

Biochemistry 384i – Foundations in Biochemistry
Arizona Online – Fall 2023

Description of the Course

Fundamental concepts in physical biochemistry (energy conversion, water, and membranes), protein structure/function, methods in protein biochemistry, enzyme mechanisms, protein-mediated cell signaling, and fundamental energy conversion pathways. This course is designed for undergraduate students with majors in any of the STEM fields, as well as pre-professional health science students with liberal arts majors who have taken the necessary prerequisite courses. Bioc 384 is the companion course to Bioc 385 “Metabolic Biochemistry.” Note that since the same textbook is used for both courses, it is possible to take them out of sequence by referring to material in the book.

Bioc 384/385 Course Prerequisites: CHEM 142/144 or CHEM 152 (General Chemistry), CHEM 241A (Organic Chemistry), and MCB 181R (General Biology) - and all prerequisites for these listed courses. Note that credit can be earned in Bioc 384 or Bioc 462A, but not both, similarly Bioc 385 or Bioc 462B.

Bioc 384 Course Objectives: *The following topics will be covered in this course:*

1. Energy conversion processes and the importance of water in biochemical reactions.
3. Structure of amino acids and the role of protein structure in mediating protein function.
4. Principles of oxygen transport and protein transport across biological membranes.
5. The catalytic properties, kinetics, and allosteric regulation of metabolic enzymes.
6. Four receptor signaling pathways mediated by GPCRs, RTKs, TNFRs, and nuclear receptors.
7. Enzymatic reactions and bioenergetics of complete glucose oxidation to yield ATP, CO₂, and H₂O.

Bioc 384: Expected Learning Outcomes: *Students will be able to:*

1. Demonstrate proficiency with vocabulary used in biochemical sciences.
2. Be proficient at calculating free energy changes of enzyme catalyzed reactions in metabolism using substrate and product concentrations; understand the functional difference between ΔG and ΔG° .
3. Describe the effect of ATP Energy Charge in the cell on flux through catabolic and anabolic pathways.
4. Be proficient at using standard reduction potentials for redox half-reactions to calculate changes in standard free energy; identify oxidation and reduction reactions, oxidants and reductants, and e⁻ pairs.
5. Articulate the biochemical mechanism of O₂ transport by hemoglobin and explain the functional definition of allostery as it applies to hemoglobin structure, as well as catalyzed enzymatic reactions.
6. Describe in detail a) the molecular pathway from GPCR activation to glucose metabolism using glucagon as the first messenger, b) the molecular pathway from insulin receptor activation to glucose metabolism in response to high serum glucose levels, and c) the function of nuclear receptors.
7. Articulate the role of metabolic flux in the complete oxidation of glucose and metabolites by the glycolytic pathway, the citrate cycle, and oxidative phosphorylation; describe metabolic regulation.

Course web site on D2L

Information about lectures, homework, exams, grades, and all other aspects of this course are available on the D2L course web site. The information contained in this course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructors. Any changes will be announced on the course web site. It is the responsibility of each student to check the course web site.

Instructor: Dr. Roger L Miesfeld: rlm@arizona.edu

Zoom Office Hours; Tues/Thur at 11:00am <https://arizona.zoom.us/j/88010884593>

Teaching Assistant: Dr. Tara Archuleta; tlarchul@arizona.edu

Zoom Office Hours; Wed/Fri at 11:00am <https://arizona.zoom.us/j/83747317394>

Land Acknowledgement

We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally recognized tribes, with Tucson being home to the O'odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.

The University of Arizona resides on ancestral lands of the Tohono O'odham nation, where many today continuously reside in their ancestral land. We acknowledge the privilege it is to teach and learn in this region and we express our gratitude to the nation.

Course Materials

Textbook: **Miesfeld & McEvoy Biochemistry** (WW Norton, 2nd Edition, July 2021, magenta cover) is made available as an E-book with all e-media ancillaries including the required online graded homework (SmartWork5) at a discount through the UA Bookstore **Inclusive Access** program.

