

## Protein Biochemistry (BIOL4800/6800)

**PREREQUISITES:** BIOL2230, BIOL2270, CHEM1212 (from old B.S. curriculum) or BIOL1108, BIOL3200, CHEM1212 (from new B.S. and B.A. curricula) or permission of the instructor

**INSTRUCTOR:** Dr. Theresa Grove  
Office: BC 1099  
Office hours: Monday 3:00-5:00 p.m. or by appointment

**COURSE GOALS AND OBJECTIVES:** This class is designed to teach you an overview into the structure and function of proteins with emphasis on properties of amino acids, protein folding, protein-protein and protein-ligand interactions, enzyme kinetics, and enzyme regulation. The laboratory component will introduce you to many techniques that are not only used by researchers who study the structure and function of proteins, but by many other scientists in diverse fields of biology such as physiology, molecular and cell biology, population genetics and microbiology. By the end of the semester you will have:

- Gained knowledge of protein structure and function
- Maintained a comprehensive scientific notebook of techniques and results
- Learned experimental techniques used to study protein structure and function
- Strengthened your ability to critically read and understand scientific literature

These goals support the Department of Biology Education and VSU General Outcomes to:

- 1) Develop and test hypotheses, collect and analyze data, and present the results and conclusions in both written and oral formats used in peer-reviewed journals and at scientific meetings
- 2) Demonstrate an understanding of the cellular basis of life.
- 3) Relate the structure and the function of DNA/RNA to the development of form and function of the organisms.
- 4) Demonstrate knowledge of scientific and mathematical principles and proficiency in laboratory practices.

**TEXT BOOK:** Introduction to Peptides and Proteins (2010) by Ulo Langel et al. (ISBN 978-1-42000-6412-4)

**OTHER READING:** The textbook may be supplemented with other handouts.

**LECTURE:** Tuesday and Thursday 8:00-9:15 a.m. (BC 1024)

**LAB:** Thursday 11:00-1:50 p.m. (BC 2070) Bring a notebook, calculator and flash drive.

**ATTENDANCE:** Attendance in lecture is expected by all students. Attendance in laboratory is mandatory; see lab policy below.

**ACCESS TO SLIDES/INFORMATION:** Lecture slides will be made available on BlazeView by 5:00 p.m. the day before lecture. These slides will not have all the information on them; it is the student's responsibility to come to class and take notes. Students are responsible for getting the notes from other students if they miss a lecture. The professor will not email slides that when students miss a lecture.

**LECTURE CONDUCT:**

- Arrive on time.
- Turn off cell phones during class and lab; there is no reason you should be texting or calling anyone.
- Don't talk during lecture; if you don't understand something or didn't hear something ask.
- Unless it's an emergency (and using your cell phone does not constitute an emergency) do not get up in the middle of lecture, leave and come back.
- Do not leave class early unless you have informed me prior to the start of the class or if it's an emergency.
- During exams NOBODY can leave the exam and re-enter the exam room. If a student leaves, their exam will be graded as is; the student will not be allowed to finish the exam.

**WITHDRAWING FROM THE COURSE:** The last day to withdraw without penalty is March 3, 2010. If you don't officially withdraw, and instead just stop coming to class, you will receive an F for the course.

**ACADEMIC CONDUCT:** Cheating and plagiarism will not be tolerated and may result in a failing grade for the assignment, exam or the class. The Department of Biology has a plagiarism policy on their website; it is your responsibility to make sure you read it and understand it.

**PRIVACY ACT (FERPA):** The Family Educational Rights and Privacy Act (FERPA) prohibits the public posting of grades by social security number or in any manner personally identifiable to the individual student. No grades can be given over the telephone or over email because positive identification can't be made.

**STUDENTS WITH DISABILITIES:** Students requiring special accommodations because of disability must discuss their needs with me as soon as possible. Those needing accommodations who are not registered with the Special Services Program must contact the Access Office for Students with Disabilities located in Farber Hall. The phone numbers are 245-2498 (voice) and 219-1348 (tty).

