

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	寻找生命的逻辑 Genome, why we are different?
2.	授课院系 Originating Department	生物系
3.	课程编号 Course Code	BIOS201
4.	课程学分 Credit Value	2
5.	课程类别 Course Type	专业选修课 Major Elective Courses
6.	授课学期 Semester	夏季 Summer
7.	授课语言 Teaching Language	中英文 Chinese and 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, please list all instructors)	课程负责人: 陈炜, 生物系, 讲席教授, chenw@sustech.edu.cn 工程师: 余春红, 生物系, 高级实验师, yuch@sustech.edu.cn 吕沫, 生物系, 高级实验师, lvm3@sustech.edu.cn Course Coordinator: CHEN Wei, Department of Biology, Chair Professor, chenw@sustech.edu.cn Instructor: YU Chunhong, Department of Biology, Senior Experimenter, yuch@sustech.edu.cn LV Mo, Department of Biology, Senior Experimenter, lvm3@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)	无 None

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			64		64
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	无 None				
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.	无 None				

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

在传统的分子生物学实验与生物信息学之间，基因组序列信息的获取以及基因测序仪是最为重要的纽带和桥梁。本课程以培养学生的科研素养为主，学生将在独特的应用场景下从生物学、基因组学、生物信息学等不同角度来探究到底什么是基金，基因与人类健康的关系，自主设计科研项目，最终通过动手实验揭秘人的特征性状与基因的关系。课程设置“应用场景介绍”、“自主设计科研项目”“湿实验”、“干实验”、“科学实践”五个单元，让学生能够深入浅出地了解基因组学与基因技术的前沿知识，完成分子生物学实验与生物信息分析。

In the traditional molecular biology experiment and bioinformatics, the acquisition of genome sequence information and gene sequencing instrument is the most important link and bridge. This course focuses on cultivating students' scientific research literacy. Students will explore what is a foundation in a unique application scenario from different perspectives such as biology, genomics and bioinformatics, and the relationship between genes and human health. They will design scientific research projects independently, and finally reveal the relationship between human characteristics and genes through hands-on experiments. The course consists of five units: "Introduction to Application Scenes", "Independent Design Scientific Research Project", "Wet Experiment", "Dry Experiment" and "Scientific Practice". Students can understand the cutting-edge knowledge of genomics and gene technology in a simple way, and complete molecular biology experiments and bioinformatics analysis.

16. 预达学习成果 Learning Outcomes

掌握基因组学与生物信息学的基本原理。

了解高通量测序数据的基本处理方法，完成从变异数据到性状预测的简单计算。

了解基因科技在司法物证、运动指导、精准营养等方面的应用。

深入华大基因与国家基因库，了解基因科技在真实产业场景中的应用。

掌握样本处理、核酸提取、文库构建、基因测序等湿实验技术流程。

完成科研项目，汇报成果。

Master the basic principles of genomics and bioinformatics.

Understand the basic processing methods of high-throughput sequencing data, and complete the simple calculation from variation data to trait prediction.

To understand the application of gene technology in judicial material evidence, exercise guidance, precision nutrition and other aspects.

Go deep into BGI and the National Gene Bank to understand the application of gene technology in real industrial scenarios.

Master wet experimental technical processes such as sample processing, nucleic acid extraction, library construction and gene sequencing.

Complete scientific research projects and report the results.

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.)

模块一，什么是基因，基因与人类健康的关系？（应用场景介绍）

1 基因与基因测序技术 1 学时

1.1 基因测序仪——观察基因的“显微镜”

1.2 人类基因组计划

1.3 如何研究人的遗传和基因信息

1.4 本学期研究内容介绍：基因型与表型

Module 1: What are genes and how do they relate to human health? (Introduction to application scenarios)

1 Gene and gene sequencing technology, 1 hour

1.1 Gene Sequencer -- a "microscope" for observing genes

1.2 Human Genome Project

1.3 How to study human heredity and genetic information

1.4 Introduction to the research content of this semester: genotype and phenotype

2 基因与运动 0.5 学时

2.1 不可思议的难题：如何分辨运动员性别

2.2 先天决定？肌肉耐力与爆发力

2 Genes and exercise, 0.5 hour

2.1 The Incredible Problem: How to Distinguish Athletes' Gender

2.2 A priori decision? Muscle endurance and explosive power

3 基因与饮食 0.5 学时

3.1 基因与酒量

3.2 什么基因导致有人喝奶拉肚子？

3. Genes and diet, 0.5 hour

3.1 Genes and alcohol consumption

3.2 What genes cause diarrhea when people drink milk?

4 认识基因实验室 2 学时

4.1 实验室介绍：移液器、PCR 仪、离心机、涡旋震荡仪、电子天平、测序仪等

4.2 移液工具的发展历史

4.3 仪器的使用：移液器、PCR 仪、离心机、涡旋震荡仪、电子天平、测序仪等

4 Cognition gene laboratory, 2 hours

4.1 Laboratory introduction: pipette, PCR instrument, centrifuge, scroll oscillation instrument, electronic balance, sequencing instrument, etc

