Biochemistry 385 – Metabolic Biochemistry
Arizona Online – Summer 2025

Description of the Course
Fundamentals of metabolism at the cellular and organismal levels, with a focus on regulatory mechanisms that control metabolic flux. Topics include metabolic flux through energy converting pathways, metabolism of carbohydrates, lipids, amino acids, and nucleotides. 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 385 is the companion course to Bioc 384 "Foundations in 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 (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 385 Course Objectives: *The following topics will be covered in this course:*
1. Metabolic flux and have foundational understanding of metabolic regulation.
2. Carbohydrate degradation/biosynthetic pathways and regulation of carbohydrate metabolism.
3. Lipid degradation and biosynthetic pathways and regulation of lipid metabolism.
4. Amino acid degradation and biosynthetic pathways and regulation of amino acid metabolism.
5. Nucleotide degradation and biosynthetic pathways and regulation of nucleotide metabolism.
6. Relationships between metabolic pathways and physiological responses to hormones.
7. Structure-function relationships of DNA, RNA, and protein modifying proteins.

Expected Learning Outcomes: *Students will be able to:*
1. Articulate core principles of seven major metabolic pathways with regard to a) the function of the pathway in cells, b) the net reaction of the pathway, c) the key regulated enzymes in the pathway, and d) an example of everyday biochemistry in which the pathway is essential.
2. Articulate the biochemical basis for DNA replication, DNA repair, and DNA recombination with regard to the major enzymes and their functions.
3. Describe in detail a) how RNA synthesis differs between prokaryotes and eukaryotes, b) the processes required for mRNA maturation in eukaryotes, and c) RNA interference.
4. Describe in detail a) how the Genetic Code was discovered and by whom, b) the essential steps in protein synthesis, and c) examples of three types of antibiotics.
5. Describe in detail a) how gene regulation differs between prokaryotes and eukaryotes and why this matters, b) specific components of the *lac* and *trp* operons and how the operons are regulated in response to metabolite availability, and c) basis of induced pluripotency.

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 (MST) https://arizona.zoom.us/j/88010884593

Grad Teaching Assistant: Jordan Yoder: JCYODER@ARIZONA.EDU
Zoom Office Hours; TBD

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.

An unbound **print copy** of the textbook (loose leaf) is available for **$40** – ***if you keep the Inclusive Access license*** and contact the UA Bookstore by email **after the OPT OUT deadline** to reserve a print copy: digitaltext@arizona.edu.

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 48 hours from **11am on Day 1** (AZ time) until **11pm on Day 3** (AZ time). As long as you begin the exam before the 11pm (AZ time) deadline on Day 3, 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**.

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)*:
1074 total pts. (89.5%) for an "A" grade
954 total pts. (79.5%) for a "B" grade
774 total pts. (64.5%) for a "C" grade
534 total pts. (44.5%) for a "D" grade
<534 total pts. (<44.5 %) 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 are 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 textbook. The 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**. 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 **Student Course 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 course, you'll have the convenience of taking your exams remotely, supported by Honorlock (opens in a new tab) (https://honorlock.com/home-c/). To help you navigate the Honorlock process effortlessly, you will receive a Student Guide. To ensure a seamless testing experience, please have your CatCard or a government-issued ID ready for identity verification. Before initiating your exam, we recommend reviewing the system requirements and acquainting yourself with Honorlock's standard rules and expectations. There's no need to create an account or pre-schedule an appointment; Honorlock access is available 24/7 via D2L, ensuring flexibility in your testing schedule.

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+
- MacOSX 10.15 or ChromeOS 120+ and Google Chrome browser 120+
- Internet: >2 Mbps download and >1 Mbps upload (Hotspots not recommended)

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

- Built-in or external devices are ok.
- Students will need to also have the following minimum requirement to test with Honorlock:
  - Desktop computer, laptop, or Chromebook (tablets and cell phones do not meet our requirements)
  - A working built-in or external webcam and microphone
  - Use of Google Chrome and disable pop-up blocker

NOTE: Honorlock is not compatible with Walmart Branded Camera (ONN) You will need stable internet connection speed. To check if your device meets minimum system requirements: https://prep.honorlock.com/system-check

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.
- **Having a cell phone or tablet in the room for use during the exam is strictly 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. 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 385 – Metabolic Biochemistry