**PRESENTATIONS:** Students are required to read current scientific literature. Each student will present one paper during a 15 minute presentation. The presenter must create powerpoint slides for the presentation that will include: 1) the general purpose of the paper that includes a brief introduction (this will require some background reading) and why this research was done; 2) the specific hypotheses tested; 3) materials and methods explanation (i.e. how they tested their hypothesis); 4) the results (you must walk the class through the data/graphs/charts etc. and explain them); 5) the discussion that includes if the author's results support the hypothesis(es)? During the presentation you will be evaluated on your apparent understanding of the paper, your explanation, critical thinking and your ability to answer questions. No, I do not expect the presenter to be able to answer every single question about the topic at hand, but he/she must have a thorough understanding of his/her paper. So everyone knows what I am expecting in a presentation, I will do the first one at the end of February during lecture.

At the end of the presentation there will be a 5 minute question period. The speaker will be evaluated in their ability to answer questions. The other students must come prepared to participate in the discussion. Therefore, every student is required to come up with a question on each paper to ask the presenter. These questions will be turned into me at the beginning of the presentation (so make sure you remember your question) and will count towards your final grade. The quality of the question will be evaluated: 1 point = good try, but the answer could be found relatively easily if looked up (i.e. in the paper itself- it was just overlooked or a textbook); 2 points = good question, shows understanding of the topic and/or method and involves critical thinking. Topics/papers will be available in February. Presentations will be given during lab periods at the end of the semester.

**LAB NOTEBOOK:** Students must keep a research notebook. It can be a spiral bound notebook or any other type of composition notebook; binders are not allowed. The notebooks must have a table of contents on the first page. During each lab period you will include the date, purpose of the experiment, protocol you follow (fill in as you go along during lab; you cannot paste lab handouts in your notebook), results, and analysis of results. Notebooks are normally not perfectly neat (no recopying after lab). There is no printer in lab, so everyone should either be prepared to email themselves any spreadsheets or graphs or bring a flash drive with them to lab. Data analysis will occur (usually) in lab; bring a calculator to lab. You will be able to use your notebooks for the lab exams.

**LECTURE EXAMS:** The dates for the exams are included in the Tentative Class Schedule. Note, that these are TENTATIVE, therefore the professor reserves the right to adjust the dates of the exams. Three exams (excluding the final) will be given throughout the semester. Each exam will be worth 100 points and will consist of a variety of types of questions that will include (but aren't limited to) matching, multiple choice, labeling, fill in the blank, and short answer. During the exam all cell phones must be turned off. Exams will not be handed back.

It is the instructor's prerogative to accept (or not accept) an excuse for a missed exam; therefore, **DO NOT MISS EXAMS!** Make-up exams are available for students with approved reasons, but these exams will be more challenging than the original exam, and the format may also be different (i.e. an oral exam). Students must contact me via email on the day of the exam for approval (**NO PHONE CALLS**) and are required to make-up the exam within 2 days of the missed exam, except under extreme circumstances. The professor reserves the right to not approve a missed exam as well as to require documentation of the reason why the exam is missed. Only students with a University related excuse may take an exam early.

**LAB EXAMS:** Two lab exams (50 points each) will be given throughout the semester. These exams will test you over the practical side of protein biochemistry and what you did in lab. These will be open notebook (handouts cannot be used).

**FINAL:** The final will be cumulative and worth 200 points. The date of the final is Wednesday, May 4 (10:15 a.m. -12:15 p.m.). **NO EARLY EXAMS WILL BE GIVEN!**

**GRADUATE STUDENTS:** Graduate students will write a 7 page paper on a protein of their choice. The due date is March 22. A separate handout will be given.

### **LAB CONDUCT**

- Arrive on time.
- Assignments are collected at the start of lab; they will not be accepted >15minutes late. Emailed assignments will not be accepted.
- You must keep a lab notebook. The notebook will help you study for the practicals AND all lab practicals will be open notebook.
- No eating or drinking during the lab.
- Attendance to lab is mandatory. Excused absences are usually given for medical emergencies and documentation must be provided; the professor determines whether or not an absence is "excused" or not. If a student misses three labs for any reason the student cannot earn higher than a D for his/her final grade. Labs cannot be made up outside of scheduled laboratory sessions. Students are responsible for learning all lab content from missed labs.
- Students must take care of lab equipment. Notify the professor if something is not working properly or if something breaks during the course of the lab.
- Labs will be handed out at the start of each lab.
- Cell phones are not allowed to be used in lab with the exception of using them as timers.

