

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	模式生物和发育生物学实验 Model Organisms and Developmental Biology Laboratory
2.	授课院系 Originating Department	生物系 Department of Biology
3.	课程编号 Course Code	BIO307
4.	课程学分 Credit Value	1
5.	课程类别 Course Type	专业选修课（生物科学、生物技术、生物信息学专业） Major Elective Courses(Biological Sciences, Biotechnology, Bioinformatics Majors)
6.	授课学期 Semester	春季 Spring
7.	授课语言 Teaching Language	中英双语 English & Chinese
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)	生悦，生物系，shengy@sustc.edu.cn Sheng Yue, Department of Biology, Email: shengy@sustc.edu.cn
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	宋亚坤，生物系，songyk@sustc.edu.cn Song Yakun, Department of Biology, Email: songyk@sustc.edu.cn
10.	选课人数限额(可不填) Maximum Enrolment (Optional)	24

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			课堂实验 28 学时 class experiment 28 h	课后实验及结果观察 4 学时 further experiment and observation of result after class 4 h *1-12 周开课，实际课堂实 验 7 周。（由于斑马鱼、 爪蟾受精的不确定性，若 当周受精失败，无实验用 胚胎，实验顺延至下周， 因此预留 5 周） The course is arranged in 1-12 weeks, 7 weeks of which are the class experiments. (Fertilization of zebrafish and xenopus are uncertainty. Failure of fertilization will lead to no embryos for experiment. In that case, the experiment will be postponed to the next week. Therefore 5 weeks are reserved.	32

12. 先修课程、其它学习要求
Pre-requisites or Other
Academic Requirements

要求先修《普通生物学实验》课程；学习本实验课的同时学习《模式生物与发育生物学》理论课课程。
Pre-study General Biology Laboratory, and study the theory courses Model Organisms and Developmental Biology with the experiments course at the same time.

13. 后续课程、其它学习规划
Courses for which this course
is a pre-requisite

14. 其它要求修读本课程的学系
Cross-listing Dept.

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

模式生物与发育生物学实验意在通过对模式动物的观察研究学习胚胎发育的原理。课程集中学习了早期胚胎发育、化学致畸、原位杂交、侧线毛细胞再生、微血管造影、体外受精及显微注射等发育生物学实验。本课程加深学生对发育生物学理论的理解，同时培养学生的动手能力、良好的科研思维与严谨治学的态度。

Model Organisms and Developmental Biology Laboratory aims to learn the principles of development through experiments with the model organisms. This course includes early embryonic development, chemical teratogenesis, in situ hybridization, regeneration of lateral line hair cell, microangiography with zebrafish embryos, in vitro fertilization and microinjection with Xenopus embryo. It will help students to have a better understanding of the theory course. At the same time, it can train the students' practical ability, critical thinking and rigorous scholarship.

16. 预达学习成果 Learning Outcomes

1. 学生将掌握发育生物学实验的常规实验仪器使用，如：拉针仪、显微注射仪、体式荧光显微镜等。
 2. 学生将熟悉常见的模式生物，如：斑马鱼，非洲爪蟾。
 3. 学生将掌握发育生物学常用的实验技术，如：胚胎培养，原位杂交，体外受精及显微注射等。
 4. 通过本课程的学习，使学生更好的理解发育的基本原理，如：前脑发育，胚轴形成及血管发生等。
1. Students will master the use of basic experimental equipments, such as micropipette puller, microinjector and fluorescence stereoscope.
 2. Students will get familiar with most used animal model, such as zebrafish and Xenopus.
 3. Students will master the classical techniques, such as embryonic culture, ISH, in vitro fertilization and microinjection.
- Students will get better understanding about the principles of development, such as forebrain development, body axis formation and angiogenesis.

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.)

一、模式生物与发育生物学实验简介及胚胎的早期发育

学时：4 学时

Lab 1 Introduction to Model Organisms and Developmental Biology Laboratory & Early Embryonic Development
Hours: 4 h

介绍模式生物与发育生物学实验安全管理制度，了解课程要求、课程评估方式、课程内容及时间安排等。本实验学生将观察斑马鱼胚胎及蛙胚胎的早期发育形态。比较卵裂期、囊胚期、原肠胚期及神经管形成期胚胎发育的特点。

Introduce model organisms and developmental biology laboratory safety, course requirement, course evaluation, course content and schedule. Recognize the early embryonic development of zebrafish and frog. Compare the characteristics of different embryogenesis process, including cleavage period, blastula period, gastrula period and neurula period.

