

BMB 401 Fall 2024

Comprehensive Biochemistry

Important dates

Class begins on **08/26/2024**.

- Exams are online on **Fridays at 4:00 PM Eastern Standard Time** on the following dates:
 - Friday, Sept. 20, 2024
 - Friday, Oct. 11, 2024
 - Friday, Nov. 8, 2024
 - Friday, Dec. 6, 2024
- *There is no final exam for this course.*

Faculty

Course Instructor of Record **Dr. Elia Hefner**

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Graduate Teaching Assistant: **Elaine Wright**

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Office hours and individual meeting times are posted on D2L.

Overview

In this course, we will cover the structures and functions of major biomolecules, to understand the roles of these molecules in metabolism. We will also cover the regulation and coordination of major metabolic pathways. This course has an emphasis on human metabolic pathways; other systems are covered when appropriate.

As this is an asynchronous course, reliable access to an internet-connected computer is necessary for success. Mozilla Firefox and Google Chrome work best for this course. The textbook that accompanies this course is *Biochemistry: Tenth Edition*, Berg, Tymoczko & Stryer W. H. Freeman & Co, ed, but other, earlier editions are allowed, to save you money. **There are copies of our textbook on reserve in the on-campus Main Library (textbook and e-book options).** You may also rent the textbook or purchase access to the e-book from Macmillan. The textbook is not required, but it may be a helpful tool for understanding the material. Check out <https://libguides.lib.msu.edu/textbooks> for more information regarding reserved textbooks from the library.

Achieve from Macmillan is also recommended but not required for this course. Additional practice problems are available on this platform. Completion of these practice problems will not directly contribute to your grade; however, students who complete more practice problems tend to perform better on exams. Previous students who used Achieve in the course appreciated the hints and feedback available. Again, you are not required to purchase any materials for the course, and you can earn an A solely using the resources on D2L.

This can be an overwhelming course because of the sheer amount of information you are required to learn, retain, and apply. If you feel overwhelmed, stressed, or anxious at any point during the semester, please reach out to me, the graduate learning assistant, or Counseling & Psychiatric Services (also known as CAPS; <https://caps.msu.edu/>). There are resources to help you do your best in the course and take care of your mental health.

I look forward to having you in class! Although this is an asynchronous course, I strongly encourage you to make time for office hours on a regular basis or set up an individual meeting just to say hello and ask any questions you might have about the course or material covered.

Class resources

The following are supplied on D2L to help you:

- Closed captioned lecture videos
- Transcripts (for most lectures)
- Blank and annotated lecture slides in PDF & PPT formats
- Ungraded self-assessments
- Achieve practice problem sets (only if you choose to purchase access)
- Practice exams and answer keys
- Online mock exams

Accessing Course Materials

- All course materials and grades will be online at <https://d2l.msu.edu>
- If you have trouble accessing course content or concerns regarding course content, please contact Dr. Hefner by email (hefnerel@msu.edu).
- If you have general technical trouble either accessing D2L or email, contact the appropriate help desk listed here:
 - Visit the MSU Help site for general problems <http://help.msu.edu>
 - Visit the Desire2Learn Help Site for D2L problems <http://help.d2l.msu.edu>
 - Call the MSU IT Service Desk, which is available 24 hours a day for any IT issue. These numbers are (517)432-6200, (844)678-6200, or e-mail at ithelp@msu.edu

Topics that are helpful to review before the semester begins

Reviewing these topics will help you to hit the ground running with the first section of the course, but it is not a requirement.

- Functional groups (e.g., ketone, aldehyde, carboxylic acid, etc.)
- pH
- Thermodynamics
- Reaction types (e.g., condensation, hydration, oxidation, etc.)
- Central dogma (replication, transcription, translation)

Goals

In this course, you will be responsible for learning a LOT material. The goals of this course are outlined below. By the end of the semester, you will have gained a lot of knowledge that will be applicable to the fields of human health, medicine, and biochemical research.

By the end of the semester, you will know the important principles of inter and intramolecular interactions, enzyme catalysis, thermodynamics, and pH. You will also know the structures and functions of important biochemical metabolites, including amino acids, monosaccharides, nucleic acids, and the general structures of fatty acids, triacylglycerols, membrane lipids and cholesterol.