The cost of ~\$92 will be applied to your bursar account **after an initial trial period**. An unbound **print copy** of the textbook (loose leaf) is available for **\$40** – **if you keep the Inclusive Access license** – contact the UA Bookstore by email to reserve a copy:

UABKS-Inclusiveaccess@arizona.edu.

If you already have the 360 day E-book license you are good to go and do not need to OPT OUT. If you have your own print copy, you will need to purchase a license for the SmartWork online homework at a cost of \$35 from the publisher. You can purchase the SmartWork package at <https://digital.wwnorton.com/biochem2> (choose “purchase options” upper corner).

Information about the UA Inclusive Access Program and process you need to follow to OPT OUT:
<https://shop.arizona.edu/textbooks/Inclusive.asp>

Do NOT sign up for the “21-day free trial” through the publisher website - everything is through D2L.

Note that this textbook was chosen because it was specifically developed for majors with an interest in the health professions or environmental studies. Royalties in excess of \$500 that are received by RLM from textbook sales to UA students in this class will be donated to the College of Science Galileo Circle for the awarding of undergraduate student scholarships:

<https://cos.arizona.edu/content/galileo-circle-scholars>.

Student Assessment: Homework, Quizzes, Discussions, Video Participation, and Exams

There are **4 Midterm Exams** worth 200 points each and a **Cumulative Final Exam** also worth 200 pts. Only the **top four scores** of these five exams are counted for a maximum of **800 points**. The midterm exams and final exam are 90 minutes and consist of 25 multiple choice questions (8 pts each) drawn randomly from a pool of ~100 questions.

The exams are proctored by Honorlock (the Honorlock link is in the D2L navigation bar). The exams are open for scheduling for 42 hours from 5am on Day 1 (AZ time) until 11pm on Day 2 (AZ time). As long as you begin the exam before the 11pm (AZ time) deadline, you will have the full 90 minutes to complete the exam without penalty. The Final Exam is based on a set of 250 multiple choice review questions taken from the Norton Publishing Test Bank, which will be posted on D2L one week before the final exam (posted in the Quizzes tab on D2L). Answers to all 250 questions are provided using the submission view. The Final Exam is not required and can be a dropped exam.

There will be 12 **D2L Quizzes** (D2Qs) worth 10 pts each with *three submission attempts*. Only the top 10 scores will be counted to give a total of **100 pts**. In addition, there will be 12 **SmartWork (SW) Assignments** each worth 10 points with *three submission attempts* for each question. Only the top 10 scores will be counted to give a total of **100 pts**.

There are **12 Discussion Assignments** worth 10 pts each. Only the top 10 scores will be counted to give a total of **100 pts**. The format for the Discussions consists of answering all of the instructor questions *in your own words* (**not copying answers** from another student or an internet resource), pose a follow-up question and choose a peer's follow-up questions and describe why you thought it was good.

Lastly, complete **PlayPosit Quiz Videos** corresponding to each module (auto-graded in D2L gradebook). Two "clicker type questions" are included in each Quiz Video with 3 *attempts* allowed. The PlayPosit questions add up to a total a total of **100 points maximum**. The graded PlayPosit "**RLM Quiz**" **Videos** close after each midterm; the ungraded "**Miesfeld**" **Videos** and PPT decks do not close.

IMPORTANT: You need to screen capture or rewrite the imbedded PlayPosit questions *during the open period* as the RLM Quiz videos with PlayPosit questions do not open again before the exam.

There are a **total of 1200 pts**, with 800 pts from online proctored Honorlock exams and 400 pts from the assigned open book/open note quizzes and discussions.

Guaranteed grade cutoffs for total points (some adjustment downward in the cutoffs may occur):

1080 total pts. (90%) for an "A" grade

960 total pts. (80%) for a "B" grade

780 total pts. (65%) for a "C" grade

540 total pts. (45%) for a "D" grade

<540 total pts. (<45 %) for a "E" grade

A grade of *Incomplete* can only be obtained at the end of the semester, when all but a minor portion of the course work has been satisfactorily completed. Consult the UA General Catalog for information. Scores will be rounded up 0.5%, so 89.5% = 90%.

