

## 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 <b>Course Title</b>	蛋白质结构与功能 <b>Protein Structure and Function</b>				
2.	授课院系 <b>Originating Department</b>	生物系 Department of Biology				
3.	课程编号 <b>Course Code</b>	BIO331				
4.	课程学分 <b>Credit Value</b>	3				
5.	课程类别 <b>Course Type</b>	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)				
6.	授课学期 <b>Semester</b>	春季 Spring				
7.	授课语言 <b>Teaching Language</b>	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） <b>Instructor(s), Affiliation &amp; Contact</b> (For team teaching, please list all instructors)	魏志毅，生物系，（办公室）88018411 Zhiyi, Wei, Department of Biology, wei.zy@sustech.edu.cn				
9.	实验员/助教、所属学系、联系方式 <b>Tutor/TA(s), Contact</b>	待公布 To be announced				
10.	选课人数限额(可不填) <b>Maximum Enrolment (Optional)</b>	15				
11.	授课方式 <b>Delivery Method</b>	讲授 <b>Lectures</b>	习题/辅导/讨论 <b>Tutorials</b>	实验/实习 <b>Lab/Practical</b>	其它(请具体注明) <b>Other (Please specify)</b>	总学时 <b>Total</b>
	学时数 <b>Credit Hours</b>	30	6	28		64

12. 先修课程、其它学习要求 <b>Pre-requisites or Other Academic Requirements</b>	BIO201 生物化学 I Biochemistry I
13. 后续课程、其它学习规划 <b>Courses for which this course is a pre-requisite</b>	None 无
14. 其它要求修读本课程的学系 <b>Cross-listing Dept.</b>	None 无

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

蛋白质是生命体中最具多样性的大分子，在几乎所有的生命进程中都扮演着必不可少的角色。蛋白质的天然结构是其功能发挥的基础，不同的结构决定了不同的功能。本课程的目标是通过介绍蛋白质结构与功能之间关系，帮助学生在前期课程的基础上进一步了解蛋白质如何行使其功能。同时，本课程也强调结构与功能研究的实验基础和技能。通过该课程的学习，学生能够对蛋白质有更深入的认识，进一步了解生命进程的分子基础，而且能够利用所学到的理论知识和实验技能解决生物学研究和医学研究中的相关问题。本课程的教学中将采用理论结合实验的方式，有效地促进学生对于课程内容的理解，并锻炼他们的动手能力，为培养高层次创新人才奠定基础。

Proteins are the most versatile macromolecules in living systems and serve crucial functions in essentially all biological processes. Our aim is to teach the basic principles governing protein structure-function relationship and the common techniques in structural and functional studies. With this course, students will have a fundamental understanding of the structure and function of proteins, an atomic overview of our living system, as well as knowledge and skills to solve problems in biological and medical research.

#### 16. 预达学习成果 Learning Outcomes

本课程的教学由理论和实验两部分组成，相辅相成，互相促进，提高教学效果。实际教学中包括多项创新型教学方式，包括：

- 1、充分结合课程的特点，利用多种先进的 3D 教学模具，帮助学生更好地理解蛋白质结构的特点和与功能之间的关系；
- 2、应用多种基于电脑的教学游戏和程序，激发学生的学习兴趣 and 热情；
- 3、创造性地结合实验来辅助教学，帮助学生了解各种实验手段和技术是如何被用于研究蛋白质结构与功能的关系的；
- 4、教学内容紧密联系实际，给学生展示如何将学到的知识应用于科学研究和医学中；
- 5、结合线上和线下的教学模式，通过提高优质的线上教学资料，有效地提高学生的学习深度和广度。

The course teaching consists of theory learning part and experimental part. The teaching combines traditional and innovative methods, including:

- 1.Help students to better understand protein structure by using 3D teaching models and practically building 3D structures by themselves;
- 2.Apply computer games and programs to stimulate learning interest;
- 3.Creatively combine the well-designed experiments with theory for students to know why and how different experimental approaches can be applied in understanding protein structure-function relationship;
- 4.Tightly link the research and medicine application to the teaching;
- 5.Effectively combine online and offline teaching by providing related online material for student to expand their leaning scope.

