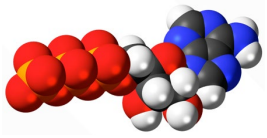
WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

Survey of Biochemistry
BIOCHEM 301 - 3 CREDITS - SPRING 2020

Course Description: Explore the basic chemical properties of proteins, lipids, carbohydrates, and nucleic acids. Topics to be discussed include protein structure and function, the chemical logic of metabolism, and the mechanisms of DNA replication, DNA transcription, DNA repair, and gene expression. At the course's conclusion, students will understand principles and themes in biochemistry that relate to metabolic diseases, drug design, virus infection and vaccination, and gene therapy. Designed for students (non-biochemistry majors) who intend to take a single course in biochemistry for their particular major or for general interest.

Course Designations:

- Breadth – Biological Science
- Level - Intermediate
- L&S Credit - Counts as Liberal Arts and Science credits



adenosine triphosphate (ATP)

Lectures: Monday, Wednesday and Friday, 1:20 PM – 2:10 PM
Room TBD

Lecture PowerPoint presentations will be posted on the BIOCHEM 301 website at Canvas. Taking careful classroom notes by using these handouts and reviewing material outside of class will be essential. The PowerPoint presentations are not intended to substitute for the lectures nor will they include every detail discussed in class. Regular attendance is required and necessary for success.

Credit Hours: This class meets for three 50-minute class periods each week. It is expected that students will work on course learning activities (textbook readings, assigned problem sets, exam preparation, and review sessions) for about two hours outside of class for every class period. Additional information relevant to class periods and expectations for student work are described below.

Instructional Mode: Face-to-face

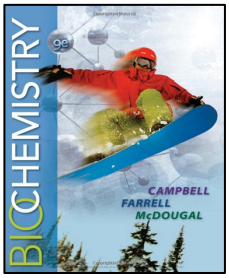
Learning Outcomes: By semester's end, students will be able to:

- Apply basic concepts of protein and enzyme structure and function
- Differentiate structures of lipids and their biochemical roles
- Differentiate structures of carbohydrates and their biochemical roles
- Differentiate structures of nucleic acids and their biochemical roles
- Apply chemical concepts involved in both anabolic and catabolic pathways
- Explain basics of gene expression and regulation
- Describe fundamentals of cancer and certain viral diseases

Prerequisites: Important for student success and progress is basic knowledge of introductory chemistry, including Chemistry 104, 109, or 116 that has introduced fundamental chemical principles. No previous coursework in organic chemistry is required. Students with credit for BIOCHEM 501 may not enroll in BIOCHEM 301.

Course Website: The Canvas website for BIOCHEM 301 contains a wealth of information, including the course syllabus, the lectures (PowerPoint presentations), lecture handouts, problem sets, problem set answers, practice exams, and study guides. We encourage you to visit Canvas often, offer feedback, and start discussion groups if interested (optional). The website is updated every class.

Required Textbook: ***Biochemistry***, 9th Edition, 2018. M.K. Campbell, S.O. Farrell, O.M. McDougal. Cengage Learning. ISBN 978-1-305-96113-5.



This textbook is designed for students in any field of science, agriculture, or medicine who want a one-semester introduction to biochemistry, but are not biochemistry majors. It is available for purchase, rental, or as an eBook. Limited copies are available at Steenbock Library Reserves Desk. It is an excellent reference for concepts covered in lecture, even though it goes into more detail than required. Many figures used in class are adapted from this textbook.

Exams: All examinations must be taken in this course (see schedule below). Make-up exams are discouraged and will be given only under extraordinary circumstances. Missed exams will be allowed only if written notice of a conflict or illness is given to the instructor 24 hours prior to the exam. There will be no early final exam given in this course.

