BIOCHEM 508 - 001 General Biochemistry II

INSTRUCTORS AND TEACHING ASSISTANTS

Prof. Sebastian Bednarek, sybednar@wisc.edu
Office hours module I: 11:15-12:15pm Monday and 2:00-3:00pm Friday (Rm 215C Biochemistry Labs) or by appointment

Prof. Robert Kirchdoerfer, rnkirchdoerf@wisc.edu
Office hours module II: 11:00am-12pm Monday and 3:30pm-4:30pm Tuesday (448 Biochemistry Labs) or by appointment

Prof. Judith Simcox, jsimcox@wisc.edu
Office hours module III: Monday 11:15-12:15pm; Wednesday 2:00-3:00pm (Rm 371B Biochemistry Labs) or by appointment

Prof. Merita Nirmali Wickramaratne, wickramaratn@wisc.edu
Office hours module IV: TBD or by appointment

Graduate Assistants:
Eddie Hoey ehoey@wisc.edu
Discussion Sections: TBD

Expery Omollo, omollo@wisc.edu
Discussion Sections: TBD

COURSE INFORMATION

Course Description: Biosynthesis of biological molecules, signal transduction mechanisms, chemistry and metabolism of nucleic acids, protein synthesis, and molecular and cellular biology. Honors credits available with consent of instructor.

Course Designations and Attributes: Level – Advanced, **Breadth** - Physical Sciences, **L&S Credit Type** – C, Honors available

Requisites: Biochem 507

Credits: 3
This class meets for three 50-minute class period each week over the ~14-week spring semester and carries the expectation that students will work on course learning activities (reading, writing, problem sets, studying, etc.) for about 2-3 hours out of the classroom for every class period. Additional information about meeting times and expectations for student work are presented below.

COURSE DETAILS

Instructional Modality: In person

Canvas Course URL: https://canvas.wisc.edu/courses/328887

Meeting Time and Location
MWF 9:55am-10:45am Room 1125 DeLuca Biochemistry Building

Discussion sections and Office Hours will be held in person

LEARNING OUTCOMES

The main focus of the first half of Biochem 508 is on biochemical information pathways that transmit genetic information into functional proteins and the role of Molecular Machines in these processes. In lectures 1-10 we will discuss the molecular mechanisms that replicate genetic information from one generation to the next with high fidelity and how specific elements of DNA are transcribed into RNA. Lectures 11-19 will address the biochemical reactions involved in the translation of genetic information into the amino acid sequences of proteins, and the mechanisms required for the maturation of nascent polypeptides into fully functional proteins. Major themes that we will cover are the energy costs and role of molecular machines in the maintenance and regulation of the flow of genetic information into proteins and how defects in these processes manifest in disease.

The second half of the course will focus on biosynthesis of metabolic intermediates and the integration and coordination of metabolism at the tissue and organismal level. In lectures 20-28 we will cover several fundamental biosynthetic processes, including those for lipids, amino

acids, and nucleotides, as well as some of the methods and techniques used to study metabolism. Lectures 28-39 will cover the signaling pathways and mechanisms that control metabolic integration throughout the body, including hormone signaling, the insulin receptor, and ion channels. Major themes that we will cover are how key biosynthetic processes are regulated and the consequences of this regulation at the individual reaction, cell, tissue, and whole-body levels.

Learning objectives for each lecture are described in study guide handouts posted for each topic.

EXAMS AND GRADING

The course will be graded out of 392 total points. These will be distributed as follows:

Exams: 350 points total

Each of the three midterm exams will count 100 points and will be held during class time (see syllabus for schedule of exams). Your best two out of the three midterm exams will be counted toward your final total point total in the course. If you miss an hour exam, your final grade will be based on the other two; make-up hour exams **will not be given**. The final exam will be worth 150 points (~100 points from the last set of lectures and ~50 points of cumulative material). The time/date for the final exam is scheduled by the University (see course schedule). An alternative time for the final will be arranged for those with three exams within 24 hours as per university policy.

We will do our best to grade the midterms fairly and accurately within a few days of the in-class exam. If you believe an error was made in grading, you must submit your test for a regrade to the graduate teaching assistants with a written explanation of the grading issue, within one week after the tests results have been returned. Final exams will not be subjected to regrading.

