Biological Sciences 103
Summer, 2026

Course Syllabus

Staff	Office Hours	Room	E-mail Address
Dr. Ken Hilt	MTu 2:10 – 3 pm	3033b Esau	klhilt@ucdavis.edu
Kat Drumright (LA)	MW 3:30 – 5 pm	2061 Esau	
Wiley Guan (LA)	MW 7:30 – 8:30 pm Tu 4 – 5 pm	Zoom 2061 Esau	

LA Learning Assistant
Zoom office hours: click the "Zoom" tab in Canvas

Dr. Hilt's office: 3033b Esau

Administrative Support Nena Herrera, William Madden, Hemang Patel, Christine Truesdale, and Makena Weston

Lectures MTuW 12:10 – 1:50 p.m. 176 Everson
Lectures are audio recorded by Academic Technology Services and uploaded to "Media Gallery" in Canvas.

Texts

Required
Biochemical Calculations, 2nd ed., I. H. Segel, John Wiley & Sons, Inc., c1976.
ISBN 0-471-77421-9

Optional
Lehninger Principles of Biochemistry, 7th ed., D.L. Nelson and M.M. Cox, c2017
ISBN 9781464126116

Biochemistry, 4th ed., D. and J. Voet, John Wiley & Sons, Inc., c2011
ISBN 978047057095 (graduate student level textbook)

Digital versions of the above textbooks are available to purchase. Click **Equitable-Access Bookshelf** in Canvas.

Scanned versions of the above textbooks are available from Shields Library. Click **Reading List** in Canvas.

Web Site
All business items will be posted on our Canvas website: the course syllabus, podcasts of each lecture, assigned homework problems, and answer keys for homework problems and current exams.

Homework

Homework is assigned, but not graded. These problems are previous exam questions. There are three homework assignments. Homework (HW) #1 covers material for the first midterm. HW #2 covers material for the second midterm. HW #3 covers half of the final exam (i.e. half of the final is equivalent to a third midterm; the other half of the final exam is cumulative).

Exams

UC Davis Academic Code of Conduct: Code's webpage

Exam	Date	Time	Points
First Midterm	Wed., Aug. 19	12:10 – 1 pm	100
Second Midterm	Wed., Sept. 2	12:10 – 1 pm	100
Final	Wed., Sept. 9	12:10 – 1:50 pm	200

Each exam tests your understanding of concepts and quantitative analyses. Equations and constants are furnished. However, you must know definitions. Bring a calculator---it must be a nonprogrammable, nongraphing calculator.

Missed Midterms: If you miss a midterm, you need to meet me at my office, 3033b Esau, at 2:10 pm on the following Monday. I will give you an oral exam. If you pass, I will move the percentage of the midterm to the final. If for any reason you do not show up, you will have a "0" on the exam.

Regrade policy: Post a note in Gradescope explaining what we should look at and why. The last day to submit a regrade request is the final exam. We will review all regrade requests at the end of the quarter.

Final exam: the final exam is only given at the stated day and time.

How to do well in the course

Focus on the lecture material and assigned homework.
Share your notes and argue concepts with a fellow classmate.
Go to office hours.

UC Davis Student Resources:

Academic Support Health & Wellness Career & Internships Campus Community
https://ebeler.faculty.ucdavis.edu/resources/faq-student-resources/

Tentative Lecture Schedule

Lecture	Date	Topic
1	August 3	Course introduction; key concepts from BIS 102 that are relevant to BIS 103
2	4	Methods used to investigate multiple cellular metabolic steps at the same time: DNA microarrays, 2D IEF/SDS PAGE gels, microcalorimetry
3	5	Key concepts in metabolism; glycolysis
4	10	Glycolysis; ΔG and Beer's Law calculations
5	11	Starch and glycogen; gluconeogenesis
6	12	Regulation of carbohydrate metabolism; TPP, glutathione, pentose phosphate pathway
7	17	Pyruvate dehydrogenase complex; catabolism of fatty acids
8	18	Krebs cycle; coupled enzyme assays
9	19	**First Midterm**
10	24	Overview of electron transport chain
11	25	Deeper view of electron transport chain
12	26	Mitochondrial ATP synthase
13	31	Photosynthesis (part I)
14	September 1	Photosynthesis (part II)
15	2	**Second Midterm**
16	7	**Holiday (Labor Day)**
17	8	Course summary
	9	**Final Exam** 12:10 – 1:50 pm (50% covers material since the second midterm; the other 50% reexamines the material for the two midterms)