D2L Exams and D2Q quizzes use the question library format, which means that questions are pulled from the RLM question library for each student as a "pooled" assessment. There are ~35-95 *questions* in each RLM D2L pool. Questions in the RLM Question Library are proprietary and unavailable to students.

Extra Credit Opportunities There are two *extra credit* opportunities worth a total of **60 points**.

- 1) Submit the **Everyday Biochemistry Extra Credit Assignment** found in the "**Assignments**" tab in D2L. This assignment consists of visiting my website at <https://everydaybiochemistry.com/everyday-biochem/> and choosing one of the examples of Everyday Biochemistry derived from the 23 chapter openings in the course textbook. Once you have chosen one that you find interesting, answer the following four questions, 1) what is the **title of the Everyday Biochemistry** example you chose?, 2) how does this example **relate to the concepts** in the corresponding chapter?, 3) what are **two personal "take-aways"** from the Everyday Biochemistry example, i.e., why did you choose it?, and 4) **describe another Everyday Biochemistry example** that would work for this chapter based on either everyday biochemistry vignettes found in the same chapter (each chapter contains many everyday biochemistry vignettes), or a new idea that you came up with for this chapter from an internet search or personal experience. The Everyday Biochemistry extra credit assignment should be ~300-600 words in .doc, docx, or .pdf file format and submitted through the Assignments D2L Drop box. It is worth a total **45 points maximum**. The Grad TA will grade your submission and it will be evaluated by TurnItIn.com software to detect plagiarism.
- 2) If >60% of the students in the class complete the anonymous **UArizona Student Survey** at the end of the semester sent from the Provost office, then every student in the class will receive **15 points**.

NOTE: Quiz and Discussion deadlines are 11:59pm AZ time with no deadline extensions.

The HONORLOCK proctoring service. In this class, you will take your tests remotely and will be proctored by [Honorlock](#) using the Honorlock tab in the D2L navigation bar. A Student Quick-Guide is linked to the Content Bar in D2L. You DO NOT need to create an account or schedule an appointment in advance, and it is available 24/7. Please read system requirements and Honorlock's rules and expectations. **Note:** *specific instructions for Bioc 384.385 students* are posted in the D2L Content bar.

Watch this video: <https://honorlock.kb.help/how-to-use-honorlock-student/>

System Requirements: *You will need a desktop or laptop with an operating system.*

- Windows 10 or 11
- MacOSX 10.14 or ChromeOS 93 and higher

NOTE: Tablets and iPads are not compatible Your device must have a webcam and microphone.

- Built-in or external devices are ok.

NOTE: Honorlock is not compatible with Walmart Branded Camera (ONN) You will need stable internet connection speed.

- Minimum of 1.5 MBPS download and 750 kbps upload. You will need to use Google Chrome as your browser.
- Google Chrome version 93 and higher.

To check if your device meets minimum system requirements, please visit <https://honorlock.com/support/> and scroll to the "System Requirement".

Honorlock's Standard Rules and Regulations

Testing Area

- Lighting in the room must be bright enough to show the student's face and the surrounding area in a clear and detailed manner. Students should be seated at a desk or table. Laying down in bed or elsewhere when taking the exam is not allowed.
- Students should clear their desk or table of all other materials (e.g., books, papers, notebooks, calculators, etc.)
- Students must show the work area, including the area under their desk, as well as the entire room during the room scan.
- No visible writing on the desk or walls is permitted.
- All third-party programs and windows (websites, Excel, Word, etc.) on the testing computer must be closed before logging into the proctored test environment.
- Loud music, television, or other distractions playing in the background are prohibited.
- No other people or parties aside from the exam taker is permitted near the testing environment, and all communication between the exam taker and other people is prohibited.