You will know the following pathways in depth:

- Glycolysis
- Gluconeogenesis
- TCA cycle
- Glycogen synthesis and catabolism
- Urea cycle
- Replication
- Transcription
- Translation

And have an appreciation for the function and the committed and regulated steps of the following pathways and processes:

- Major buffering systems
- Heme synthesis and catabolism
- Pentose phosphate pathway
- Fatty acid synthesis and catabolism
- Amino acid synthesis and catabolism
- Nucleic acid synthesis and catabolism
- Membrane lipid formation, including cholesterol synthesis and derivatives
- Lipid transport

Exams

- All four exams must be taken.
- No request for a grade increase, other than that due to grading error, will be honored. Your final grade will be that which you have fairly earned.
- All exams will consist of 44 questions that may consist of multiple choice, multiselect, matching, or true/false questions.
- All exams have a 65-minute time limit unless specified by an accommodations letter.
- A mock exam will be posted to D2L approximately one week prior to each exam and become unavailable at 9AM on exam day.

Students requiring accommodations for exams:

- Persons requiring accommodations due to disability should contact the **Resource Center for Persons with Disabilities (RCPD) at Michigan State University** prior to the beginning of class to obtain a letter that states the accommodations required. This accommodations letter should be uploaded to D2L for Dr. Hefner to review. To make an appointment with a specialist at RCPD, call: (517) 353-9642 Or TTY: (517) 355-1293 or visit the RCPD website: <https://www.rcpd.msu.edu/>
- Persons living outside the continental US may request accommodations for purposes of alternate exam timing.

Exam Day Details

- **Exams are open note.** Please still make sure you study as if the exam is closed note. You will not have enough time to look up every question. You may access any notes you have made, but you must complete the exam on your own. **Please do not access internet resources or contact others while completing the exam.** I have chosen not to use LockDown Browser because I believe it is invasive and suggests that I do not trust you as students to complete the exam as I have outlined.
- **Exams begin at 4PM ET.** You will have a total of 65 minutes to complete the exam. The 65-minute timer will begin counting down at 4PM ET. For example, if you log on to D2L at 4:15 PM, you will only have 50 minutes to complete your exam instead of the full 65 minutes. If you have submitted a valid accommodations letter, your exam time will reflect your accommodations, but you still need to begin your exam at 4PM. **If you have a time conflict (work, class, etc.), please complete the exam makeup request form on D2L.**
- Make sure you are connected to a **reliable internet connection** and that your electronic device is fully charged. Make up exams will not be given for loss of internet or laptop/computer/tablet dying.
- If you have a question during the exam, post your question in the Exam Questions Discussion Forum available only during the exam window. The instructor and TA will monitor the forum to answer any questions you may have.
- **Each exam contains 44 questions for a total of 108.5 points.** Extra credit is built into each exam as you can score higher than 100 points on each exam. Questions are displayed five per page. **Answer each question before advancing to the next page as you cannot go back.** Your grade will be available upon submission.
- **Missed Exams:** In the event you need to request a makeup exam, **please complete the exam makeup request form on D2L.**

Grading Scale:

This is the grading scale that will be used to determine your grade. Points are not rounded at the end of the course, and there is no grading curve.

Points Earned	Course Grade
340.00 or more	4.0
314.00 – 339.99	3.5
284.00 – 313.99	3.0
258.00 – 283.99	2.5
232.00 – 257.99	2.0
202.00 – 231.99	1.5
176.00 – 201.99	1.0
Below 176.00	0.0

There are four (4) exams and no additional graded assignments. Each exam is worth

108.5 points (100 points + 8.5 points extra credit). This means 34 points of extra credit are available, spread equally over the four exams.

Academic Honesty:

There are many ways to get help and be successful in this course. If you are struggling for any reason, including personal/family reasons, please reach out to Dr. Hefner. **Exams are open note and help is readily available to help you become a better learner and critical thinker, not just a good test taker. There is no reason valid reason to cheat.** Honor yourself and your peers by following the code of academic honesty.

With that said, no cheating of any kind will be tolerated. **Using resources outside of those approved by the instructor, including AI such as Chat GPT, is cheating.** Students found to be cheating on an exam, will receive a zero for that exam and will be reported. Further actions may include dismissal from the university. University policy regarding academic honest can be found here: <https://www.msu.edu/~ombud/academic/integrity/index.html>.

Again, please use all your resources to do well instead of cheating. I want everyone to do well, and there are no “gotchas” in this course. If you are having a hard time for any reason, please email me, stop by virtual office hours, or set up an individual appointment.