<b>ASSESSMENT:</b>	Exams (3 exams; 100 points each)	300 points
	Lab exams (2 exams; 50 points each)	100 points
	Journal Article Presentations	50 points
	Homework and other Assignments (Graduate Student Paper)	~50 points (50 points)
	<b>Total Points = 500 (Graduate Students = 550)</b>	

**GRADE SCALE:** For all students, grades will be based on the above assessments. The grading scale I will use is:

A	90-100%
B	80-89
C	70-79
D	60-69
F	<60

### **TENTATIVE LAB SCHEDULE**

#### **January**

- 13 No lab
- 20 Making solutions and buffers  
Principles of sample homogenization and cell fractionation
- 27 Protein assays and standard curves

#### **February**

- 3 Protein electrophoresis and Western blot (transfer)
- 10 Western blot (cont'd)  
Transformation of green fluorescent protein (GFP)
- 17 Determine transformation efficiency of GFP and replat  
Size exclusion chromatography
- 24 GFP purification and electrophoresis  
Pour affinity column for LDH purification

#### **March**

- 3 **Lab Exam**
- 10 Examine GFP gel and determine size of GFP  
Purify lactate dehydrogenase from muscle and enzyme assay of LDH (freeze samples)
- 17 **No lab Spring Break**
- 24 Protein assay of fractions containing LDH and electrophoresis to examine purity
- 31 Biofuel lab and enzyme characterization

#### **April**

- 7 RNAi  
Immunology  
Presentations
- 14 RNAi cont'd  
Presentations
- 21 Presentations
- 28 **Lab Exam**

## TENTATIVE LECTURE SCHEDULE

### January

- 11 Introduction and Overview of course
- 13 Chapter 1: Amino Acids (pp. 5-20)
- 18 Amino Acid Structure (cont'd)
- 20 Chapter 2: Noncovalent Interactions (pp. 21-34)
- 27 Chapter 3: Structural Organization of Proteins (pp. 35-57)

### February

- 1 Structural Organization of Proteins (cont'd)
- 3 Catch-Up and Review
- 8 **Exam 1**
- 10 Chapter 4: Biosynthesis of Proteins Biosynthesis of Proteins (pp. 61-80)
- 15 Biosynthesis of Proteins Biosynthesis of Proteins (cont'd)
- 17 Chapter 5: Posttranslational Modifications Review (pp. 81-97)
- 22 Chapter 6: Protein Folding (pp. 101-121)
- 24 Chapter 7: Intracellular Sorting of Proteins (pp. 123-134)

### March

- 1 Intracellular Sorting of Proteins (cont'd)
- 3 Chapter 8: Protein Turnover (pp. 317-143)
- 8 **Exam 2** (This Exam may be pushed back to March 10)
- 10 Chapter 21: Enzymes (pp. 283- 311)
- 15 No class spring break
- 17 No class spring break
- 22 Enzymes (cont'd)
- 24 Chapter 22: Nucleic Acid-Binding Proteins (pp. 313-322)  
Chapter 23: Cell Surface Receptors and Signaling (pp. 323-335)
- 29 Chapter 24: Membrane Proteins (pp. 337-341)  
Chapter 25: Antibodies (pp. 343-354)  
Chapter 26: Fibrous Proteins (pp. 355-364)
- 31 Control of Protein Function (Handout)

### April

- 5 Control of Protein function (cont'd)
- 7 **Exam 3**
- 12 Methods to Study Proteins (select pages from Chapters 9-20)
- 14 Methods to Study Proteins (cont'd)
- 19 Methods to Study Proteins (cont'd)
- 21 Chapter 28: Misfolding-Based Diseases (pp.381-388)  
Chapter 29: Miscalcavage-Based Diseases (pp.389-399)
- 26 Chapter 30: Missequence-Based Diseases (pp. 395-399)  
Chapter 31: Peptides and Proteins as Drugs (pp. 401-413)
- 28 Catch-Up and Review