4.2 Development history of pipetting tools

4.3 Application of instruments: pipette, PCR instrument, centrifuge, scroll oscillator, electronic balance, sequencing instrument, etc

5 法医探案实录 1 学时

5.1 罗曼诺夫王朝的真假公主

5.2 司法物证与法医学

5.3 基因身份证与亲子鉴定

5.4 外部可见特征（EVC）预测及 DNA 绘制人脸图像

5 Forensic investigation records, 1 hour

5.1 The true and false Romanov princesses

5.2 Judicial material evidence and forensic medicine

5.3 Genetic ID card and paternity test

5.4 Exterior Visible Feature (EVC) prediction and DNA rendering of face images

6 基因型与表型 1 学时

6.1 如何进行基因定位——以运动基因为例

6.2 从 DNA 到 RNA 到蛋白质——mRNA 剪切和表观遗传

6.3 大海捞针——全基因组关联分析

6 Genotype and phenotype, 1 hour

6.1 How to carry out gene mapping -- taking motor genes as an example

6.2 From DNA to RNA to protein -- mRNA splicing and epigenetics

6.3 Finding a needle in a haystack -- genome-wide association analysis

7 七个诺贝尔奖 3 学时

7.1 从嗜热细菌 PCR

7.2 怎么检测 DNA

7.3 工具酶——大自然赋予生物学的礼物

7.4 实验 1: 用 Nanodrop 检测 DNA 的浓度和纯度

实验 2: 制作 DNA 项链

7 Seven Nobel Prizes, 3 hours

7.1 PCR from thermophilic bacteria

7.2 How to test DNA

7.3 Tool Enzymes -- Nature's Gift to Biology

7.4 Experiment 1: Determination of DNA concentration and purity by Nanodrop

Experiment 2: Make a DNA necklace

模块二，自主设计科研项目

8 像科学家一样思考 2 学时

8.1 科研文献阅读指导

8.2 归纳与演绎

8.3 假设驱动与数据驱动

8.4 学生分组讨论和文献阅读：肌肉爆发力，皮肤虹膜颜色、头发粗细、晒黑风险、乳糖代谢能力、酒精代谢能力等。

Module 2: Independent design of scientific research projects

8 Think like a scientist, 2 hours

8.1 Guidance for reading scientific research literature

8.2 Induction and Deduction

8.3 Hypothesis driven and data driven

8.4 Students' group discussion and literature reading: muscle explosive power, iris color of skin, hair thickness, tanning risk, lactose metabolism, alcohol metabolism, etc.

9 生命大数据 5 学时

9.1 如何玩转生物数据：生物信息学概览

9.2 学生讲解分组讨论的结果，汇报如何开展实验，利用生物大数据和基因检测技术可以做什么？

9. Big Data of Life, 5 Hours

9.1 How to Play with Biodata: An Overview of Bioinformatics

9.2 Students explain the results of group discussion, report how to carry out the experiment, and what can be done by using biological big data and genetic testing technology?

模块三，基因组学创意性实验（湿实验）

10 生物样本与人类遗传资源管理 6 学时

10.1 常见核酸提取方法介绍（磁珠法、过柱法、沉淀法等）

10.2 唾液样本的采集

10.3 知情同意书与人类遗传资源管理规定

10.4 唾液 DNA 提取实验

Module 3, Genomics creative experiment (wet experiment)

10 Biological samples and human genetic resources management, 6 hours

10.1 Introduction of common nucleic acid extraction methods (magnetic bead method, column method, precipitation method, etc.)

10.2 Collection of saliva samples

10.3 Informed Consent and Human Genetic Resources Management Regulations

10.4 Salivary DNA extraction experiment

11 DNA 的游泳比赛 5 学时

11.1 高通量自动提取方法介绍

11.2 电泳和 DNA 指纹图谱

11.3 Qubit 定量实验及 DNA 投入量的计算

11.4 DNA 电泳检测实验

11.5 电泳胶图的解读

11 DNA swimming competitions, 5 hours

11.1 Introduction of high throughput automatic extraction methods

11.2 Electrophoresis and DNA fingerprinting

11.3 Qubit quantitative experiment and calculation of DNA input

11.4 DNA electrophoresis test

11.5 Interpretation of electrophoresis gel diagram

12 如何“钓取”目标 DNA 6 学时

12.1 测序文库的概念与应用

12.2 片段打断与筛选

12.3 DNA 小片段文库与 RNA 文库的制备

12.4 PCR 引物设计与扩增子文库制备

12.5 第一轮 PCR 建库实验

12.6 DNA 纯化实验

12 How to "fish" target DNA, 6 hours

- 12.1 Concept and application of sequencing library
- 12.2 Segment Interruption and Screening
- 12.3 Preparation of small DNA fragment libraries and RNA libraries
- 12.4 PCR primer design and preparation of amplicon library
- 12.5 The first round of PCR database building experiment
- 12.6 DNA purification experiments