Testing Behavior:

- Students must not leave the room during the testing period at any time or take the computer into another room without Honorlock's permission.
- No breaks will be permitted.
- Use of hats, hoodies, headsets, or earplugs is prohibited.
- Cell phone use is prohibited.
- The student's face must remain within view of the camera at all times.
- Honorlock will not add more time for proctoring questions or technical issues during the exam.

For assistance, email support@honorlock.com or chat directly with support through the Live Chat feature on the [Honorlock dashboard](#).

Make-Up Exam Policy Students who know in advance that they will be unable to take an examination must contact the instructor to *request* an alternate time to take the exam. Depending on the justification, a make-up exam *may* be given; I do not give early exams. If a late exam is not possible, then that exam must be taken as your dropped exam. In the case of an emergency during the window of the scheduled class exam, the student must contact the instructor as soon as possible to make exam arrangements.

Accessibility and Accommodations: At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, <https://drc.arizona.edu>) to establish reasonable accommodations.

Threatening Behavior Policy The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

UA Nondiscrimination and Anti-harassment Policy The University is committed to creating and maintaining an environment free of discrimination; see

<http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Absence and Class Participation Policy The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at: <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop> The UA policy regarding absences from exams for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>. Absences from exams as pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>.

Code of Academic Integrity Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See:

<http://deanofstudents.arizona.edu/codeofacademicintegrity> <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.

The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>.

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may constitute copyright infringement.

Confidentiality of Student Records <http://www.registrar.arizona.edu/ferpa/default.htm>

Subject to Change Statement

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

Biochemistry 384 – Foundations in Biochemistry

Module	Topic-Rev	Lecture Title (PPT and Lecture Video)	Textbook Readings
1 <i>D2Q-01R</i> <i>SW-01R</i>	MO1.T01	<i>Introduction to Biochemical Principles</i>	<i>Chapter 1.1</i>
	MO1.T02	<i>The Complexity of Life</i>	<i>Chapter 1.2</i>
	MO1.T04	<i>Review of Thermodynamics</i>	<i>Chapter 2.1</i>
	MO1.T05-7	<i>Principles of Bioenergetics</i>	<i>Chapter 2.1</i>
	MO1.T08	<i>Water is Essential for Life</i>	<i>Chapter 2.2</i>
2 <i>D2Q-02R</i> <i>SW-02R</i>	MO2.T01	<i>Structure of DNA and RNA</i>	<i>Chapter 3.1</i>
	MO2.T03	<i>RNA Biochemistry and Binding Proteins</i>	<i>Chapter 3.1</i>
	MO2.T06	<i>Protein Polymers</i>	<i>Chapter 4.1</i>
	MO2.T07	<i>Chemistry of Amino Acids</i>	<i>Chapter 4.1</i>
	MO2.T08	<i>Chemistry of the Peptide Bonds</i>	<i>Chapter 4.1</i>
3 <i>D2Q-03</i> <i>SW-03</i>	MO3.T01	<i>Protein Structure: Primary and Secondary</i>	<i>Chapter 4.2</i>
	MO3.T02	<i>Protein Structure: Tertiary and Quaternary</i>	<i>Chapter 4.2</i>
	MO3.T03	<i>Mechanisms of Protein Folding</i>	<i>Chapter 4.3</i>
		EXAM 1 Topics covered in Modules 1-3	
4	MO4.T01	<i>Protein Purification; Chromatography</i>	<i>Chapter 5.1</i>
	MO4.T02	<i>Protein Purification; Electrophoresis</i>	<i>Chapter 5.1</i>
	MO4.T03	<i>Protein Structure Methods</i>	<i>Chapter 5.2, 5.3</i>
	MO4.T04	<i>Major Protein Classes</i>	<i>Chapter 6.1</i>
<i>D2Q-04</i> <i>SW-04</i>	MO4.T05	<i>Hemoglobin: Structure and Function</i>	<i>Chapter 6.2</i>
	MO4.T06	<i>Oxygen Binding to Hemoglobin</i>	<i>Chapter 6.2</i>
5	MO5.T01	<i>Hemoglobin: Allostery and Evolution</i>	<i>Chapter 6.2</i>
	MO5.T02	<i>Membrane Transport Proteins</i>	<i>Chapter 6.3</i>
	MO5.T03	<i>Passive Transport</i>	<i>Chapter 6.3</i>
	MO5.T04	<i>Active Transport</i>	<i>Chapter 6.3</i>

