

## **BIOL 482/582: Protein Structure and Function**

### **Objectives:**

This course provides a detailed look at protein structure and function. At the end of this course students will be able to identify main the elements of protein and domain structure and understand the basis for identifying and understanding the nature of protein-protein binding sites and catalytic residues. A portion of the course involves ‘hands on’ computer labs to teach students how to understand and identify homologous domains within proteins and classes of proteins and to observe and manipulate known protein structures. We also cover aspects of how mistakes in protein folding leads to diseases such as cystic fibrosis and prion diseases.

**Required Text:** Proteins Structure and Function. David Whitford. ISBN 978-0-471-49894-0

**Prerequisites:** Undergraduate/MMBB (BIOL) 380; Graduate/MMBB541

**Time and Place:** TR 3:30-4:45 in LSS 163

### **Grading:**

Three exams (including final)(100 points each)	300
Computer lab assignments:	75
3 other assignments 25 points each.	75
Total	450

Assignments must be printed off and turned in at start of class. Emailed assignments not accepted except for the computer lab assignment.

Graduate students also required to give a 30-40 min oral presentation (50 points).

**Office hours:** Wednesday 10-12 am, LSS 148. Or by appointment. MWF preferred.

### **Course Materials:**

Course Handouts will be posted prior to class on the Blackboard class site. All of you should receive an email about the course from Blackboard with instructions of how to access the class site.

The topics covered in each class may vary depending on how much we cover, but the exam dates are firm. Figures in handouts not specifically cited generally from either Branden and Tooze Introduction to Protein Structure or Petsko and Ringe Protein Structure and Function.

### **Exams:**

There will be three exams during the year, each covering the material in a portion of the lectures. The exams will be based on the material covered during class and will be closed books. The lecture notes, your class notes and the required readings should be sufficient to study for the exams. The material covered in student presentations will also be part of the third test. **There will be no retests, no extra credit or dropped exams.**

Only official UI excuses will be accepted for missing an exam (i.e. death in the family, orders from doctor or call to military service). In these cases, a retake will be administered during finals and it will be a comprehensive exam. Grading mistakes must be claimed within 1 week from when exam is returned.

### **Class ethics**

Plagiarism and cheating as defined in the UI student manual are not acceptable. First time will result in a 0 in your exam or assignment, second time will be grounds for a failing final grade. You may work together on

assignments but each of you must turn in work in your own words. If there is significant overlap/identity in answers, all students involved risk getting 0 points.

One of the biggest challenges for students trying to summarize scientific papers is avoiding plagiarism. For guidelines on what is and what is not plagiarism and examples of each, please see the following website. A PDF of this content is also posted on the class website. Every year students in my class receive zeros on some assignments due to plagiarism.

<http://ori.hhs.gov/avoiding-plagiarism-self-plagiarism-and-other-questionable-writing-practices-guide-ethical-writing>

## **Course structure and Main Topics**

### **Part 1**

Relationship between altered protein function and human disease  
Basics of protein structure, function and evolution  
Preface, Chapters 1-6

### **Part 2**

Method to study protein structure and function  
Enzyme kinetics  
Small molecular screens to identify modulators of protein function  
Introduction to bioinformatics and structure databases.  
Chapters 7-11

### **Part 3**

Bioinformatics of protein sequence and structure  
Computer lab to explore bioinformatics databases  
Computer lab to explore protein structure databases

### **Part 4**

Mechanisms of protein function  
Proteomics and systems biology  
Chapter 12

## **Learning Objectives: During this course, students will...**

Learn to recognize the relationships among gene sequences, amino acid sequences, protein structures and protein functions.

Appreciate how mutations may affect protein structure and function and lead to human diseases.

Recognize the importance of computing in protein science.

Be able to describe basic structural units of a protein and be familiar with methods to determine protein structure.

Learn the basic types of data and databases that support research in protein science.

Learn how evolutionary divergence of enzymes leads to proteins with new functions.

Learn basics of enzyme mechanisms and inhibitor development.

Learn methods for separation and analysis of proteins and analysis of protein-protein and protein-DNA interactions.

Gain a sense of what is meant by proteomics and systems biology.

## Syllabus for BIOL 482/582 Protein Structure and Function

Instructor: Jill Johnson

### Course Outline

Week of	Tuesday	Thursday
Aug 22	Overview Proteins and amino acids. Chapters 1 and 2.	Description of protein structure. Chapter 3 up to page 63
August 29	Chapter 3, Immunoglobulins and hemoglobins, with examples of how hemoglobins contribute to disease.	Chapter 4. Fibrous proteins and their link to diseases.
Sept 5	Importance of cofactors- Molybdenum cofactor deficiency. PKU. Assignment.	Chapter 5 Membrane proteins and protein sorting (part of Ch. 8, 11)
Sept 12	Chapter 6. Diversity of proteins	Examples of proteins, including those with dual function or two different structures.
Sept 19	<b>Exam 1</b>	Chapter 9. Protein expression, purification and characterization.
Sept 26	Chapter 10. Methods to determine protein structure.	Chapter 8. Protein synthesis, processing and turnover.
Oct 3	Chapter 11. Protein folding and misfolding.	Protein-DNA and protein-RNA interaction
Oct 10	CFTR mutations and treatment strategies, screens for small molecule modifiers. Assignment.	Enzyme kinetics
Oct 17	Chapter 7. Enzyme kinetics, more on small molecules like GLEEVEC and molecular graphics	<b>Exam 2</b>
Oct 24	<b>Computer lab.</b>	<b>Computer lab</b>
Oct 31	<b>Computer lab. (Jill gone)</b>	<b>Computer lab (Jill gone)</b>
Nov. 7	<b>Computer lab.</b>	<b>Computer lab assignments due .</b>
Nov 14	Summary of computer lab. Example of paper that uses many of techniques we've discussed.	Examples of ways to regulate protein function.
Nov 21	BREAK	BREAK
Nov 28	Proteins and systems biology	Proteins and disease. Ch. 12. <b>Assignment.</b>
Dec 5	Student presentations	Student presentations.
Dec 12	Exam 3 Monday Dec 12 3-5 pm.	

**Grading:** Three exams (including final)(100 points each), one big assignment based on computer labs (100 points). 75 points from other assignments. Exam 3 will include questions about the computer lab section.

This syllabus is a draft and will be updated throughout the semester, but exam dates are fixed.