BIO307 模式生物和发育生物学实验 课程大纲

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 one
5.	课程类别 **Course Type**	专业选修课 Major Electie Courses
6.	授课学期 **Semester**	春季 Spring
7.	授课语言 **Teaching Language**	中文/英文 Chinese/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,**	生悦，生物系，shengy@sustc.edu.cn Sheng Yue, Department of Biology, Email: shengy@sustc.edu.cn

	please list all instructors）	
9.	实验员/助教、所属学系、联系方式（请列出本课所有教辅人员） **Tutor/TA(s), Contact (Please list all)**	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 *1-7 周开课（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） The course is arranged in 1-7 weeks. (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. ）	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《模式生物和发育生物学》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 teratogenisis, 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. 4. 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.)**

实验一、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

Experiment 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.

实验二、GSK3 小分子抑制剂 BIO 对前脑发育的影响
学时：4.5 学时

Experiment 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。并进行斑马鱼胚胎原位杂交的预处理。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 teratogenisis. 4 class hours for the classroom teaching and 0.5 class hour for the results observed in the next day.

实验三、mRNA 合成
学时：4 学时

Experiment 3 Synthesis of mRNA
Hours: 4 h

本实验学生将学习 mRNA 的合成过程，制备斑马鱼 ntl 和 pax2a 基因探针用于原位杂交，制备非洲爪蟾β-catenin 和 EGFP mRNA 用于后续显微注射实验。

Learn how to synthetize mRNA probe. Prepare the ntl and pax2a gene probes of zebrafish. Pretreat the zebrafish embryos for in situ hybridization.

实验四、原位杂交
学时：6 学时

Experiment 4 *In Situ* Hybridization (ISH)
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.

实验五、斑马鱼胚胎血管造影
学时：4 学时

Experiment 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.

实验六、非洲爪蟾体外受精及胚胎显微注射
学时：5 学时

Experiment 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.

实验七、侧线毛细胞再生
学时：4.5 学时

Experiment 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 Cu2+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 Cu2+ 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.

实验顺序根据胚胎发育情况可能会有调整

The order of experiment may be adjusted according to the embryonic development.

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.

教学评估 ASSESSMENT

19.	评估形式 **Type of Assessment**	评估所需时间 **Duration**	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**		0		
	课程项目 **Projects**		0		
	平时作业 **Assignments**		30%		notebook
	期中考试 **Mid-Term Test**		0		
	期末考试 **Final Exam**		0		
	期末报告 **Final**		0		

	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**

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**	生命科学学院 School of Life Science
3.	**课程编号** **Course Code**	BIO307
4.	**课程学分 Credit Value**	1 one
5.	**课程类别** **Course Type**	专业选修课 Major Electie Courses
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@sustech.edu.cn Sheng Yue, School of Life Science, Email: shengy@sustech.edu.cn

9.	实验员/助教、所属学系、联系方式 **Tutor/TA(s), Contact**	无 NA / 待公布 To be announced / 已确定的实验员/助教联系方式 Please list all Tutor/TA(s) 宋亚坤，生物系，songyk@sustech.edu.cn Song Yakun, Department of Biology, Email: songyk@sustech.edu.cn
10.	**选课人数限额(可不填)** **Maximum Enrolment（Optional）**	20

		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
11.	授课方式 **Delivery Method**					
	学时数 **Credit Hours**			课堂实验 28 学时 Class experiment 28 h	课后实验观察 4 学时 *1-7 周开课（由于斑马鱼、果蝇受精的不确定性，若当周受精失败，无实验用胚胎，实验开课时间根据胚胎实际情况会有调整） Observation after class 4 h. The course is arranged in 1-7 weeks. (Fertilization of zebrafish and *Drosophila* are uncertainty. Failure of fertilization will lead to no embryos for experiment. In that case, the experiment will be adjusted according to the embryonic development.）	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《模式生物和发育生物学》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**	无 None
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、自噬、原位杂交、侧线毛细胞再生、显微注射及微血管造影等发育生物学实验。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 teratogenisis, autophagy in *Drosophila* larvae, ISH, regeneration of lateral line hair cell, microinjection and microangiography with zebrafish embryos. 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，果蝇。
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，自噬形成及血管发生等。

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 *Drosophila*.
3. Students will master the classical techniques, such as embryonic culture, ISH, in vitro fertilization and microinjection.
4. Students will get better understanding about the principles of development, such as forebrain development, autophagy 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.)