Grades: A student's final grade will be based on the following point system and curved grading:

		POINTS
1.	Two one-hour exams (100 points each)	200
2.	Final exam	100
3.	Problem sets	100
	TOTAL:	400

A = 90 – 100%
AB = 86 – 89.9%
B = 80 – 85.9%
BC = 76 – 79.9%
C = 65 – 75.9%
D = 55 – 64.9%
F = 0 – 54.9%

After the final exam is graded, the instructors may apply a curved grading scheme to the final grade percentages to ensure an equitable distribution of grades. However, students should be reassured that their final grade will not be lower than the grading scale above. Application of a grading curve, if used, will not lower a student's grade; it will only raise it. The grading distribution applied is:

A = 25%
AB = 10%
B = 25%
BC = 10%
C = 25%
D or F = 5%

Exam Regrading Policy: If you have questions concerning a grade or score on an exam, please see your instructor promptly. If you desire to have the exam regraded, you must return it to the instructor within one week of taking the exam. Your graded exam must be accompanied with a written description of the perceived problem, which is to be stapled to the front page of the exam. In such cases, the entire exam will be regraded.

Problem Sets: A total of 10 problem sets will be given throughout the course. Printed copies will be provided in class and electronic copies can be downloaded from the BIOCHEM 301 website at Canvas. The problem sets must be completed by each individual student and returned to the instructor on the indicated due date to receive full credit. Although students are encouraged to work in groups, identical group answers are not acceptable. The problem sets are designed to facilitate student understanding of course information. The instructors will discuss the answers at discussion sessions, if appropriate. The answer key to each problem set will be posted on the BIOCHEM 301 website after the date by which it is due.

Discussions: In class discussion sessions for BIOCHEM 301 will be included as needed throughout the course, 1:20-2:10 PM in our lecture hall, Biochemistry Room TBD. Part of your grade will be based on the completion of problem sets. Your instructors will lead a discussion about the assigned problem sets and answer general questions on the lecture material. NOTE: each instructor will also be available for office appointments should you desire to meet individually to discuss class material.

Instructor Availability: Your instructors will be present immediately after class or by appointment (see contact information below).

Instructors:

Paul Friesen

Professor-Dept. of Biochemistry & Institute for Molecular Virology
Office: 721 Bock Labs
Phone: 262-7774
Email: pfriesen@wisc.edu

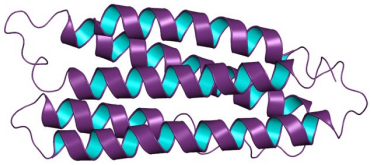
Hazel M. Holden

Professor – Dept. of Biochemistry

Office: 3424A BSB
Phone:262-4988
Email: Hazel_Holden@biochem.wisc.edu

Ivan Rayment

Professor – Dept. of Biochemistry
Office: 3424B BSB
Phone: 262-0437
Email: Ivan_Rayment@biochem.wisc.edu



apolipophorin

Materials on Reserve: Various course-related materials will be placed on reserve at Steenbock Library (Babcock and Observatory Drive). These resources include the recommended textbook and other useful reading materials.

Rules, Rights & Responsibilities

See the Guide's Rules, Rights and Responsibilities

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 integrity. 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 are 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 and Inclusion:

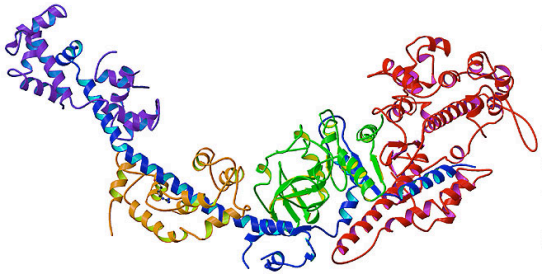
Institutional Statement on Diversity: "Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. 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/

Course Schedule:

Part 1. Introduction to Biochemistry: Protein Composition, Structure, and Function.

The first section will introduce you to proteins and lipids. This simple knowledge underlies all of biochemistry. The goal is not to insist on memorizing a bunch of boring tedious facts, but rather one of obtaining insight into the chemistry that connect atoms to life.



