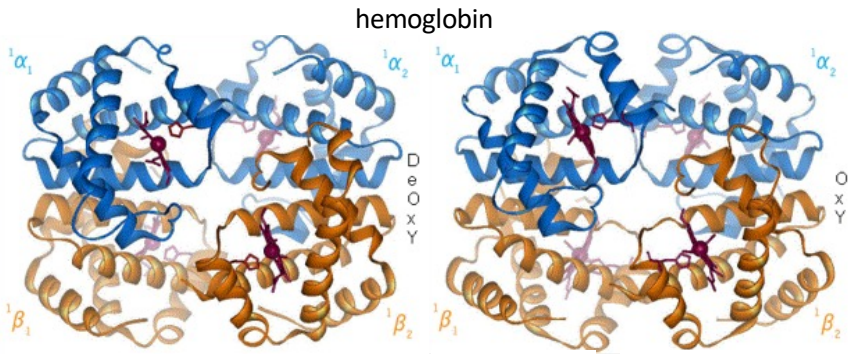
Biochemistry - Fall 2023

BIOL GU4501
TR 2:40-3:55
301 Uris

Mary Ann Price
744A Mudd

Optional
Recitations: TBA



Instructor Information

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Course Description, Goals and Objectives

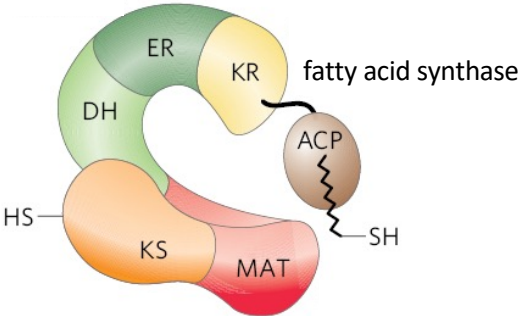
In this course, we will explore the basic biochemistry of living systems and how this knowledge can be harnessed to create new medicines. We will learn how living systems convert environmental resources into energy through metabolism, and how they use this energy and these materials to build the molecules required for the diverse functions of life. We will discuss the applications of this biochemical knowledge to mechanisms of disease and to drug discovery. We will look at examples of drug discovery related to neurodegeneration, cancer, and the SARS-CoV-2 COVID19 pandemic. This course satisfies the requirement of most medical schools for introductory biochemistry, and is suitable for advanced undergraduates, and beginning graduate students. Intro Bio I and II and Organic Chemistry I and II are pre-requisites for this course.

Learning Goals:
We expect that at the conclusion of the course, you should be able to explain at a high level:

- the basic mechanisms by which living systems harness energy from their environment
- how living systems construct the molecules necessary for the functions of life
- how these processes go awry in a variety of disease, including cancers
- how drugs can be designed to treat such diseases

Learning objectives:
At the end of this course, students should be able:

- To diagram the major metabolic pathways and compare how these pathways are dysregulated in normal tissues in and disease states
- To know what techniques are used to uncover such knowledge and how to design and interpret experiments that will address these questions
- To collaborate with other people in the analysis and interpretation of biochemical data, and
- To be able to communicate, defend and refute interpretations of data.

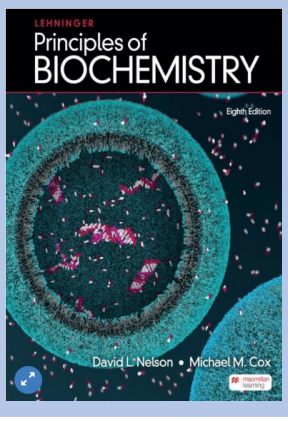


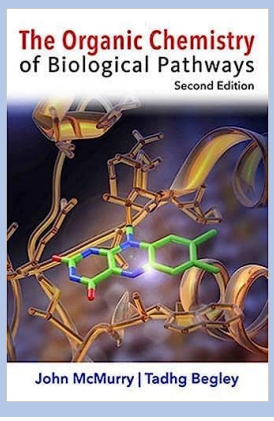
Inside the Syllabus

CourseWorks2/Canvas

All the materials needed for a particular lecture will be posted in a folder for that lecture (in Files (left menu) > Lecture Materials). Video recordings* of lectures will be in Course Video Recordings (left menu). Practice exams and exam keys will be posted at the appropriate times (in Files > Exams).
*The class will be recorded at my discretion to support your learning. At any point, I have the right to discontinue the recording if it is deemed to be obstructive to the learning process.