实验一、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

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早期胚胎发育的形态，比较蛙卵裂期、囊胚期、原肠胚期及神经管形成期胚胎发育的特点，学习不同发育阶段的果蝇幼虫及成体表型观察。

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

Introduce model organisms and developmental biology laboratory safety, course requirement, course evaluation, course content and schedule. Recognize the early embryonic development of zebrafish. Compare the characteristics of different embryogenesis process in frog, including cleavage period, blastula period, gastrula period and neurula period . Observe the phenotypes of *Drosophila* larvae and adults at different developmental stages.

实验二、GSK3 小分子抑制剂 BIO 对前脑发育的影响
学时：4.5 学时

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。并进行斑马鱼胚胎原位杂交的预处理。包括课堂上课 4 学时和第二天观察结果 0.5 学时。

Experiment 2 Study forebrain development with a small molecule GSK3 inhibitor BIO Hours: 4.5 h

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 teratogenisis. Pretreat the zebrafish embryos for ISH. 4 class hours for the classroom teaching and 0.5 class hour for the results observed in the next day.

实验三、mRNA 合成
学时：4 学时

本实验学生将学习 mRNA 的合成过程，制备斑马鱼 ntl 和 pax2a 基因探针用于后续原位杂交实验。并挑选处女蝇用于后续基因杂交。

Experiment 3 Synthesis of mRNA
Hours: 4 h
Learn how to synthetize mRNA. Prepare the ntl and pax2 gene probes of zebrafish for ISH. Collect the virgins of *Drosophila* for genetic crosses.

实验四、原位杂交
学时：7 学时

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 pax2 基因在 dome 期及 ntl 基因在胚胎发育 24h 的表达情况。并进行果蝇基因杂交。包括课堂上课 4 学时和第二、三天继续实验 2 学时及第三天观察结果 1 学时。

Experiment 4 *In Situ* Hybridization (ISH)
Hours: 7h

Students will understand the principle of ISH. Detect the pax2a gene expression at dome and ntl gene at 24hpf in zebrafish using ISH. Mix virgins and males of *Drosophila* for genetic crosses. 4 class hours for the classroom teaching,2 class hours for the further experiments in the next 2 days and 1 class hour for the results observed in the third day.

实验五、斑马鱼胚胎血管造影
学时：4 学时

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。

Experiment 5 Microangiography with Zebrafish Embryos
Hours: 4 h

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.

实验六、侧线毛细胞再生
学时：4.5 学时

Experiment 6 Regeneration of Lateral Line Hair Cells
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。

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.

实验七、果蝇幼虫脂肪体自噬
学时：4 学时

本实验学生将学习自噬形成的过程及检测方法。通过果蝇三龄幼虫脂肪体的分离及染色，观察果蝇幼虫脂肪体细胞的自噬现象。并总结本课程的所有实验内容，收集课程意见及建议。

Experiment 7 Monitor Autophagy in *Drosophila* larval fat body & Course Review
Hours: 4h

Students will learn about the formation process and detection methods of autophagy. Isolate the fat body of third instar larvae. Stain and observe the autophagy in larval fat body cells. The other objective of this course is to review all the experiments and to collect the suggestions and comments about our laboratories.

实验顺序根据胚胎发育情况可能会有调整

The order of experiment may be adjusted according to the embryonic development.

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

教材由课程的负责老师共同编写。 Manual is written by teachers in charge of the course.

课程评估 ASSESSMENT

19.

评估形式 **Type Assessment**	评估时间 **of 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**		10%		
小测验 **Quiz**		10%		
课程项目 **Projects**		0		
平时作业 **Assignments**		30%		
期中考试 **Mid-Term Test**		0		
期末考试 **Final Exam**		0		
期末报告 **Final Presentation**		30%		
其它（可根据需要改写以上评估方式）**Others (The above may be modified as necessary)**		10%		

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

教学负责人签字： 日期：