

Bi214 General Biology IV: Mechanisms, Fall 2023

Course Description

This course expands upon the introductory material that was presented in BI 211, as many upper division subjects in Biology necessitate a good working knowledge of genetics (transmission and molecular) and biochemistry (protein structure and function). We will emphasize key experiments, and how biochemists and geneticists design, execute, and interpret them. The first part of the course will be dedicated to an understanding of protein structure, and how that structure governs protein function. We will begin with a study of the properties of amino acids; we will then investigate how amino acids join together to define the primary protein structure, and how portions of the primary structure are folded into a few common functional 3-dimensional themes. Using the oxygen transport molecule hemoglobin as an example, we will then look at how the overall shape and cooperation between regions of a protein affect the protein's function. The biochemistry portion of the class will conclude with a look at DNA structure with the goal of understanding how its structure allows for replication and protein binding. We will also examine how chemical changes to the structure can lead to mutations.

During the genetics half of the course, we will begin with a description of some inherited metabolic errors, and what essential genetic principles were learned from their initial study. After a review of basic genetic principles, we will explore basic tools used by a geneticist, such as phenotypic analysis of mutants to determine a gene's function, and complementation tests and other approaches to determine a mutant's gene identity.

Finally, using this knowledge we can explore a simple set of genes in a bacterium to see how genes are turned on and off (how transcription is stimulated or prevented). This can be described as the flipping of genetic switches in response to a cell's needs. We will use the well-studied example of the lac operon, to explore this form of gene regulation.

Bi211 and Bi212, or the equivalent, and a full year of General Chemistry are prerequisites.

Class Learning Objectives:

Biochemistry

- You have an understanding of a protein's structure from the unique chemical properties of the amino acids to the three-dimensional shape of the polypeptide; you can then consider how protein structure affects protein function, using hemoglobin as an example.
- You can explain the basic components of DNA's structure, and explain how tautomeric shifts cause mutations.

Genetics:

- You have an understanding of some important tools in forward genetics: mutagenesis, conditional mutants to uncover gene function, and complementation tests. Yeast metabolic pathways will be used as an example.
- You have a basic understanding of the gene's structure, can explain how activators and suppressors regulate transcription, can make predictions about how mutations in regulatory proteins or DNA elements affects cellular pathways, and discuss these mechanisms using the lac operon as an example.

Laboratory

- You have an understanding of how molecular modeling can be used to examine chemical structures (polypeptides and DNA), can perform some basic techniques in molecular biology such as using a pipet, running a DNA gel and plating cultures, and finally you've been exposed to some common model organisms (*E. coli*, *S. cerevisiae*, and *C. elegans*).

Teaching Team!

Instructors	GEs
Dr. Connolly (Lecture) amyc@uoregon.edu	Sarah Welch sjones18@uoregon.edu
Katie Pérez (Lab Preparator) kperez@uoregon.edu	Maggie Barry mlbar@uoregon.edu
Jana Prikryl (Lab) Jprikryl@uoregon.edu	Aubrey Mayer ajmay@uoregon.edu
	Gonzalo Morales Chaya gonzalom@uoregon.edu

For a list of BULAs and BTUs, see "teaching team" page on canvas.

Lecture

Monday, Wednesday 12:00-1:20 pm, in 129 McKenzie Hall

- **Pre-Class Videos and Module Quizzes:** The content for the class will be delivered through pre-recorded videos. You will need to watch them and complete the corresponding module quiz before coming to class. You will be allowed two attempts for these module quizzes, but the first attempt must be **completed by 11:59 PM** the night before. The second attempt must be completed within one week, after that time the quiz is no longer available to take.

- **Class:** Class time will consist of a brief review from the videos, discussing the module quiz, followed by practice problems that are substantially more challenging, meant to prepare you for the exams.

Exams: Exams will be closed book, closed notes. You will need a scientific calculator for at least exam 1 and the final. To help prevent the circulation of exams, the exams will not be made available. However you will be allowed to view exams after you have taken them at designated “exam viewing” times.