二、GSK3 小分子抑制剂 BIO 对前脑发育的影响

学时：4.5 学时

Lab 2 Study forebrain development with a small molecule GSK3 inhibitor BIO

Hours: 4.5 h

本实验学生将学习 Wnt/ β -catenin 信号通路，了解原肠胚期此通路的异常激活可导致发育异常，探讨 GSK3 小分子抑制剂 BIO 对斑马鱼前脑发育的影响，通过实验了解化学致畸。包括课堂上课 4 学时和第二天观察结果 0.5 学时。

Learn about the Wnt/ β -catenin pathway. When Wnt pathway is ectopically activated during gastrulation, the embryos will produce dysplasia. Students will investigate the effects of GSK3 inhibitor BIO on forebrain development in zebrafish and understand more about the chemical teratogenesis. 4 class hours for the classroom teaching and 0.5 class hour for the results observed in the next day.

三、原位杂交（1）

学时：4 学时

Lab 3 In Situ Hybridization (ISH)(1)

Hours: 4 h

本实验学生将配置原位杂交实验的试剂，并进行斑马鱼胚胎的固定。

Prepare the reagents for in situ hybridization (ISH) of zebrafish. Fix and dehydrate of zebrafish embryos.

四、原位杂交（2）

学时：6 学时

Lab 3 In Situ Hybridization (ISH)(2)

Hours: 6h

本实验学生将学习原位杂交实验的原理，通过斑马鱼胚胎原位杂交，观察斑马鱼 *pax2a* 基因在 *dome* 期及 *ntl* 基因在胚胎发育 24h 的表达情况。包括课堂上课 4 学时和第二天继续实验 1 学时及第三天观察结果 1 学时。

Students will understand the principle of ISH. Detect the *pax2a* gene expression at *dome* and *ntl* gene at 24hpf in zebrafish using ISH. 4 class hours for the classroom teaching, 1 class hour for the further experiment in the second day and 1 class hour for the results observed in the third day.

五、斑马鱼胚胎血管造影

学时：4 学时

Lab 5 Microangiography with Zebrafish Embryos

Hours: 4 h

本实验学生将学习拉针仪及显微注射仪的使用方法。在斑马鱼胚胎静脉窦注射荧光染料，通过血管造影观察脉管系统。

Learn how to use the micropipette puller and microinjector. Inject fluorescent dye directly into the sinus venosus of zebrafish embryo. Then observe the functional vasculature by microangiography.

六、非洲爪蟾体外受精及胚胎显微注射

学时：5 学时

Lab 6 In vitro Fertilization and Microinjection with Xenopus Embyo

Hours: 5h

本实验学生将学习体轴形成的原理，学习非洲爪蟾体外受精的方法，并在 2 细胞期和 4 细胞期注射 β -catenin RNA 诱导第二体轴形成。包括课堂上课 4 学时和第三天观察结果 1 学时。

Students will understand the principle of body axis formation. Mix the sperm suspension with the eggs to perform the in vitro fertilization with *Xenopus*. Inject capped β -catenin RNA solution to the blastomeres at 2 cell and 4 cell stage. Then incubate and observe the second body axis formation. 4 class hours for the classroom teaching, 1 class hour for the results observed in the third day.

七、侧线毛细胞再生

学时：4.5 学时

Lab 7 Regeneration of Lateral Line Hair Cells & Course Review

Hours: 4.5h

本实验学生将以侧线毛细胞为模型学习再生，探讨 Cu^{2+} 对斑马鱼侧线毛细胞发育及损伤后再生的影响。包括课堂上课 4 学时和第二天观察结果 0.5 学时。并总结本课程的所有实验内容，收集课程意见及建议。

Students will use lateral line hair cell as a model to study regeneration. Students will investigate the effects of Cu^{2+} on development in zebrafish and regeneration after injury. 4 class hours for the classroom teaching, 0.5 class hour for the results observed in the next day. The other objective of this course is to review all the experiments and to collect the suggestions and comments about our laboratories.

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

教材由课程的负责老师、工程师共同编写。

Manual is written by teachers and engineers in charge of the course.

参考资料：

Westerfield M. The zebrafish book: a guide for the laboratory use of zebrafish (*Brachydanio rerio*)[M]. Eugene, OR: University of Oregon Press, 1993.

Tickle C. Principles of development[M]. Oxford university press, 2011.

Hogan B, Costantini F, Lacy E. Manipulating the mouse embryo: a laboratory manual[M]. Cold Spring Harbor, NY: Cold

spring harbor laboratory, 1986.

Kimmel C B, Ballard W W, Kimmel S R, et al. Stages of embryonic development of the zebrafish[J]. Developmental dynamics, 1995, 203(3): 253-310.

Westerfield M. The zebrafish book[M]. University of Oregon press, 2000.

New D A T. A new technique for the cultivation of the chick embryo in vitro[J]. Journal of Embryology and experimental Morphology, 1955, 3(4): 326-331.

Ashburner M. Drosophila. A laboratory handbook[M]. Cold Spring Harbor Laboratory Press, 1989.

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		20		
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		30		notebook
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)		40		Experimental operation 10% Report 30%

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

本课程经生物系本科教学指导委员会审议通过。
This Course has been approved by Undergraduate Teaching Steering Committee of Department of Biology.