13 给 DNA 加个“条形码” 5 学时

- 13.1 Barcoding 设计原理及发展历史
- 13.2 Barcoding 的科研与产业应用
- 13.3 测序引物设计与扩增子测序文库介绍
- 13.4 第二轮 PCR 建库实验
- 13.5 DNA 纯化实验

13 Put a "barcode" on your DNA, 5 hours

- 13.1 Design principle and development history of Barcoding
- 13.2 Research and industrial application of Barcoding
- 13.3 Design of sequencing primers and introduction of amplicon sequencing library
- 13.4 The second round of PCR database building experiments
- 13.5 DNA purification experiments

14 快速读取 DNA 序列 6 学时

- 14.1 什么是测序？如何准确测序？
- 14.2 一、二、三代测序技术发展史
- 14.3 DNBSEQ 测序原理
- 14.4 制备 DNB
- 14.5 测序仪上机

14 Fast reading of DNA sequence, 6 hours

- 14.1 What is sequencing? How to sequence it accurately?
- 14.2 History of the first, second and third generations of sequencing technology
- 14.3 Principle of DNBSeg sequencing
- 14.4 The preparation of the DNB
- 14.5 Sequencer on machine

模块四， 科学实践

15 科学实践课（华大基因实习基地） 11 学时

- 15.1 国家基因库参观 5 学时
 - 1. 国家基因库室内参观（展厅、测序实验室、冷冻库等）
 - 2. 国家基因库室外参观（活体库）
- 15.2 基因科技的产业应用 6 学时
 - 1. 人类基因组研究：大队列数据分析
 - 2. 基因组与人类疾病研究案例解析
 - 3. 基因组研究成果在临床应用上的转化：唐筛、肿瘤易感基因等
 - 4. 从人类基因组图谱到单细胞图谱

5. 动植物基因组研究案例解析
6. 基因组学在群体遗传研究中的应用
7. 人体共生微生物及多组学技术在肠道菌群研究中的应用

Module 4, scientific practice

15 Science Practice Course (BGI Practice Base), 11 hours

15.1 Visit to National Gene Bank, 5 hours

1. National Gene Bank Indoor Visit (exhibition hall, sequencing laboratory, freezer, etc.)
2. National Gene Bank Outdoor Visit (Living Library)

15.2 Industrial application of gene technology 6 hours:

1. Human Genome Studies: Large Cohort Data Analysis
2. Case studies on genomes and human diseases
3. Transformation of genomic research results in clinical application: Tangsift, tumor susceptibility genes, etc
4. From human genome atlas to single cell atlas
5. Case studies on animal and plant genomes
6. Application of genomics in population genetic research
7. Application of human symbiotic microorganisms and multiomics techniques in the study of intestinal flora

模块五，揭秘基因与人类的关系（干实验）

16 谜底揭晓 2 学时

16.1 测序数据分析流程简介

16.2 报告解读

Module 5: Uncovering the relationship between genes and humans (dry experiment)

16 The answer to the riddle is revealed, 2 hours

16.1 Brief introduction of sequencing data analysis process

16.2 Report interpretation

17 一起做数学题 2 学时

17.1 外部可见特征表型预测

17.2 酒量特征表型预测

17 Do a math problem together, 2 hours

17.1 Externally visible phenotypic prediction

17.2 Phenotypic prediction of alcohol consumption

18 小组讨论 5 学时

18.1 分组讨论和文献阅读

18.2 小组汇报：与预期项目设计的区别，实验结果的分析。

18 Discussion, 5 hours

18.1 Group discussion and literature reading

18.2 Group report: difference from the expected project design, analysis of experimental results.

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

基因组学，杨焕明，科学出版社，2016 年

Genomics, Huanming Yang, Science Press, 2016

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		20		
课堂表现 Class Performance		20		
小测验 Quiz				
课程项目 Projects		30		
平时作业 Assignments		20		
期中考试 Mid-Term Test				
期末考试 Final Exam				
期末报告 Final Presentation		10		
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

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.