



Survey of Biochemistry **BIOCHEM 301 - 3 CREDITS - SPRING 2023**

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. This course is not meant to fulfill the needs of pre-med and pre-vet students.

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: Microbial Sciences Building 1420

Lecture PowerPoint presentations will be posted on the BIOCHEM 301 website at <https://canvas.wisc.edu/courses/344301>. 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: in person

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

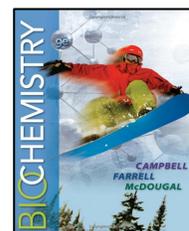
- Apply basic concepts of protein and enzyme structure and function
- Differentiate structures of lipids and their biochemical roles
- Differentiate structures of carbohydrates and their biochemical roles
- Differentiate structures of nucleic acids and their biochemical roles
- Apply chemical concepts 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:

		<u>POINTS</u>	
1.	50-minute exam	100	
2a.	50-minute exam	65	
2b.	50-minute exam	65	
3.	Final Exam	100	
4.	Quizzes/Problem Sets	70	
		<u>TOTAL</u>	400
		<u>POINTS</u>	

A	= 90 – 100%
AB	= 86 – 89.9%
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/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. In such cases, the entire exam will be regraded.

Quizzes/Problem Sets: A total of four quizzes (10 points each) will be given in the first two-thirds of the course. The quizzes must be completed by each individual student and submitted to Canvas on the indicated due date to receive full credit. During the last third of the course (Friesen), three Problem Sets (10 points each) will be assigned. Copies will be provided in class and can be downloaded from the BIOCHEM 301 website at Canvas. 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 answer key to each problem set will be posted on the BIOCHEM 301 website after the date by which it is due. In addition, the answers will be discussed during discussion hours.

Discussions: In class discussion sessions for BIOCHEM 301 will be included as needed throughout the course. 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 available immediately after class or by appointment (see contact information below).

Instructors:



Paul Friesen

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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.

Course Evaluations:

UW-Madison uses a digital course evaluation survey tool called [AEFIS](#). For this course, you will receive an official email two weeks prior to the end of the semester, notifying you that your course evaluation is available. In the email you will receive a link to log into the course evaluation with your NetID. Evaluations are anonymous. Your participation is an integral component of this course, and your feedback is important to the instructors. We strongly encourage you to participate in the course evaluation.

Rules, Rights & Responsibilities

Please see the following link:

<https://guide.wisc.edu/undergraduate/#rulesrightsandresponsibilitiestext>

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, please refer to <https://conduct.students.wisc.edu/academic-misconduct/>

Use of Lecture Materials:

Lecture materials and recordings for this course are protected intellectual property at UW-Madison. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record our lectures without our permission unless you are considered by the university to be a qualified student with a disability requiring accommodation [[Regent Policy Document 4-1](#)]. Students may not copy or have lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the

instructor's express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university's policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

Accommodations for Students with Disabilities:

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 ([UW-855](#)) require the university to provide reasonable accommodations to students with disabilities to access and participate in its academic programs and educational services. Faculty and students share responsibility in the accommodation process. Students are expected to inform faculty Dr. Rayment of their need for instructional accommodations during the beginning of the semester, or as soon as possible after being approved for accommodations. The course faculty will work either directly with the student or in coordination with the McBurney Center to provide reasonable instructional and course-related accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. (See: [McBurney Disability Resource Center](#))

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." Please see <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 tedious facts, but rather one of obtaining insight into the chemistry that connect atoms to life.

CLASS	Date	Topic	Instructor	Suggested Reading
1	Jan 25	Introduction	Rayment	Chapter 1
2	Jan 27	Chemistry	Rayment	
3	Jan 30	Water-buffers (Quiz 1)	Rayment	Chapter 2
4	Feb 1	Amino acids	Rayment	Chapter 3
5	Feb 3	Protein structure	Rayment	Chapter 4
6	Feb 6	Hemoglobin (Quiz 2)	Rayment	
7	Feb 8	Protein function	Rayment	Chapter 6
8	Feb 10	Enzyme structure	Rayment	Chapter 7
9	Feb 13	Enzymes (Quiz 3)		
10	Feb 15	Lipids and Membranes	Rayment	Chapter 8
11	Feb 17	Membrane proteins	Rayment	Chapter 8
12	Feb 20	Membrane Proteins and Review (Quiz 4)	Rayment	
13	Feb 22	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.

CLASS	Date	Topic	Instructor	Suggested Reading
14	Feb 24	Carbohydrates	Holden	Chapter 16
15	Feb 27	Carbohydrates	Holden	
16	Mar 1	Glycolysis	Holden	Chapter 17
17	Mar 3	Glycolysis	Holden	Chapter 17
18	Mar 6	Citric acid cycle	Holden	
19	Mar 8	Citric acid cycle/ electron transport	Holden	Chapter 20
20	Mar 10	Electron transport	Holden	Chapter 20
March 11- 19 -----SPRING BREAK-----				
21	Mar 20	Lipid transport	Holden	Chapter 20
22	Mar 22	Exam #2a Normal Class Period	Holden	
23	Mar 24	Lipid metabolism	Holden	Chapter 21
24	Mar 27	Lipid metabolism	Holden	Chapter 21
25	Mar 29	Storage mechanisms	Holden	
26	Mar 30	Nitrogen metabolism	Holden	Chapter 18
27	Apr 3	Nitrogen metabolism	Holden	Chapter 23
28	Apr 5	Exam #2b Normal Class Period	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-threatening 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 7	The Nature of DNA and genes	Friesen	Chapter 9
30	April 10	DNA replication and repair	Friesen	Chapter 10
31	April 12	RNA synthesis: transcription – Part I	Friesen	
32	April 14	RNA synthesis: transcription – Part II	Friesen	Chapter 11
33	Apr. 17	Protein synthesis: translation – Part I	Friesen	Chapter 12
34	Apr. 19	Protein synthesis: translation - Part II	Friesen	
35	Apr. 21	Regulation of gene expression – I	Friesen	Chapter 11
36	Apr. 24	Regulation of gene expression – II	Friesen	
37	Apr. 26	Biochemistry of viruses – Part I	Friesen	Chapter 14
38	Apr 28	Biochemistry of viruses – Part II	Friesen	
39	May 1	Antiviral drugs and viral vaccines	Friesen	
40	May 3	Biochemistry of cancer – Part I	Friesen	Chapter 13-14
41	May 5	Biochemistry of cancer – Part II	Friesen	

Final day of Class: May 5th (Friday)

Final Exam: May 12, 7:45 – 9:45 AM. Date and room to be confirmed.