Labs

Thurs/Fri (1 hour 50 min) in Klamath 13

- **Lab Reports (on paper):** A pdf of the lab handout for the week can be found on Canvas. You must come to lab with a printed version of this pdf to fill out during our time together (printers are available to use with your Duck ID in all residence halls and the UO libraries). **The lab reports are found at the end of the labs and are due at the beginning of the next lab, except the last lab, which is due at the end of the lab period.**
- **Lab Quizzes (on canvas):** You will have a lab quiz due **Wednesday night at 11:59 PM**. The lab quiz is administered through canvas and will contain questions meant to prepare you for the upcoming lab, in addition (starting lab 2) questions that will quiz you over the previous week’s lab. Unlike the module quizzes, you can only take the pre-lab quizzes one time. You are welcome to ask for help during our office hours and work with your peers on this assignment.
- **Lab Participation:** Associated with your lab grade is an attendance, courtesy, and active participation component. If you attend lab regularly (and on time), actively participate, and clean-up after yourself you should receive full credit. *Note: There is one lab that will require you to return to the lab two times; see schedule.*

Lab Times	GE(s)	BULA
Thursday 9:00-10:50 AM	Sarah Welch sjones18@uoregon.edu	Ellie
Thursday 11:00-12:50 AM	Gonzalo Morales Chaya gonzalom@uoregon.edu	Rachel & Jasmine M.
Thursday 1:00-2:50 PM	Maggie Barry mlbar@uoregon.edu	Jaden & Anais
Thursday 3:00-4:50 PM	Maggie Barry mlbar@uoregon.edu	Tucker & Eric
Friday 9:00-10:50 AM	Aubrey Mayer ajmay@uoregon.edu	Ciarra & Peter
Friday 11:00-12:50 AM	Aubrey Mayer ajmay@uoregon.edu	Aiden & Ava
Friday 1:00-2:50 PM	Sarah Welch sjones18@uoregon.edu	Jasmine W. & Yahir

Office Hours/Help Sessions

We will have office hours every school/business day. You can find the schedule and room location on Canvas in the first module under “Office Hours.

Required Supplies

- Scientific Calculator
- There is no book this term. Instead we are providing links to open access (Free!) textbooks and other material where it's available in the modules to support your understanding. You can find these in the modules as "Supplemental reading."
- We are providing pdf's of each lab exercise. You must print these out prior to coming to lab.

Communication Guidelines

In order for the teaching staff to effectively help a number of students, please use the following guidelines:

- **Lecture Content:** If you have questions about module quizzes, or problem sets, and content in general, please do the following in the following order.
 1. Come to office hours
 2. Use Canvas's discussion section to ask a question. The teaching team will be monitoring it frequently. It's an efficient way for our teaching staff to answer a number of questions at once.
 3. Email Dr. Connolly
- **Lab Content:** For lab questions specifically, please do the following in the following order
 1. Use remaining lab time to work through lab reports, since help is readily available.
 2. Come to office hours
 3. Use Canvas's discussion section to ask a question.
 4. Email your GE
 5. Email Dr. Jana Prikryl, jprikryl@uoregon.edu
- **Personal matters or grading questions:** Please email directly the instructors for these matters.
 1. **Module quiz and exam** grading questions, errors, and requests should be sent to Dr. Connolly, within one week.
 2. Questions about **lab report grades** and **pre/post-lab quizzes** should be directed to your GE. Requests for regrades must occur within one week of receiving the grade. If the matter cannot be resolved with your GE contact Dr. Jana Prikryl.
- **Class Announcements:** Finally, we will also communicate with you through our Canvas site. Announcements can be automatically forwarded to your UO email, and can even reach you by text. Check and adjust your settings under Account > Notifications.

