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Fall 9-1-2021

BCH 480.01: Advanced Biochemistry I

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Recommended Citation

Bowler, Bruce E., "BCH 480.01: Advanced Biochemistry I" (2021). *University of Montana Course Syllabi*. 12129.

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Course Goals: BCH 480 lays the foundation for understanding the chemistry of life. The main goal of this course is to understand how small molecules (amino acids, nucleic acids, lipids, sugars) are assembled into intricately structured macromolecules (proteins, RNA and DNA) or macroscopic structures (membranes). The course aims to develop an understanding of the physical and chemical basis for the assembly of these complex structures, which are responsible for life. The course ends with a study of the process by which stored information (DNA) is first transcribed into RNA and then translated into proteins via the genetic code. BCH 480 provides the basis for understanding catabolic and anabolic metabolism and the means by which living organisms communicate with their environment. These topics will be the heart of BCH 482, Advanced Biochemistry II.

Meeting time: 10:00 – 10:50 am, MWF in UH 210

Instructor: Bruce Bowler, Chem 310, 406-243-6114, bruce.bowler@umontana.edu

Office Hours: MW 11 – 12 and Th 1 – 2 pm Chem 310, or by appointment (Masks required).

Text: Garrett and Grisham *Biochemistry*, 4th, 5th or 6th edition may be used. Assigned homework problems will be from the 4th edition.

Course website: [Moodle](#)

Evaluation:	a) Three 2-hour midterm exams – 200 points each (lowest midterm score is dropped)	50%
	b) Four in-class quizzes – 50 points each	25%
	c) 2-hour final exam – 200 points	25%

Course Content and Exam Date Overview:

Topic	Text Chapter
Overview	1
Properties of Water	2
Thermodynamics of Life	3
Quiz 1 (Wednesday, Sept. 15, in class; Chapters 1 – 3)	
Amino Acids	4
Proteins: Primary Structure, Purification, Analysis	5
Quiz 2 (Friday, Oct. 1, in class; Chapters 4 – 5)	
Proteins: Secondary, Tertiary and Quaternary Structure	6
Exam 1 (Tuesday, Oct. 5, 7 – 9 pm, Chapters 1 – 5, 6.1 – 6.3)	
Carbohydrates	7
Lipids	8
Quiz 3 (Friday, Oct. 22, in class; Chapters 6.4, 6.5, 7, 8, 9.1)	
Membranes and Membrane Transport	9
Exam 2 (Tuesday, Nov. 2, 7 – 9 pm, Chapters 6.4, 6.5, 7 – 9)	
Nucleotides and Nucleic Acids	10
Nucleic Acid Structure	11
Recombinant DNA	12
DNA Replication, Recombination and Repair	28
Quiz 4 (Friday, Nov. 19, in class; Chapters 10 – 12, 28.1 – 28.2)	
Transcription and Regulation of Gene Expression	29
Exam 3 (Tuesday, Dec. 7, 7 – 9 pm, Chapters 10 – 12, 28, 29)	
Protein Synthesis	30
Final Exam (Comprehensive, Wednesday, Dec. 15, 8:00 – 10:00 am, UH 210)	

Course Information:

Prerequisites: Biochemistry is a subdiscipline of chemistry. Therefore, students need strong preparation in the basic physical and chemical principles presented in **College Chemistry** and the structure and reactivity of carbon compounds covered in **Organic Chemistry**. Students who are less well prepared in these prerequisites will be expected to review material from general and organic chemistry as needed, so that they can master the material in BCH 480.

Requirements: A detailed schedule of topics and readings is provided below. Students should study all assigned reading in the text carefully prior to the corresponding lectures. Selected problems from the end of each chapter will be assigned each week to aid in learning the material covered in the lecture. Answers will be provided on Moodle. Similar questions could appear on quizzes or exams.