Quizzes/Surveys: 42 points

There will be 1 survey to determine discussion section times (2 pts) and 8 Quizzes (5 pts each) related to material covered in lecture and supplemental videos. The survey and quizzes will be online and need to be completed by the deadline indicated in the course schedule. No time extensions will be permitted.

There will be a course evaluation available in the last few weeks of the semester. If 75% of the class completes the course evaluation before it closes, everyone will receive *5 extra credit points.* Course evaluations are an important element for ensuring that the course is meeting the needs and expectations of students and are used to guide course development. Some in-class time will be provided to complete this anonymous survey.

Grades

Final letter grades for the course will only be assigned after all possible total points for the course have been tabulated. We (the instructors and graduate assistants) will not discuss with you your expected letter grades during the semester and individual midterm exams are not assigned letter grades. However, our policy is to guarantee some minimum grade cutoffs:

- Those scoring ≥90% of the total 392 points in the class, a letter grade of “A”.

- Those scoring ≥80% of the total 392 points in the class, a minimum letter grade of "B".
- Those scoring ≥70% of the total 392 points in the class, a minimum letter grade of "C".

Some semesters, we end up with median scores on the three midterm exams that differ by ten points or more. If there is a wide variation in median scores this semester, we may decide to normalize your scores on all three exams to the same median, making each exam equally valuable in determining your final grade. Although we offer you the option of discarding your lowest score, we do not recommend skipping the third exam simply because you have two good scores already. Doing so can work against you when we normalize before deciding which exam to drop for each student.

To help focus your preparation for exams, we will post on Canvas study guides for each lecture that include a list of learning objectives and terms you should know. We will also provide an example practice exam. We encourage you to use the Piazza discussion board to ask questions and answer questions other students have asked. The graduate assistants and professors will monitor these discussions and answer questions. However, we often find that students in this class do a terrific job of answering each other's questions, too, and we encourage you to participate in these exchanges.

COURSE WORKLOAD

This 3-credit class carries the expectation that students will work on course learning activities for about 2-3 hours out of the classroom for every class period (~150 hours during the 14 week semester). These learning activities include *attending lectures and participating in class activities, reviewing lecture-videos, participation on discussion boards, working problem sets, reading, writing, and studying.* See table for a suggested breakdown of time spent on learning activities for this course.

Learning Activity	Hours per Week	Weeks	Total
In class lectures/exams	**3**	**14**	**42**
Readings – textbooks, articles, videos posted on Canvas.	**2**	**14**	**28**
Review of Study Guide concepts and terms	**2.5**	**14**	**35**
Problems from study guide	**2**	**14**	**28**
Discussion section/Office hours	**1**	**14**	**14**
		Total	**147**

SECTION INFORMATION

Office Hours and Discussion Sections

Your instructors will be available to help you during office hours and discussion sections, listed above and on the Canvas course homepage, or by appointment. During the discussion sessions, the course graduate assistants will address questions related to material presented in lecture and go over any problems you have difficulty with. **Attendance** is not required but **is very strongly recommended**. You are free to attend any session.

Letters of Recommendation

Strong letters of recommendation for graduate and other professional programs require personal knowledge of an individual's work ethic, intelligence, drive, ability to overcome challenges, and growth potential. Due to the large course size, it is difficult to provide these individually tailored letters that will provide persuasive points that are required for graduate program admittance. It is recommended that you request letters from research mentors, professors with which you have strong rapport, or academic counselors. If you wish to obtain a letter of recommendation from one of the course instructors, it is required that you have 3 personal interactions with the instructor. These personal interactions include attendance at office hours or individual meetings that are scheduled with the instructor.

TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS:

Textbook

In this course, examination questions are derived primarily from the lecture material, textbook and assigned supplemental videos and practice materials. We will assign readings and problem sets from *Lehninger Principles of Biochemistry* by Nelson and Cox (W.H. Freeman, 8th edition). If you have access to another recent textbook of biochemistry and want to use it instead, we will be happy to help you locate the sections that correspond to each of the lectures shown on the syllabus. A few copies of Lehninger and several other textbooks are on reserve at the Steenbock Library, as well as a few copies of the study guide.

