dedifferentiation; stemness and reprogramming; important technologies; therapeutic and non-therapeutic applications; and topics related to ethics, regulation, and intellectual properties.

In addition, the students will further consolidate their understanding of important basic concepts of biological research, including necessity and adequacy, biological model systems used, core signalling pathways, use of mechanisms borrowed in embryology to simulate differentiation in petri dishes, disease modelling, and regenerative medicine.

Lastly, the students will gain insight into the process of discoveries in stem cell research and learn how to critically evaluate experimental evidence. Equipped with critical thinking skills, key techniques, and gaps of research directions and barriers to clinical translation, the students will be on solid ground for the next level of academic learning and research.

11. 教学方法 Teaching Methods

学生如何有效地学习所讲授的课程内容是教学成功与否的关键因素，而主动学习是理解和保留知识的最有效方法。教学目标可以通过课堂授课、家庭作业、测验和后续评估来实现，也可以通过提供合适的环境在课堂上进行有效的互动和讨论、小组合作项目、写作练习、辩论、模拟和思考配对分享等方式，让学生参与主动学习。高阶思维包括分析、综合和评估，给学生提供有利于创新思维的环境与工具，并为学生和学生之间、学生和老师之间的双向互动提供友好的氛围。

创新的基础是独立思考，因此鼓励批判性和创造性思维。让学生们选择经典的科学问题，就最新进展做口头报告，并以短文形式陈述自己的独到见解。特别鼓励学生积极提出自己的想法，不要轻易接受一种现成的理论。讲授时注意引导学生就干细胞生物学的重要现象展开讨论，从中发掘归纳出科学问题，并寻找相应的解决问题的思路和方法，比较在不同实验技术背景下研究思路的差异。

鼓励学生就课堂相关主题进行科学演讲，在友好和兴奋的环境中理解和交流他们的想法，提高其对课程材料理解水平、交流能力和信心。

安排适当时间讲授当前发表的重要研究成果，这些研究成果借鉴了课程中涵盖的干细胞生物学原理和方法，因此有助于学生融会贯通，激发学生的创新热情和主动性。

建立老师与学生之间的信任，鼓励学生在课堂内外的出色表现。积极开发新的课程材料，使之具有挑战性；同时依赖于学生的积极反馈，不断更新、改善，增强教学的质量。

使用多媒体（包括访问互联网，幻灯片和动画），补充教科书，和讲义，并努力争取为学生提供学习干细胞实验室技能的机会。

How effectively students learn what is being taught is a key factor in the success of teaching, and active learning is the most effective way to understand and retain knowledge. Teaching objectives can be achieved through classroom lessons, homework, quizzes and follow-up assessments, as well as by providing the right environment for effective interaction and discussion, group projects, writing exercises, debates, simulations, and think-pair-pair, to engage students in active learning. Higher order thinking includes analysis, synthesis, and evaluation, providing students with an environment and tools conducive to creative thinking, and providing a friendly atmosphere for two-way interaction between students and between students and teachers.

Independent thinking is the basis of innovation, thus encouraged in the class. Students may choose topics of classic scientific questions and give oral presentations on the latest developments. They may also present their unique insights in the form of short commentary essays. Students are especially encouraged to actively contribute their own ideas and not to accept a ready-made theory easily. During the lecture, students should be guided to discuss the important phenomena of stem cell biology, explore and summarize scientific problems, find corresponding ideas and methods to solve problems, and compare the differences in research ideas using different experimental techniques.

Students are encouraged to give scientific presentations on aspects of stem cell biology, communicating their ideas in a friendly and exciting environment to improve their level of understanding of the course material, as well as their communication skills and confidence.

Time will be scheduled to present important current research findings that draw on the principles and methods of stem cell biology covered in the curriculum, thus helping students to integrate and stimulate their enthusiasm and initiative for innovation.

Build trust between teachers and students and encourage students to excel in and out of the classroom. Actively develop new course materials to make them challenging. At same time, relying on the positive feedback of students to constantly update, improve and enhance the quality of teaching.

Use multimedia (including access to the internet, slides, and animations), in supplement to textbooks, and lecture notes. Make every effort to provide students with the opportunity of performing laboratory experiments.