#### 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.)**

**Lectures:**

**Part 1. From Sequence to Structure (8hrs)**

具体介绍以下概念 (\*为重点)

1-1.1 Amino Acids

1-1.2 The Peptide Bond

1-1.3 Interactions that Stabilize Folded Proteins

1-1.4 Properties of Secondary Structures\*

Related Experiment: Sequence analysis II

1-2.1 Tertiary Structure

1-2.2 Protein Motifs\*

1-2.3 The Protein Domain and Classification\*

Related Experiment: Structure DIY, Protein databases

1-3.1 Alpha Domains\*

1-3.2 Beta Domains\*

1-3.3 Alpha/Beta Domains\*

1-3.4 Alpha+Beta and Cross-Linked Domains

1-3.5 Protein Family

Related Experiment: Structure comparison

1-4.1 Protein Folding\*

1-4.3 Protein Stability

1-4.3 Quaternary Structure

1-4.4 Protein Assembly

Related Experiment: Surface analysis

**Part 2. From Structure to Function (8hrs)**

具体介绍以下概念 (\*为重点)



2-1.1 Molecular Recognition

2-1.2 Functional Sites

2-1.3 Active Sites

2-1.4 Location and Nature of Binding Sites\*

Related Experiment: Identification of functional sites

2-2.1 Catalysis

2-2.2 Proximity and Ground-State Destabilization\*

2-2.3 Stabilization of Transition States and Exclusion of Water\*

2-2.4 Active-Site Geometry and Chemistry\*

2-2.5 Cofactors

2-2.6 Multi-Step Reactions

2-2.7 Multifunctional Enzymes

Related Experiment: Identification of functional sites

2-3.1 Membrane Protein Structure and Folding\*

2-3.2 Membrane Protein Prediction

2-3.3 Structure and Function of GPCR

2-3.4 Structure and Function of Ion Channel

2-3.5 Other Membrane Proteins

Related Experiment: Membrane protein analysis

2-4.1 Functional Properties of Structural Proteins

2-4.2 Scaffold Proteins

2-4.3 Flexibility and Protein Function\*

Related Experiment: Surface analysis

### Part 3. Control of protein function (12hrs)

具体介绍以下概念 (\*为重点)

3-1.1 Protein Interaction Domains

3-1.2 Regulation by Location\*

3-1.3 Control by pH and Redox Environment\*

Related Experiment: Interaction analysis I

3-2.1 Effector and Allostery \*

3-2.2 Competitive Binding and Cooperativity

3-2.3 Conformational Change \*

Related Experiment: Structural Comparison

3-3.1 Protein Switches Based on Nucleotide Hydrolysis \*

3-3.2 GTPase Switches

3-3.3 ATPase and Motor Protein Switches

3-3.4 Two-Component Signaling System

Related Experiment: Interaction analysis II

3-4.1 Regulation by Post-Translational Modification \*

3-4.2 Addition of chemical groups

3-4.3 Methylation and Epigenetics

3-4.4 Glycosylation

3-4.5 Protein Targeting by Lipid Modifications

Related Experiment: Sequence analysis II

3-5.1 Control of Protein Function by Phosphorylation \*

3-5.2 Structures of Protein Kinases

3-5.3 Regulation of Signaling Protein Kinases

Related Experiment: Sequence analysis II

3-6.1 Control by Proteolysis \*

Week	Content	Experiment
<b>From sequence to structure</b>		
1	Introduction	
2	Amino acids and secondary structure	
3	Tertiary structure	Sequence analysis I
4	Protein folding and quaternary structure	Sequence analysis II
<b>From structure to function</b>		
5	Functional sites in protein structures	Structure DIY
6	Catalysis	Protein databases
7	Membrane proteins	Structure comparison
8	Structural proteins	Surface analysis
<b>Control of protein function</b>		
9	Environmental controls	Identification of functional sites
10	Cooperativity and allostery	Membrane protein analysis
11	Regulation switches	Interaction analysis I
12	Modification regulations	Interaction analysis II
13	Kinase and signalling regulation	Protein structure prediction
14	Other regulations	Structure quality check
15	<b>Structure determination</b>	Lab tour of instrument for structural studies
16	<b>Project presentation</b>	<b>Experimental design</b>
3-6.2 Activation of Precursors		
3-6.3 Protein Splicing		
3-6.4 Ubiquitination and SUMOylation		
Related Experiment: Sequence analysis II		
<b>Part 4. Structure Determination (2hrs)</b>		
4-4.1 Structure Determination Methods		
4-4.2 X-Ray Crystallography		
4-4.3 NMR		
4-4.4 CryoEM		
4-4.5 Other Methods		
Related Experiment: Structure quality check, Lab tour of instrument for structural studies		
教学日历/Schedule		

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

教材/Textbook

Protein Structure and Function, Gregory Petsko & Dagmar Ringe, 2008

参考书/Reference book

Proteins: Structure and Function, David Whitford, 2013

**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				
课堂表现 Class Performance				
小测验 Quiz		30		13 次实验课+实验考核
课程项目 Projects		20		12 次 Journal Club
平时作业 Assignments				
期中考试 Mid-Term Test				
期末考试 Final Exam		30		
期末报告 Final Presentation		20		Presentation + Article
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.