



Biochemistry 601: Structure and Function of Proteins

Credits: 2

Course Designations and Attributes:

- Breadth - Physical Science counts towards the Natural Science requisite
- Level - Advanced
- L&S Credit - Counts as Liberal Arts and Science credit in L&S
- Grad 50% - Counts toward 50% graduate coursework requirement

Time: Lectures on Tuesdays and Thursdays at 9:55 AM (Nutritional Sciences, Room 290).

Instructional Mode: Face-to-face with lectures

How Credit Hours are Met by the Course:

- Two hours (i.e. 50 minutes) of classroom with direct faculty instruction and a minimum of four hours of out of class student work each week over approximately 14 weeks

Instructors:

- Professor Hazel M. Holden
- Professor Ivan Rayment
- Dr. Nathan Wlodarchak

Instructor Availability:

- Immediately after class or by appointment

Instructor Email/Preferred Contact:

- Room 3424A BSB, phone: 262-4988 Hazel_Holden@biochem.wisc.edu
- Room 3424B BSB, phone: 262-0437 Ivan_Rayment@biochem.wisc.edu

Official Course Description:

- Protein structure and function.
- Organic chemistry of enzymatic catalysis.
- Analysis of enzyme kinetics and receptor-ligand interactions.
- Enzymatic reaction mechanisms.

Prerequisites:

- CHEM 345 and BIOCHEM 501 or 507

Course Learning Outcomes:

Overview: The goal of this course is to provide an overview of the properties of proteins. In particular, the course covers the fundamentals of protein structure and stability and the role of proteins as catalysts. At the end of the course the students will be able to apply their knowledge and understanding for critically evaluating primary biochemical literature relating to protein structure, protein folding, enzyme catalysis and mechanisms, and receptor-ligand interactions.

Specific Learning Outcomes:

- Understand basic stereochemical principles of protein components
- Understand the chemistry of the amino acids
- Understand the noncovalent forces that control the secondary and tertiary structure of proteins
- Understand the fundamental strengths and weaknesses of structures determined by X-ray crystallography and electron microscopy
- Understand chemical kinetics as they apply to enzymes
- Understand the role of cofactors in enzyme chemistry
- Understand the fundamental underpinnings of protein stability, protein evolution, and their application to protein engineering by site-directed mutagenesis
- Understand the key features of representative enzyme families including the ATPases and the peptidases
- Understand the differences and unique properties of membrane proteins
- To be able to critically read the primary biochemical literature regarding protein structure, function, and enzyme catalysis

Grading:

- Three exams (100 points each), one PyMOL assignment (50 points), four reading assignments (25 points each) and one kinetic problems assignment (50 points).
- The total number of points is 500.
- The final grades are curved.
- Attendance is part of the grading.

Required Textbook, Software & Other Course Materials:

- There is no required text book, though examples of useful reference books will be listed as appropriate to the material under consideration. PDFs of the introductory materials will be provided on-line through Canvas.

Exams, Quizzes, Homework, & Other Graded Assignments:

- There will be three exams. The first two will occur during the class period at the times defined in the course outline at the end of this document. The final exam will be given during the official end-of-term examination period (TBD). The exams are not cumulative. The exams will be closed-book with no access to electronic devices. Each exam will be worth **100 points**.
- There will be four assignments that will focus on critical reading of the primary biochemical literature. The first two assignments will be handed-in at the time of the second exam. The third and fourth assignments will be handed-in on the last day of class. *All submissions must be typed*. Each reading assignment will be worth **25 points**.
- There will be a PyMOL homework assignment that is directed at learning to critically assess the quality of molecular structures. The software is available for free from DoIT. This assignment will be completed and submitted as a hard copy or on-line through Canvas prior to the second exam. This homework is worth **50 points**.
- There will be a homework assignment directed towards learning enzyme kinetics. A hard copy of the answers to these questions will be submitted in-class prior to the second exam. Answers to the kinetic problems must be logical and legible. This homework is worth **50 points**.

Preliminary Outline of Lectures for Fall 2018

Lecture	Instructor	Date
Basic Stereochemistry of Protein Components	Holden	Sept. 6
Chemical Properties of the Amino Acids	Holden	Sept. 11
Chemical Properties of the Amino Acids	Holden	Sept. 13
Noncovalent Forces and Protein Conformation	Holden	Sept. 18
X-ray Crystallography for Dummies	Holden	Sept. 20
X-ray Crystallography for Dummies	Holden	Sept. 25
Cryo-Electron Microscopy	Rayment	Sept. 27
Tertiary Structure	Holden	Oct. 2
Exam No. 1		Oct. 4
Tertiary Structure - continued	Wlodarchak	Oct. 9
Post-translational modifications	Wlodarchak	Oct. 11
Quaternary Structure	Rayment	Oct. 16
Kinetics	Holden	Oct. 18

Kinetics	Holden	Oct. 23
Catalysis	Holden	Oct. 25
Catalysis	Holden	Oct. 30
Peptidases	Holden	Nov. 1
ATP-Dependent Enzymes	Rayment	Nov. 6
First reading assignment, PyMOL assignment, and kinetic problems are due on November 6th		
Exam No. 2	Nov. 8	
Cofactors/Coenzymes	Holden	Nov. 13
Cofactors/Coenzymes	Holden	Nov. 15
Protein Stability	Rayment	Nov. 20
Consequences of Site-Directed Mutagenesis	Rayment	Nov. 27
Protein Evolution	Rayment	Nov. 29
Membrane Proteins	Rayment	Dec. 4
What Can Go Wrong in an X-ray Analysis	Holden	Dec. 6
Why Take Biochemistry 601?	Holden	Dec. 11
Second reading assignment is due on December 11th		
Exam No. 3		TBD

Academic Integrity:

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity/.

Accommodations for Students with Disabilities:

McBurney Disability Resource Center Syllabus Statement: "The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform Professor Holden of their need

for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Professor Holden will work either directly with the student or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA." <http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php>

Diversity & Inclusion:

Institutional Statement on Diversity: "Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals."

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world." <https://diversity.wisc.edu/>