12. 教学内容
Course Contents

Module 1:	Introduction to Stem Cell Biology (4 hours)
Section 1	What defines a stem cell?
Section 2	Types of stem cells
Section 3	Stem cells in vivo
Section 4	Stem cells in vitro
Module 2:	Introduction to Development (4 hours)
Section 5	Early development: fertilization, totipotency, and pluripotency
Section 6	Gastrulation and lineage commitment in the early embryo
Section 7	Mechanisms of cell fate determination in vivo
Section 8	Specification and development of primordial germ cells
Module 3:	Pluripotency and Reprogramming in Vitro (8 hours)
Section 9	Establishment of embryonic stem cells (ESCs)
Section 10	Characterization of pluripotent stem cells (PSCs)
Section 11	Molecular mechanisms underlying pluripotency
Section 12	Induction of pluripotency
Section 13	Potential of induced PSCs (iPSCs) in basic and clinical applications
Section 14	Alternative PSCs
Section 15	Reprogramming using defined factors
Section 16	Mechanisms of reprogramming
Module 4:	Adult Stem Cells and Regeneration (5 hours)
Section 17	Tissue regenerative capacity
Section 18	Regeneration in planaria, zebrafish, axolotl, and mammals
Section 19	Facultative stem cells
Section 20	Transdifferentiation
Section 21	Dedifferentiation and plasticity
Module 5:	Directed Differentiation and Transdifferentiation (5 hours)
Section 22	In vivo differentiation
Section 23	Specification during development
Section 24	Specification in adults
Section 25	In vitro differentiation

Section 26	Transdifferentiation and direct programming
Module 6:	Leveraging Tools to Study Stem Cell Biology (6 hours)
Section 27	Editing the stem cell genome
Section 28	In vivo tools in stem cell biology
Section 29	Computational tools to dissect stem cell heterogeneity
Section 30	In vitro cultures of adult stem cells to analyse differentiation capacity
Module 7:	Clinical Applications of Stem Cell Biology (9 hours)
Section 31	Overview of the clinical application of stem cell technologies
Section 32	Pluripotent stem cell differentiation
Section 33	Transdifferentiation and direct programming
Section 34	Adult stem cell disease modelling and therapy
Section 35	Stem cell therapy guidelines and clinical trials
Module 8:	Ethical Issues in Stem Cell Research (7 hours)
Section 36	Embryo ethics
Section 37	Ethics of egg donation
Section 38	Ethics of gene editing
Section 39	Premature translation of stem cell interventions
Section 40	Fetal tissue
Section 41	Access to future stem cell therapies
Section 42	Responsible communication of science to the public

13. 课程考核
Course Assessment

课程考核方式

1. 出勤: 10%
2. 平时作业: 30%
3. 简要领域进展报告和评论性短文: 25%
4. 期末考试: 35%

Grading

1. Attendance 10%
2. Assignments 30
3. Short Presentations & Commentary Essays 25%
4. Final Exam 35%

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

教材 Textbooks

- Stem Cells, Scientific Facts and Fiction, 3rd edition, by Christine Mummery, Anja van de Stolpe, Bernard Roelen, Hans Clevers, Academic Press, January 20, 2021, eBook ISBN: 9780128226773, Paperback ISBN: 9780128203378

参考资料（书与网上资源） Reference materials (books and online resources)

- Essentials of Stem Cell Biology, 3rd edition, by Robert Lanza and Anthony Atala, 2014 Elsevier Inc. ISBN: 978-0-12-409503-8
- Stem cells _ from biology to therapy, edited by Robert A Meyers, Wiley-Blackwell 2013 © 2013 Wiley-VCH Verlag GmbH & Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany. Print ISBN: 978-3-527-32925-0 ePDF ISBN: 978-3-527-66854-0 ePub ISBN: 978-3-527-66852-6 Mobi ISBN: 978-3-527-66853-3
 - A Closer Look at Stem Cells: Learn about stem cells.
【<https://www.closerlookatstemcells.org/learn-about-stem-cells/>】
 - Genetics Society of America: Primer in genetics. 【<https://genetics-gsa.org/education/primers-in-genetics/>】
 - HHMI: BioInteractive resources.
【https://www.biointeractive.org/search?sort_by=created&redirect=1&field_biointeractive_topics%5B0%5D=26679】
 - Michael Barresi lab: Developmental Tutorials
【<https://blogs.smith.edu/blog/barresilab/devideutorials/>】 and Developmental Documentaries.
【<https://blogs.smith.edu/blog/barresilab/developmental-documentaries/>】
 - iBiology Research Talks: Development and Stem Cells. 【<https://www.ibiology.org/research-talks/development-and-stem-cells/>】

入课前应熟悉的教科书材料 Textbooks that cover pre-requisite materials

- Developmental Biology, 12th edition, 2019 by Michael Barresi and Scott Gilbert, Oxford University Press.
- Molecular Biology of the Cell, 6th edition, 2017 by Bruce Alberts, Garland Science. Or similar introductory cell biology textbook.
- Stem Cells for Dummies, 1st edition, 2010 by Lawrence S.B. Goldstein.