Spartan Code of Honor: The Associated Students of Michigan State University (ASMSU) adopted the following Spartan Code of Honor:

“As a Spartan, I will strive to uphold values of the highest ethical standard. I will practice honesty in my work, foster honesty in my peers, and take pride in knowing that honor is worth more than grades. I will carry these values beyond my time as a student at Michigan State University, continuing the endeavor to build personal integrity in all that I do.”

Class Schedule

Cramming is not advised for this class. Exams are spaced approximately 3 – 4 weeks apart. Each exam covers ~10 lectures which average 1 hour each. Watching the lecture is only part of the work necessary to ~~survive~~ be successful. You also need to factor in time for completing practice problems, rewatching lectures that were confusing or complex, reading the textbook (if you’re into that kind of thing), etc. I strongly recommend that you watch one lecture at least every other day. On days you are not watching a lecture, you should be completing practice problems, drawing pathways, writing summaries, or some other activity to increase your understanding of the presented material. If, however, you choose to cram all the material for this class, understand that you are increasing your likelihood of failure and the level of frustration and anxiety you experience.

*****Please keep in mind that the lecture videos for this course are in the process of being updated.*****

Lecture Topics

- 1 Why Study Biochemistry? / Four Classes of Macromolecules
- 2 Molecular Forces, Properties of Water, and Thermodynamics
- 3 Weak acids & bases, Buffers, and Blood pH Regulation
- 4 Amino Acids - Structure and Function
- 5 Basic Principles of Biochemistry

- 6 The Central Dogma
- 7 Protein Structure Hierarchy
- 8 Protein Folding, Degradation, Amyloidosis
- 9 Exploring Topics in Homology
- 10 Myoglobin and Hemoglobin Structure, Function, Pathology

Exam I. Covering Lectures 1-10

- 11 Heme Synthesis, Degradation, Clinical Importance Of Bilirubin
- 12 Enzymes I: Nomenclature, Kinetics
- 13 Enzymes II: Kinetics continued, Profile of Carbonic Anhydrase, Enzyme Regulation
- 14 Vitamins, Coenzymes, Cofactors
- 15 Carbohydrate Structure and Nomenclature
- 16 Glycolysis I: Glucose as a Fuel Source
- 17 Glycolysis II: The Use of Other Fuel Sources
- 18 Gluconeogenesis
- 19 The Pyruvate Dehydrogenase Complex, Overview of the TCA Cycle

Exam II. Covering Lectures 11-19

- 20 TCA Cycle, Enzymes and Regulation
- 21 Electron Transport Chain
- 22 ATP Synthesis, Mitochondrial poisons
- 23 Glycogen Metabolism I
- 24 Glycogen Metabolism: Regulation
- 25 Pentose Phosphate Pathway
- 26 Lipids I: TAG and Fatty Acid Catabolism
- 27 Lipids II: Additional topics in Fatty Acid Oxidation
- 28 Lipids III: Fatty Acid Synthesis
- 29 Lipids IV: TAG and Phospholipid Synthesis
- 30 Lipids V: Cholesterol Synthesis and Transport

Exam III. Covering Lectures 20-30

- 31 Protein Degradation, The Urea Cycle, and Amino Acid Catabolism
- 32 Amino Acid Metabolism
- 33 Higher Order Structure of DNA
- 34 DNA Replication
- 35 DNA Repair and Recombination
- 36 Transcription Part I
- 37 Transcription Part II
- 38 Transcriptional Regulation
- 39 Translation Part I
- 40 Translation Part II

Exam IV. Covering Lectures 31-40

Study Tips

Please do not just memorize! It's important to understand **what** is happening and **why**. Practice **applying** your knowledge. Understanding the **what and why** is critical

for understanding, retaining, and applying knowledge. Below are some questions to consider as you watch lectures, take notes, and study.

What kind of reaction is happening?

- Is carbon lost or gained?
- Is ATP used or produced?
- Are electrons lost or gained from the substrate – and if so, what is the electron carrier?
- Are there cofactors needed in this reaction? Why?
- Where and when does this reaction happen?
- Why does this reaction make sense?
- Why are specific enzymes regulated?
- Why does the regulation of these enzymes by these effectors make sense?
- Why do things happen as they do in this pathway or cycle?
- What is the overall purpose of this pathway or cycle?

The knowledge you will gain in this course is valuable. A basic understanding of how the human body operates can help you make more informed decisions about your health. Be sure to share your knowledge with friends and family to help them take better care of themselves and their loved ones, too. Whatever your next step is after this course, I hope it leads to greatness!

*All the best,
Dr. Elia Hefner*