Module	Topic-Rev	Lecture Title (PPT and Lecture Video)	Textbook Readings
D2Q-05 SW-05	MO5.T05	<i>Muscle Contraction</i>	Chapter 6.4
6	MO6.T01	<i>Overview of Enzymes</i>	Chapter 7.1
	MO6.T02	<i>Enzyme Function</i>	Chapter 7.2
	MO6.T03	<i>Enzyme Mechanisms</i>	Chapter 7.3
	MO6.T04	<i>Enzyme Reactions</i>	Chapter 7.3
	D2Q-06 SW-06	MO6.T05	<i>Enzyme Kinetics</i>
		EXAM 2 Topics covered in Modules 4-6	
7	MO7.T01	<i>Enzyme Inhibition</i>	Chapter 7.5
	MO7.T02	<i>Enzyme Regulation</i>	Chapter 7.5
	MO7.T03	<i>Cell Signaling</i>	Chapter 8.1
	D2Q-07 SW-07	MO7.T04	<i>G Protein-Coupled Receptors</i>
8	MO8.T01	<i>Growth Factor Signaling</i>	Chapter 8.3
	MO8.T02	<i>Insulin Signaling</i>	Chapter 8.3
	MO8.T03	<i>Tumor Necrosis Factor Signaling</i>	Chapter 8.4
	MO8.T04	<i>Nuclear Receptor Signaling</i>	Chapter 8.5
	MO8.T05	<i>Overview of Metabolism</i>	Chapter 9.1
	D2Q-08 SW-08	MO8.T06	<i>Metabolic Flux</i>
9	MO9.T01	<i>Simple Sugars</i>	Chapter 9.2
	MO9.T02	<i>Glycolysis Energetics</i>	Chapter 9.3
	MO9.T03	<i>Glycolysis Reactions</i>	Chapter 9.3
D2Q-09 SW-09	MO9.T04	<i>Glycolysis Regulation</i>	Chapter 9.4
	MO9.T05	<i>Glycolysis Shared Intermediates</i>	Chapter 9.5
		EXAM 3 Topics covered in Modules 7-9	
10	MO10.T01	<i>REDOX Reactions</i>	Chapter 10.1
	MO10.T02	<i>Pyruvate Dehydrogenase Overview</i>	Chapter 10.2
	MO10.T03	<i>Pyruvate Dehydrogenase Reactions</i>	Chapter 10.2

Module	Topic-Rev	Lecture Title (PPT and Lecture Video)	Textbook Readings
<i>D2Q-10 SW-10</i>	MO10.T04	<i>Citrate Cycle Reactions</i>	<i>Chapter 10.3</i>
11 <i>D2Q-11 SW-11</i>	MO11.T01	<i>Citrate Cycle Regulation</i>	<i>Chapter 10.4, 10.5</i>
	MO11.T02	<i>Chemiosmosis</i>	<i>Chapter 11.1</i>
	MO11.T03	<i>Electron Transport System - Part 1</i>	<i>Chapter 11.2</i>
	MO11.T04	<i>Electron Transport System - Part 2</i>	<i>Chapter 11.2</i>
12 <i>D2Q-12 SW-12</i>	MO12.T01	<i>ATP Synthase</i>	<i>Chapter 11.3</i>
	MO12.T02	<i>Mitochondrial Transport</i>	<i>Chapter 11.4</i>
	MO12.T03	<i>Regulation of Oxidative Phosphorylation</i>	<i>Chapter 11.5</i>
		EXAM 4 Topics covered in Modules 10-12	
		FINAL EXAM: Based on a Set of 250 Questions (Final Exam Question Set is available in the D2L Quiz tab)	