Myosin: a molecular motor that converts chemical energy into directed movement

CLASS	Date	Topic	Instructor	Suggested Reading
1	Jan 22	Introduction	Rayment/Holden	Chapter 1
2	Jan 24	Chemistry	Holden	
3	Jan 27	Water-buffers (problem set 1)	Rayment	Chapter 2
4	Jan 29	Amino acids	Rayment	Chapter 3
5	Jan 3	Protein structure	Rayment	Chapter 4
6	Feb 3	Hemoglobin (problem set 2)	Rayment	
7	Feb 5	Protein function	Rayment	Chapter 6
8	Feb 7	Enzyme structure	Rayment	Chapter 7
9	Feb 10	Enzymes (problem set 3)		
10	Feb 12	Lipids and Membranes	Rayment	Chapter 8
11	Feb 14	Membrane proteins	Rayment	Chapter 8
12	Feb 17	Review (problem set 4)	Rayment	
13	Feb 19	**EXAM #1**		

Part 2. Biochemistry of Metabolism: Catabolic and Anabolic Pathways

Oftentimes the topic of metabolic pathways sends shivers down even the most seasoned biochemists, and rightly so. It is too often presented in an utterly boring manner that divorces these important pathways from daily human experience. Indeed, it is sometimes nearly impossible to see the forest through the trees. The goal of this section is to provide a fundamental biochemical framework to allow you to see that forest and yet to appreciate and marvel at the chemical complexities required for life.

human galactokinase

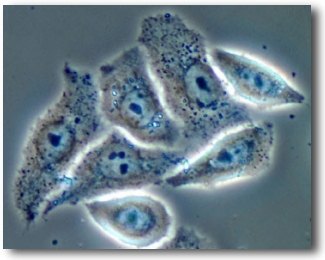
CLASS	Date	Topic	Instructor	Suggested Reading
14	Feb 21	Carbohydrates	Holden	Chapter 16
15	Feb 24	Carbohydrates	Holden	
16	Feb 26	Glycolysis (problem set 5)	Holden	Chapter 17
17	Feb 28	Glycolysis	Holden	Chapter 17
18	Mar 2	Citric acid cycle	Holden	
19	Mar 4	Citric acid cycle	Holden	Chapter 20
20	Mar 6	Electron transport	Holden	Chapter 20
21	Mar 9	Electron transport (problem set 6)	Holden	Chapter 20
22	Mar 11	Lipid metabolism	Holden	Chapter 21
23	Mar 13	Lipid metabolism	Holden	Chapter 21
Mar 14- 22	**-----SPRING BREAK-------**			
24	Mar 23	Storage mechanisms (problem set 7)	Holden	
25	Mar 25	Nitrogen metabolism	Holden	Chapter 18
26	Mar 27	Nitrogen metabolism	Holden	Chapter 23
27	Mar 30	Review	Holden	
28	Apr 1	**EXAM #2**	Holden	

Part 3. Biochemistry of DNA, Gene Expression, Viruses, and Cancer

Genes encode proteins that form the basis of all metabolic pathways in the body. The timing and level of gene expression must be carefully regulated. When genes are improperly turned on or off there are severe consequences (diseases). In this last section, we will discuss the structure of genes, how they are regulated, and the dire effects of gene mutations that cause diseases like cancer. We will learn how viruses usurp the host's cell own machinery to multiply and cause life-threating diseases, including AIDS and cancer. Effective therapeutic treatments depend on understanding basic biochemical principles in gene expression and protein function.

Class	Date	Topic	Instructor	Suggested Reading
29	April 3	The nature of nucleic acids & gene organization	Friesen	Chapter 9
30	April 6	DNA replication	Friesen	Chapter 10
31	April 8	Discussion (problem set 8)	Friesen	
32	April 10	RNA synthesis	Friesen	Chapter 11
33	Apr. 13	The genetic code & protein synthesis	Friesen	Chapter 12
34	Apr. 15	Discussion (problem set 9)	Friesen	
35	Apr. 17	Regulation of gene expression	Friesen	Chapter 11
36	Apr. 20	Biochemistry of viruses	Friesen	Chapter 14
37	Apr. 22	Discussion (problem set 10)	Friesen	
38	Apr. 24	Viral diseases & vaccines: Influenza and HIV	Friesen	Chapter 14
39	Apr. 27	Biochemistry of cancer - I	Friesen	
40	Apr. 29	Biochemistry of cancer – II & Gene therapy	Friesen	Chapter 13, 14
41	May 1	Discussion and Course Review	Friesen	

FINAL EXAM (Time, Room, Bldg. to be announced)



HeLa cells (cancer)