Module	Topic	Lecture Title (PPT and Lecture Video)	Textbook Readings
1	MO1.T01	*Review of Bioenergetics*	*Section 2.1*
	MO1.T02	*Overview of Metabolism*	*Section 9.1*
	MO1.T03	*Overview of Enzymes*	*Sections 7.1, 7.5*
D2Q-1 and SW-1	MO1.T04	*Plants Harvest Energy from the Sun*	*Section 12.1*
2	MO2.T01	*Energy Conversion by Plant Photosystems*	*Section 12.2*
	MO2.T02	*Photophosphorylation*	*Section 12.3*
	MO2.T03	*The Calvin-Benson Cycle*	*Section 12.4*
D2Q-2 and SW-2	MO2.T04	*C4/CAM Pathways Reduce Photorespiration*	*Section 12.4*
3	MO3.T01	*Overview of Carbohydrate Structure and Function*	*Section 13.1*
	MO3.T02	*Biological Functions of Glycoconjugates*	*Section 13.2*
	MO3.T03	*The Pentose Phosphate Pathway*	*Section 14.1*
D2Q-3 and SW-3	MO3.T04	*The Gluconeogenic Pathway*	*Section 14.2*
		EXAM 1 Topics covered in Modules 1-3	
4	MO4.T01	*Overview of Glycogen Metabolism*	*Section 14.3*
	MO4.T02	*Regulation of Glycogen Metabolism*	*Section 14.3*
	MO4.T03	*Structure and Function of Fatty Acids*	*Section 15.1*
D2Q-4 and SW-4	MO4.T04	*Triacylglycerols are Energy Storage Lipids*	*Section 15.2*
5	MO5.T01	*Cell Membranes Contain Three Major Lipids*	*Section 15.3*
	MO5.T02	*Lipids Function in Cell Signaling*	*Section 15.4*
	MO5.T03	*Fatty Acid Oxidation: Palmitate*	*Section 16.1*
D2Q-5 and SW-5	MO5.T04	*Other Fatty Acid Oxidation and Ketogenesis*	*Section 16.1*
6	MO6.T01	*Synthesis of Fatty Acids*	*Section 16.2*
	MO6.T02	*Synthesis of Triacylglycerols & Membrane Lipids*	*Section 16.2*
	MO6.T03	*Cholesterol Synthesis and Metabolism*	*Section 16.3*

Module	Topic	Lecture Title (PPT and Lecture Video)	Textbook Readings
D2Q-6 and SW-6	MO6.T04	*Nitrogen Fixation and Assimilation*	*Section 17.1*
		EXAM 2 Topics covered in Modules 4-6	
7	MO7.T01	*Protein Turnover*	*Section 17.2*
	MO7.T02	*Amino Acid Degradation*	*Section 17.2*
	MO7.T03	*Amino Acid Biosynthesis*	*Section 17.3*
D2Q-7 and SW-7	MO7.T04	*Synthesis of Amino Acid Derivatives*	*Section 17.4*
8	MO8.T01	*Purine Metabolism*	*Sections 18.1, 18.2*
	MO8.T02	*Pyrimidine Metabolism*	*Section 18.3*
D2Q-8 and SW-8	MO8.T03	*Deoxynucleotide Metabolism*	*Section 18.4*
9	MO9.T01	*Metabolic Integration*	*Section 19.1*
	MO9.T02	*Metabolic Energy Balance*	*Section 19.2*
D2Q-9 and SW-9	MO9.T03	*Biochemistry of Nutrition and Exercise*	*Section 19.3*
		EXAM 3 Topics covered in Modules 7-9	
10	MO10.T01	*Overview of DNA Replication*	*Section 20.1*
	MO10.T02	*Biochemistry of DNA Synthesis*	*Section 20.1*
	MO10.T03	*Mechanisms of DNA Repair*	*Section 20.2*
	MO10.T04	*Mechanisms of DNA Recombination*	*Section 20.3*
D2Q-10 and SW-10	MO10.T05	*Structure and Function of RNA*	*Section 21.1*
11	MO11.T01	*Biochemistry of RNA Synthesis*	*Section 21.2*
	MO11.T02	*RNA Processing*	*Section 21.3*
	MO11.T03	*Regulation of Eukaryotic RNA Processing*	*Section 21.4*
	MO11.T04	*Deciphering the Genetic Code*	*Section 22.1*
D2Q-11 and SW-11	MO11.T05	*Biochemistry of Protein Synthesis*	*Section 22.2*

Module	Topic	Lecture Title (PPT and Lecture Video)	Textbook Readings
12	MO12.T01	*Post-translational Modification of Proteins*	*Section 22.3*
	MO12.T02	*Mechanisms of Prokaryotic Gene Regulation*	*Sections 23.1, 23.2*
D2Q-12 and SW-12	MO12.T03	*Mechanisms of Eukaryotic Gene Regulation*	*Section 23.3*
		EXAM 4 Topics covered in Modules 10-12	
		FINAL EXAM: Based on a Set of 250 Questions *(Final Exam Question Set in the D2L Quiz tab)*	