Quizzes and Exams: There are 4 in-class quizzes on the dates listed in the overview and detailed schedules. ***If you miss an in-class quiz, you will receive a zero for that quiz.*** Midterm exams will be held at 7 pm on three evenings during the semester (see overview and detailed class schedule). The midterm exams are scheduled in the evening to allow students more time (two hours) to complete the exams (if you work or have other evening obligations please make appropriate arrangements). Even though the lowest of your three midterm exam scores will be dropped, it is to your advantage to take all midterm exams even if you are satisfied with your first two midterm scores. ***Because your lowest exam score will be dropped, there will be no makeup exams.*** The final exam is **comprehensive**. If you have a legitimate conflict with an exam/quiz date (travelling with a varsity team, religious holiday, etc.), you must inform the instructor ***at least 1 week before*** the exam/quiz to make alternate arrangements.

Graduate Increment: For graduate student taking BCH 480 for graduate credit, there will be a two part graduate increment. The first part will involve a literature search to find a journal article related to course content. The second part will involve writing a critical summary of the article. These assignments will replace the lowest quiz grade. Details of the assignment will be provided in a separate document.

Student participation: You are encouraged to ask questions during class, to clarify details of the lecture or the material in the text. Questions relevant to your own interests with respect to research, human health, and etc. are also welcome.

Moodle Supplement: There will be a Moodle Supplement for BCH 480, which will provide:

- Lecture notes, posted in advance of class
- Practice Exams and Quizzes, posted in advance of midterm and final exams
- Answers to problems from the text
- Answer keys for quizzes and exams, after the graded exam/quiz is returned
- Weekly announcements: quiz/exam reminders, assigned homework problems, etc.

COVID safety in the classroom:

- UM has adopted a policy that mask use is required in classrooms.
- If you feel sick and/or are exhibiting COVID-19 symptoms, please don't come to class and contact the Curry Health Center at (406) 243-4330.
- If you are required to isolate or quarantine, you will receive support in the class to ensure continued academic progress. The Moodle supplement should allow you to keep abreast of the course material. If you have to quarantine, please contact me as soon as possible (email or phone) regarding other accommodations you may need as a result of quarantine.
- UM recommends students get the COVID-19 vaccine. Please direct your questions or concerns about vaccines to Curry Health Center.

- Where social distancing (maintaining consistent 6 feet between individuals) is not possible, specific seating arrangements will be used to support contact tracing efforts.
- Class attendance and seating will be recorded to support contact tracing efforts.
- If I need to use Zoom to record classes because of COVID, I will inform you in advance of each class that is recorded.

Course and University Policies:

- The \pm grading system will be employed.
 - See the [Catalog for Academic Policies and Procedures](#) which includes grading policies
- Unless otherwise specified, you will only be allowed pen or pencil for quizzes and exams.
- Students are encouraged to work together to master the material in this course including solving problems at the back of each chapter, sharing information or resources, and testing each other's understanding of the material. Those are all acceptable forms of collaboration. However, all written work on exams and quizzes is expected to be each student's own work.
- See the [Student Conduct Code](#) for the definition and potential consequences of academic misconduct and plagiarism.
- Information on disability accommodations is available on the [University of Montana Accessibility Website](#).
- Last day to add a class in CyberBear without instructor consent is Wednesday, Sept. 8, 2021 by 5:00 pm.
- Last date to add/drop on CyberBear without a fee and with a refund is Monday, September 20, 2021 by 5:00 pm. An instructor override is needed to add a class.
- Last date to drop without approval from the dean is Monday, Nov. 1, 2021 at 5:00 pm using the add/drop link in CyberBear. A "W" will be assigned. After this date a grade of WP or WF will be assigned by the instructor. A fee of \$10 is assessed for each add/drop after September 20, 2021.
- Courses may not be dropped after Friday, December 10, 2021 at 5:00 pm. More details on add/drop policies are available in the [Autumn 2021 Official Dates and Deadlines page](#) on the Registrar's website.

