BMB 401 Summer 2023

Comprehensive Biochemistry

Prefer watching videos? Watch the video version of the syllabus on d2l.

Important dates

Class begins 05/15/2023

- **Midterm Exams Thursdays 3:00-4:00 PM Eastern Standard Time ONLY**
  - **June 8,**
  - **June 29,**
  - **July 27,**
  - **and August 17**
- *There is no final exam for this course.*

Faculty

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

email: hefnerel@msu.edu

Graduate Learning Assistant: **TBD**

Office hours and individual meeting times will be posted on d2l and by email.

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: ninth Edition,* Berg, Tymoczko & Stryer W. H. Freeman & Co, ed, but other, earlier editions are allowed, to save you money. **There are copies of the 9th edition 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.

Please keep in mind that while there are no class meetings, you are required to take all exams in-person.

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.

Topics that are helpful to review before the semester begins

It is not required that you know these topics before taking the course, but it will help you to hit the ground running with the first section of the course if you are already familiar with the following topics.

- 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

Midterm Exams

- All four midterm 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 midterm exams will consist of 43 questions that may consist of multiple choice, or true/false questions. Alternate exams may also contain short answer questions.
- All midterm exams have a one-hour time limit.
- 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 VISA form that states the accommodations required. This VISA should be sent to Dr. Hefner. 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

- All exams are administered in-person, in paper and pencil format.
  - All exams *must* be taken at the posted time (given in Eastern time)
  - Persons living in other time zones must test at the same time as persons who are testing in MI (Eastern time).
- All midterm exams will consist of 43 questions that may consist of multiple choice, or true/false questions. Alternate exams may also contain short answer questions.
- All midterm exams have a one-hour time limit.
- **My cell phone will be on during all exams to provide a direct link to off- campus testing centers. I apologize for the potential distraction this may introduce.**
- **All bags, backpacks, and other personal items will be placed at the front of the room for exams. Be sure to have pencils to fill out the Scantron sheet before putting down your belongings.**
- **Pick up one Scantron sheet and find a seat with an exam. Please do not move the exam to a different seat.**
- **Please arrive on time! Anyone late by more than 15 minutes may be refused an exam.**
- No headphones are allowed. All cell phones, (besides mine) and other electronic equipment that may beep, ring, sing, chirp, etc. must be silenced and put away. This includes Apple watches, FitBits, and Airpods as well. We will not be held accountable for lost items.
- **Calculators may NOT be used in these exams. Any calculations required on the exam will contain simple math.**
- **Missed Exams: Make up exams are given SOLELY at the discretion of the instructor. Please contact Dr. Hefner as soon as possible if you missed an exam.**

Accessing Course Materials

- All course materials and all grades will be online at **https://d2l.msu.edu**
- Video lectures are streamed online via YouTube links posted in Exam Content on d2l
- All video lectures are close captioned.
- Blank lecture slides and annotated lecture notes are available in PDF format for download.
- Transcripts of the lectures are also posted and may be downloaded to use as notes, so you do not have to write down every word from the lectures yourself.
- If you have trouble accessing course content or concerns regarding course content, please contact Dr. Hefner by email.
- 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 (Note: my experience is that calling is generally faster and easier than email)

Grading Scale:

This is the grading scale that will be used to determine your grade. Please take note that a final grade of **85 or higher is considered a 4.0** in this course.

- 4.0 85.0 – 100
- 3.5 78.5 – 84.99
- 3.0 71.0 – 78.49
- 2.5 64.5 – 70.99
- 2.0 58.0 – 64.49
- 1.5 50.5 – 57.99
- 1.0 44.0 – 50.49
- 0.0 Below 44.0

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. Honor yourself and your peers by following the code of academic honesty.

With that said, no cheating of any kind will be tolerated. 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, reviewing flashcards, 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. There will be a combination of updated lectures and lectures from the previous instructor. You will be afforded the opportunity to give anonymous, constructive feedback on updated lectures to help guide the creative process.*****

Lecture Topics

1 Why Study Biochemistry? / Four Classes of Macromolecules
2 Basic Principles of Biochemistry
3 Molecular Forces, Properties of Water, and Thermodynamics
4 Weak acids & bases, Buffers, and Blood pH Regulation
5 The Central Dogma
6 Amino Acids Structure and function
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: Fatty Acid Catabolism
27 Lipids II: Additional topics in Fatty Acid Oxidation
28 Lipids III: Steroid Synthesis
29 Lipids IV: Cholesterol Transport
30 Lipids V: TAG and Phospholipid Synthesis
Exam III, Covering Lectures 20-30
31 Protein Metabolism; The Urea Cycle
32 Amino Acid Metabolism
33 Nucleic Acid Metabolism I: Nucleotide Structure, Function and Synthesis I
34 Nucleic Acid Metabolism I: Synthesis II; Pathology
35 DNA Structure II; Replication I
36 Replication II: Mutation and Repair
37 Transcription
38 Transcriptional Regulation
39 Translation
40 Metabolism Overview
Exam IV, Covering Lectures 31-40

Class resources

The following are supplied on d2l to help you:

- Closed Captioned lecture videos
- Lecture slides in PDF format
- Self-assessments for each lecture (think of this as homework that is not-for-credit and make sure to do it!)
- Practice exams and keys (PDFs and/or Word docs)
- Online Mock Exams in d2l (in the Quizzes section under assessments) These open approximately one week before each exam and will close, and remain closed, at 9 AM on exam day.

Previous Students' Advice

1) Watch each lecture all the way through once without taking notes to follow along and get an idea of what is being said, and what is most important to know.
2) Watch the lecture again to take notes (or highlight the lecture transcript).

Students have said that this method is faster in the long run and makes it easier to understand the overall concepts better.

Most importantly: 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