Textbooks:





Recommended Textbook: Nelson and Cox (2021) *Lehninger Principles of Biochemistry*, 8e, W.H. Freeman. Available here. Earlier editions are fine.

Supplemental Textbook: J. McMurry and T. Begley (2005) *The Organic Chemistry of Biological Pathways,* 2e, Roberts and Company.

Free Online Textbook: Denise R. Ferrier (2017) *Biochemistry*, 7e, Lippincott Illustrated Reviews. Available here.

Lecture slide figures come from Lehninger.

Grade Breakdown

Pre-class quizzes:	10%
In-class Poll Everywhere:	10%
Team problems:	20%
3 Exams x 20% each	60%

Pre-class quizzes

Before each class after week 1, you will be assigned a quiz, via the assignments tab in CourseWorks2/ Canvas. The quiz will cover material from the previous classes and/or the assigned research article. Even if you will miss class or join by Zoom, please complete the quiz on time. These quizzes count for 10% of your final grade.

Team Problems

Every Thursday (see § on schedule, p 3), there will be team problems for the last ~15-20 minutes of class, to be completed in small groups of 3-4 students. These problems are purposefully challenging, to give you and your group members an opportunity to discuss class material and to learn from each other. Team problems will count for 20% of your final grade.

Poll Everywhere

We will be answering problems in class using Poll Everywhere. To sign up, please go to https://pollev.com/registrations and click on "Sign Up" then enter your Columbia email (UNI@Columbia.edu) and create a password, and enter your name. It is critical that you use your Columbia UNI so that your participation will be integrated with Canvas/Courseworks so you can receive credit for participating. Additional information is available from CUIT here. Poll Everywhere questions will count for 10% of your final grade. Notify me if you have an excused absence so that your grade can be calculated accordingly.

Study Tips (from Marilla Svinicki (2014) *National Teaching and Learning Forum* **24** (1))

1. **Spacing Effect** Spaced schedules of studying and self-testing produce better long-term retention than a single study session or test. This means you should study regularly (*e.g.,* weekly) and not just before each exam. This is why we have a quiz due before each class and three exams throughout the semester, to assist you in realizing this goal. In other words, keep up.
2. **Generation Effect** Learning is enhanced when learners produce answers, rather than simply recognizing answers. This means that rather than simply reading problems and their solutions, you need to try to solve the problem and only look at the solution after you have generated your own answer. This is also why we solve problems during class, to give you a chance to answer before seeing the solution.
3. **Feedback Effect** Learners benefit from feedback on their performance in a learning task. This means that after each quiz, exam and class, you should review your performance and determine what you understood and what you did not understand. You can then evaluate which study strategies were effective and which were not, and adapt your strategies to be more effective in the future. We provide as much feedback as possible via the grading, and in office hours, but please come and ask for more feedback if you are not sure about what you need to do to perform well and learn maximally in this course.

Accommodations

In order to receive disability-related academic accommodations for this course, students must first be registered with their school Disability Services (DS) office. Detailed information is available online for both the Columbia and Barnard registration processes. Refer to the appropriate website for information regarding deadlines and disability documentation requirements.

Course Policies

Late Assignment Policy. Quizzes will be posted at least 24 hours before each class. The quiz must be completed before class starts. **No quizzes will be accepted after the start of class.**

Attendance and Team Problems. You may submit one in-class problems set up to 48 hours late without penalty. Thus, if you miss a class due to an outside activity, interview, or illness, you must still review the material covered in the missed class, complete the in-class problems, and submit the answers within 48 hours.