Detailed Schedule and Readings:

Month	Date	Day	Topic	Reading
August	30	M	Course Overview	1.1 – 1.2
September	1	W	Introduction	1.3 – 1.6
	3	F	Properties of Water	2.1
	6	M	Labor Day Holiday, no class	
	8	W	pH and Acid/Base Chemistry	2.2 – 2.4
	10	F	Introduction to Thermodynamics	3.1 – 3.2
	13	M	High energy molecules and energy coupling	3.3 – 3.8
	15	W	Quiz 1 (Chapters 1 – 3); Intro to amino acids	4.1
	17	F	Acid-base properties of amino acids	4.2 – 4.4
	20	M	Spectroscopy of amino acids; peptide bonds	4.5 – 4.7
	22	W	Introduction to protein structure and purification	5.1 – 5.2
	24	F	Amino acid analysis and protein sequencing	5.3 – 5.4
	27	M	Protein sequence alignment	5.5
	29	W	Peptide synthesis and protein function	5.6 – 5.8
October	1	F	Quiz 2 (Chapters 4 – 5); Protein secondary structure	6.1 – 6.3
	4	M	Protein tertiary structure	6.4

	5	T	Exam 1 (Chapters 1 – 5 and 6.1 – 6.3)	7 – 9 pm
	6	W	Protein quaternary structure	6.5
	8	F	Carbohydrates: monosaccharides	7.1 – 7.2
	11	M	Carbohydrates: monosaccharide chemistry	7.2
	13	W	Carbohydrates: oligosaccharides	7.3 – 7.7
	15	F	Lipids: fatty acids and glycerophospholipids	8.1 – 8.3
	18	M	Lipids: sphingolipids, steroids, lipid signaling	8.4 – 8.9
	20	W	Membranes: physical properties, fluid mosaic model	9.1
	22	F	Quiz 3 (Chapters 6.4, 6.5, 7, 8, 9.1); Membranes: membrane proteins	9.2
	25	M	Membranes: membrane organization and dynamics	9.3 – 9.4
	27	W	Membranes: membrane transport	9.5 – 9.7
	29	F	Membranes: membrane transport proteins	9.8 – 9.10
November	1	M	Nucleic Acids: Bases, nucleosides and nucleotides	10.1 – 10.3
	2	T	Exam 2 (Chapters 6.4, 6.5, 7 – 9)	7 – 9 pm
	3	W	Nucleic Acids: DNA, RNA, restriction enzymes	10.4 – 10.6
	5	F	DNA: Sequencing, structure and properties	11.1 – 11.3
	8	M	DNA: supercoiling and chromosome structure	11.4 – 11.5
	10	W	DNA: chemical synthesis; RNA: structure	11.6 – 11.7
	12	F	Recombinant DNA: cloning	12.1
	15	M	Recombinant DNA: libraries, expression, PCR, mutagenesis	12.2 – 12.6
	17	W	DNA Metabolism: DNA replication, polymerases	28.1 – 28.2
	19	F	Quiz 4 (Chapters 10 – 12, 28.1 – 28.2); DNA Metabolism: Eukaryotic replication	28.3 – 28.5
	22	M	DNA Metabolism: recombination	28.6 – 28.7
	24	W	Thanksgiving Holiday, no class	
	26	F	Thanksgiving Holiday, no class	
	29	M	DNA Metabolism: repair	28.8 – 28.10
December	1	W	DNA Transcription: prokaryotes	29.1 – 29.2
	3	F	DNA Transcription: eukaryotes	29.3 – 29.6
	6	M	Protein Synthesis: Genetic code, tRNAs	30.1 – 30.3
	7	T	Exam 3 (Chapters 10 -12, 28, 29)	7 – 9 pm
	8	W	Protein Synthesis: Ribosomes and translation	30.4 – 30.5
	10	F	Protein Synthesis: Ribosomes and translation	30.6
	15	W	Final Exam (Comprehensive), 8:00 – 10:00 am, UH 210	