Study Materials

For each lecture, Study Guides will list key concepts, terms, and suggested textbook reading and problem sets. In addition, we will suggest problems, mostly taken from the end-of-chapter problems in the textbook to help you prepare for the exam. Note that the problems in the textbook have answers in an appendix. If you still have trouble understanding the solution to a problem, please contact a graduate assistant, who will go over the problem in an office hour or discussion section. Although the problems will not be collected or graded, it will be to your great advantage to work them as soon as possible after the relevant lecture. For more tips on how to succeed in 508, please see "How to Do Well". In addition, supplementary reading material for the course will be posted on Canvas module lecture pages.

Lecture Videos

We will be livestreaming and recording all of our lectures and making them available to you via Canvas course website. *Please note that we do not consider the lecture videos a substitute for attending lectures. The lecture recordings are meant as a study aid.* Please be aware of the

possibility that—due to technical or human error—a lecture may not get recorded. It is also possible that material may be presented or discussed during a lecture that is not adequately recorded, so we strongly encourage you to attend all lectures.

Top Hat

This semester we will be using Top Hat to engage with students during lectures. This will include polling the class and answering questions. Top Hat is a bring-your-own-device solution, which means that students can use any web-enabled device (laptop, tablets, smartphones) to participate. Participation using Top Hat will not be used to determine grades for this course but is strongly encouraged. Set up your Top Hat account at https://it.wisc.edu/services/top-hat/ and use the join code 846829 to access the BIOCHEM 508 course.

Piazza

In addition, we will be using Piazza as a platform to help discuss course concepts with classmates, the graduate assistants, and instructors. Rather than emailing questions to the teaching staff, we encourage you to post your questions on Piazza.

OTHER COURSE INFORMATION

Honors credit

Biochemistry 508 can be taken for honors credit. To receive honors credit for Biochem 508, you must have chosen the honors option when you registered for 508, complete the Honors-specific extra assignments (for details see the Biochemistry 508 Honors document on the course website) and receive a grade of "B" of better in the course.

RULES, RIGHTS & RESPONSIBILITIES

- See the Guide's to 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 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. Disciplinary actions include but are 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

"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 faculty 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. Faculty, 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."

Exceptions to exam scheduling policies stated above will only be considered for students with an accommodation approved by the McBurney Center.
http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

DIVERSITY & INCLUSION

"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

Example of Lecture study guide:

09/09/23 Lecture 2: DNA metabolism II: Topoisomerases and DNA Polymerases
Reading:
Lehninger 6th ed. Chapter 24 pp. 989-1003, 7th ed. Chapter 24 pp. 967-982, 8th ed. Chapter 24 pp. 895-902
Lehninger Chapter 25 6th edition p. 1009-1024, Chapter 25 7th edition p. 987-1002, Chapter 25 8th ed. 914-926
Problems: Lehninger end-of-chapter 24 problems: 6th edition, 8, 9, 11, 14, 15: 7th edition, 8, 9, 11, 14, 15: 8th edition, 8, 9, 11, 14, 15
Lehninger Chapter 25 problems 6th ed. 1, 2, 3, 5, 6, 7, 8, 11; 7th ed. 1, 2, 3, 5, 6, 7, 8, 11; 8th ed. 2, 3, 5, 6, 7, 8, 11
Supplemental reading:
"The Salvation of Doug": Complementary ways in which Biochemical and Genetic approaches are utilized.

Learning objectives:
- Describe the function/activities of bacterial and eukaryotic Type 1 and 2 topoisomerases
- Understand how agarose gel electrophoresis can be used to identify the different forms of DNA molecules.
- Describe the fundamental structure of eukaryotic DNA
    - Nucleosome
    - Compare the relationship between plectonemic and solenoidal supercoiling
    - Discuss how underwinding of eukaryotic chromatin is achieved in the absence of a topoisomerase that can generate negative supercoils
- know the basic rules of replication: semiconservative replication; discontinuous strand synthesis
- know the common properties of DNA polymerases; understand the basic mechanism of the DNA polymerization reaction and its energetics
- Describe the properties/activities of DNA polymerases I and III (e.g. the role of polymerase exonuclease activity in proofreading)
- Compare the fidelity, polymerization rate, processivity for DNA Pol I and III

Know these terms
Terms in bold are in the glossary

supercoiling, plectonemic and solenoidal	histones
topoisomerases	nucleosome
chromatin	30 nm DNA fiber
Template	leading vs lagging strand
semiconservative vs conservative replication	exonuclease
replication fork	endonuclease
origin of replication (ori)	DNA polymerase I
Okazaki fragments	DNA polymerase III