Regrade policy. If an error was made in grading your exam, you may submit a regrade request up to one week after exam return. See the Canvas site for instructions and a regrade request form.

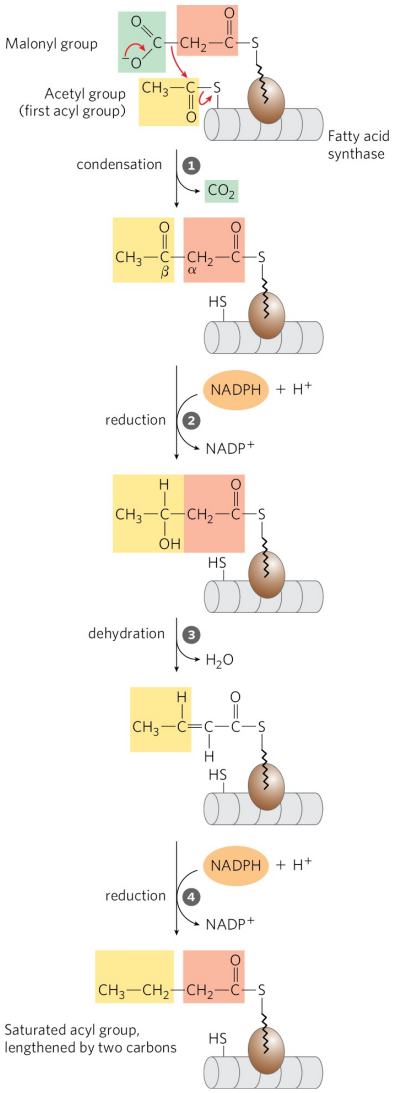
Technology Policy. I encourage the responsible use of technology in my class. Laptops and tablets are permitted for taking notes and for annotating handouts/slides. Also, questions during class will be answered via Poll Everywhere, thus every student needs to bring a smart phone, tablet or laptop each day. A few extra computers and/or tablets will be available for emergencies. Be aware that electronic devices can be distracting to other students, so please use them only at appropriate times.

Honor Code/Academic Integrity. Your full observance of the Faculty Statement on Integrity and Columbia College Honor Code is expected. Both can be found here.

Course Schedule (subject to change except exam dates)

Date	Lecture	Topic
September 5	Lecture 1	Course overview, intro to amino acids and proteins
September 7 §	Lecture 2	Protein structure
September 12	Lecture 3	Enzyme and protein function I
September 14 §	Lecture 4	Enzyme and protein function II
September 19	Lecture 5	Protein structure paper
September 21 §	Lecture 6	Orgo for Biochem; Glucose metabolism
September 26	Lecture 7	Gluconeogenesis; Pentose Phosphate Pathway (PPP)
September 28 §	Lecture 8	Regulation of metabolism
October 3	Lecture 9	Enzyme paper
October 5	Exam 1	Exam 1 covers Lectures 1-8
October 10	Lecture 10	TCA cycle
October 12 §	Lecture 11	Amino acid oxidation
October 17	Lecture 12	Oxidative phosphorylation I
October 19 §	Lecture 13	Oxidative phosphorylation II
October 24	Lecture 14	Caloric restriction and reactive oxygen species papers
October 26 §	Lecture 15	Lipid metabolism I (catabolism)
October 31	Lecture 16	Lipid metabolism II (anabolism)
November 2	Exam 2	Exam 2 covers Lectures 9-15
November 7	HOLIDAY	
November 9 §	Lecture 17	Regulation of metabolism II
November 14	Lecture 18	Brown adipose tissue and UCP1 paper
November 16 § *	Lecture 19	(in case we fall behind)
November 21	Lecture 20	Cell death
November 23	HOLIDAY	
November 28	Lecture 21	Cell death paper
November 30 §	Lecture 22	Principles of drug design
December 5	Lecture 23	Drug design paper I
December 7 §	Lecture 24	Drug design paper II
TBA	FINAL	Lectures 16-24; probably December 21, 1-4pm

§ Team problems; *last day to drop, P/F



Lehninger, Fig. 21-2