Suggested Reading (chapters)

Lecture	Segel	Lehninger
2		3, 9
3		Preface to 13
4	3, 5	14
5 - 6		14, 15
7		16
8	5	17
10 - 14		19, 20, 21

BIS 103 Course Objectives

This course will enable students to describe how the major biomolecules in living systems are interconverted to provide energy to do biological work including the synthesis of needed biomolecules. Students will build upon their BIS102 skills to use quantitative methods to examine molecular processes in living systems and to predict the direction of cellular conversions.

By the end of this course students will be able to:

1. Understand the shared and unique properties, in general terms, of aerobic and anaerobic metabolism and prokaryotic and eukaryotic metabolism.

2. Understand that metabolism is the science of changing of chemicals. Understanding metabolism therefore requires being able to recognize features in chemicals, and to learn how chemical structures define cellular functions. Just as you are able to distinguish a dollar bill from Yen or Euros, so is the chemical structure of ATP and other small molecules important to understand the economies of the cell.

3. Understand selected approaches and experiments, both historical and modern, used to elucidate metabolic principles and pathways.

4. Building on knowledge from BIS102, be able to understand and quantitatively evaluate how chemical energetic principles drive all processes in cells and specifically the directionality of specific processes. Be able to use this analysis to new pathways and reactions.

5. Understand and be able to describe in words the structure and composition of the major carbohydrate storage forms in living organisms. Understand how this storage form is synthesized and broken down. Know the structure of the major lipid storage form, triacylglyceride, and understand its role in energy storage and utilization.

6. Understand the concept of the dual role of metabolism, that is, that it functions in both anabolic and catabolic directions. Using examples from primary metabolism, understand why pathways such as glycolysis, the TCA cycle and the pentose phosphate pathway serve in energy production and also for the production of biosynthetic intermediates to synthesize building blocks for biopolymers such as proteins, DNA/RNA and storage/structural polymers such as glycogen or starch, cell wall polysaccharides, and membrane lipids. Learn the important role of metabolic co-factors such as ATP, coenzyme A and NADH and how these co-factors enable the functioning of metabolism.

7. Understand that mammals need to effectively use a variety of nutrients for energy metabolism, including proteins (amino acids) and lipids in addition to carbohydrates. In a similar way to carbohydrates, catabolism and anabolism of proteins and lipid compounds involves multiple reactions, but ultimately their utilization can be understood by the needs of organisms to grow, or to store or utilize metabolic energy. Understand that mammals have lost specific pathways and therefore need to take in vitamins and essential fatty acids and amino acids.

8. Understand that higher eukaryotes must coordinate the metabolism in different organs. Hormones in mammalian cells are integrators of carbohydrate, amino acid and lipid metabolism. Understand how hormones coordinate metabolism of multiple organs and of multiple types of compounds to achieve a specific metabolic goal. In this class, we learn about two hormones that regulate carbohydrate metabolism, glucagon and insulin. There are other hormones, but the focus of this class is on these two. We will look for a few specific physiological responses, for example, low blood glucose or high adrenaline.

9. Understand the Chemiosmotic Theory and the mechanism generating the proton motive force. Understand how the proton motive force is used in the mechanism of ATP synthase, the major molecular motor, which is responsible for the synthesis of the majority of ATP.

10. Understand in general ways the various mechanisms how the activity of pathways are regulated, ranging from inherent isoenzyme activity differences (as an example, hexokinase vs. glucokinase) to allosteric modifications of the same enzyme. Learn these concepts using glycogen in mammals as the example, including its synthesis and breakdown, in addition to regulation of gluconeogenesis and glycolysis. Understand how the regulation of specific enzymes in a pathway enables organisms to route metabolic fluxes specific to the need of cells under certain biological conditions.