课程大纲
COURSE SYLLABUS

1.	**课程名称(中英文)** **Course Title(Chinese and English)**	Model organisms and developmental biology (模式生物和发育生物学)
2.	**课程类别 Course Type**	Major(专业课)
3.	**授课院系** **Originating Department**	Department of Biology (生物系)
4.	**可选课学生所属院系** **Open to Which Majors**	生物系及相关院系
5.	**课程学时 Credit Hours**	48
6.	**课程学分 Credit Value**	3
7.	**授课语言** **Teaching Language**	English Preferred （英语为主）
8.	**授课教师 Instructor(s)**	仲寒冰
9.	**先修课程、其它学习要求** **Pre-requisites or Other Academic Requirements**	Cell Biology (细胞生物学)

10. 教学目标 Course Objectives

This course introduces the biological characteristics of popular model organisms, including mouse, chick, zebrafish, Drosophila, C.elegans, and Sea urchin, and great achievements obtained with these animal models. This course aims to provide a broad look at development integrating classical experiments with modern molecular and genetic techniques. We will explore the basic body plan of the embryo and how organs are formed, with special emphasis on vertebrate models. Lectures will focus on experimental design and discovery through experiments. In-class activities, problem sets, and exams will similarly require that students put themselves in the shoes of a scientist at the bench and design experiments to test certain hypotheses or evaluate hypothetical experiments.

Students are expected to achieve:

1. Learn how to choose an appropriate model organism.

2. Understand the fundamentals and key questions of developmental biology.

	3. Train themselves and apply what they learn to their own research.
11.	**教学方法及授课创新点 Teaching Methods and Innovations**
	课堂讲授时注意引导学生就重要生物学现象展开讨论，从中发掘归纳出生物学问题，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。鼓励学生积极提出自己的想法，不要轻易接受一种现成的理论。学生们将选择经典的科学问题，就最新进展做口头报告。
12.	**教学内容及学时分配 Course Contents and Course Schedule**
	Lecture 1. History and basic concepts 1.1The origins of developmental biology 1.2 A conceptual tool kit Lecture 2. Development of the Drosophila body plan 2.1 Drosophila life cycle and overall development 2.2 Setting up the body axes 2.3 Localization of maternal determinants during oogenesis 2.4 Patterning the early embryo 2.5 Activation of the pair-rule genes and the establishment of parasegments 2.6 Segmentation genes and compartments 2.7 Specification of segment identity Lecture 3. Development of C. elganss 3.1 Life cycle. 3.2 Hermaphrodite and male. 3.3 History. Sydney Brenner chose it to study how genes specify highr organisms. 3.4 Complete cell lineage is known. 3.5 The structure of the nervous system is known at electronic microscope level. 3.6 RNAi. the impact of the highly improbable. 3.7 Asymmetric cell divison. P granules.

3.8 Cell-cell determines DV axis.

3.9 Pecocious and retarded.

3.10 MicroRNA

Lecture 4. Sea urchin and ascidians

4.1 Sea urchin and the discovery of cyclin

4.2 Ascidians

Lecture 5. Vertebrate development I: life cycles and experimental techniques

5.1 Vertebrate life cycles and outlines of development of Xenopus

5.2 Experimental approaches to studying vertebrate development

Gene expression pattern. In situ hybridization. Sequencing.

Loss of function. Knock out. Knock down (anti-sense, RNAi)

Gain of function. Overexpression.

Time course control. Knock in and Cre-loxp.

Knock out techniques, ZFN, TALEN, Cas9.

The flaws of traditional transgenic approaches. Random insertion can cause unexpected problems. The example of Sirtuin.

Chip-seq.

Lecture 6. Vertebrate development II: axes and germ layers

6.1 Setting up the body axes

6.2 The origin and specification of the germ layers

Lecture 7. Vertebrate development III: patterning the early nervous system and the somites

7.1 The role of the organizer and neural induction

7.2 Somite formation and antero-posterior patterning

7.3 The initial regionalization of the vertebrate brain

Lecture 8. Development of the nervous system

8.1 neural tube。

8.2 MHB and ZLI。

8.3 Zebrafish acerebellar mutant and FGF signalling。

8.4 Rhombomeres are compartments。

8.5 Ephrin and eph。

8.6 The position of the nucleus of a neural stem cell moves in out and in during cell cycle.

8.7 The birth of a neuron.

8.8 The migration along glial cell.

8.9 Mouse reeler mutant.

8.10 The story of Cajal.

8.11. Axon guidance. Growth cone. Long and short range mechanisms.

8.12 Optic chiasm.

8.13 Frog retina assay.

Lecture 9. Axon guidance

9.1 Neural circuit.

9.2 The polarity of neuron. Growth cone, axon, dendrite.

9.3 Rao paper, GSK3beta.

9.4 Pyramidal cell.

9.5 Chick spinal cord inverted assay.

9.6 Commisural neuron guidance.

9.7 Slit-Robo model.

9.8 Optic chiasm.

9.9 Frog retina rotation assay.

9.10 Sperry and chemoaffinity hypothesis.

9.11 Netrin.

9.12 Semaphorin.

9.13 Slit-robo.

9.14 Pals1 KO.

9.15 Freach patient.

Lecture 10. Germ cells, fertilization, and sex

10.1 The development of germ cells

10.2 Fertilization

10.3 In mammals，induced by cell-cell interactions。

10.4 Germ cells migrate to gonad。

10.5 Oogenesis and spermatogenesis in mammals。

10.6 Genomic imprinting and epigenetics。

10.7 Fertilization。

10.8 Block of polyspermy。

10.9 Sex determination。

10.10 Sry gene。

10.11 Dosage compensation of X-linked genes。

10.12 Determination of the sexual phenotype

10.13 Fetal diagnostic。

Lecture 11. The development of blood and blood vessel

11.1 Vasculogenesis and angiogenesis.

11.2 Zebrafish model for angiogenesis.

11.3 The formation of lumen. Two models.

11.4 Hematopoiesis. Two waves.

11.5 The orgin of HSC.

11.6 The two models of development of aorta and vein.

11.7 The story of Folkman, VEGF and Endostatin

Lecture 12. Organogenesis

12.1 The vertebrate limb

12.2 Insect wings and legs

12.3 Vertebrate and insect eyes

12.4 Liver

12.5 Heart

Lecture 13. Growth and aging

13.1 Growth

13.2 Aging and senescence

Lecture 14 Regeneration

14.1 Amphibian limb regeneration involves cell dedifferentiation and new growth

14.2 The limb blastema gives rise to structures with positional values distal to the site of amputation

14.3 Retinoic acid can change proximo-distal positional values in regenerating limbs

14.4 Insect limbs intercalate positional values by both proximo-distal and circumferential growth

14.5 Heart regeneration in the zebrafish involves the resumption of cell division by cardiomyocytes

14.6 The mammalian peripheral nervous system can regenerate

14.7 Neurodegenerative diseases and neuroregeneration

Midterm exam

Discussion session

Presentations

Final Exam

13.	**课程考核 Course Assessment**
	1. Class participation，20% 2. Presentation，20% 3. Midterm exam，25% 4. Final exam，35%
14.	**教材及其它参考资料 Textbook and Supplementary Readings**
	No textbook required. Reference books. Principles of Development, 5th, Lewis Wolpert, Cheryll Tickle, and Alfonso Martinez Arias, OXFORD University Press, ISBN: 9780199678143 Developmental biology, 10th, Scott F. Gilbert, Sinauer Associates,Inc. ISBN: 978-1-60535-192-6