Grading Breakdown

Content	Method 1 (Canvas) Lower of Exam 1 and 2 dropped	Method 2 Opt out of Final, Exam 1 and 2 counted more heavily
Module Quizzes (lowest two dropped)	10%	10%
Exam 1 and Exam 2	20%	50%
Final	30%	0%
Lab Attendance (lowest dropped)	5%	5%
Lab Quizzes (lowest score dropped)	18%	18%
Lab Reports (lowest score dropped)	17%	17%

Grading Scale

The grading scale below will be used to determine your grades. Cut offs may be drawn lower for any grade but will never be drawn higher. The exact cut-offs for grades won't be made public. A+ grades are special and are rewarded in cases of outstanding performance. **At the end of the term do not ask for your grade to be bumped or for extra assignments or extra credit.** I endeavor to make the class fair for everyone and cannot grant these kinds of requests.

A+	A	A-	B+	B	B-	C+	C	C-	D	F
100 and above	93-99	90-92	87-89	83-86	80-82	77-79	73-76	70-72	60- 69	59 and below

Philosophy on Grades: I endeavor to provide you with a number of assignments where you can earn points simply by doing the work well, coming to office hours to get help, and full participating (module quizzes, lab quizzes, lab reports, participation). But exams are always harder; these are the places where you must reason through questions on your own. Be sure to put out the effort on the smaller assignments in class so you can bolster your exam grades if need be!

Philosophy on Curves: I hope to not need to curve. But if so, I'd rather students see a curve reflected in real-time, as opposed to at the end of the course. I will curve individual exams if need be. If an average of at least 70% on the exam is not achieved by the class, the exam will be curved to at least 70%.

Late Policies and Missed work:

According to the Office of the Provost, policies to deal with late or missed work must be "reason-neutral," meaning the instructor needs a one-size-fits-all policy on dealing with missed assignments. The policy to handle missed work is embedded in the grading structure of this course. One of each type of the assignments can be dropped. So whether you didn't do as well that day or you had an emergency come up, you will automatically get one of each type of assignments dropped.

- **Late Penalty:** Module quizzes and lab quizzes submitted any time after 11:59 PM of the day its due will **receive a flat 15% deduction** off the total points. Late lab reports will also receive at flat 15% deduction. You have one week to turn in a late assignment (quiz or lab report) before it becomes a 0. But the last week of class, everything must be turned in by Friday of Week 10. Late policies are strict because it's essential that students show up prepared to class and lab.
- **Extensions:** As much as I would like to help you out as situations arise, with such a large class size, these requests become hard to manage. So don't worry too much if you're having a bad day and accrue a late penalty, because 1) you can turn it in late for a 15% deduction and 2) your lowest score (lab quiz and lab reports) or two lowest scores (module quizzes) are dropped.
- **Lab Attendance:** Labs are not easily made up because a great deal of prep goes into setting them up and taking them down each week. If you must miss, please contact your GE as soon as possible. Your first miss will be dropped (we drop one lab report grade for every student) your second miss can be made up with an online assignment administered by your GE. These assignments are different from the original lab and are often difficult, as they account for missed preparation, groupwork, and individual work. Please do not miss labs for frivolous reasons as there will be no additional makeup lab opportunities available after two misses, regardless of reason; you should save misses for if you really need them.
- **Make up exams:** No make-up exams will be given, but this is why the grading policy has worked into it a mechanisms to drop the lowest exam. Please see Grading Breakdown.

Accommodations for students with disabilities:

If you have a documented disability and anticipate needing accommodations in this course, please provide Dr. Connolly, Dr. Prikryl and your lab instructor with a notification letter from the Accessible Education Center stating your approved accommodations. If you have flexibility on attendance or due dates, it is imperative that you reach out to your instructor early on to discuss an arrangement with how you are going to handle missed days or late assignments.

Academic Misconduct

I expect you to hold yourself to high ethical standards. When students model trustworthy behavior, it makes it easier for me to be more lenient during times when students run into real trouble and need help. It should go without saying that, all work submitted in this course must be your own. Instances of suspected cheating or plagiarism on exams, quizzes, and reports will be referred to the Office of Student Conduct and Community Standards. Your instructors take these cases seriously. Academic misconduct could result in a failing mark for quiz, exam, report or for the course. For definitions of violations, a description of the hearing process, and a summary of penalties for findings of academic misconduct, go to <http://policies.uoregon.edu/vol-3-administration-student-affairs/ch-1-conduct/student-conduct-code>

Posting course material on internet sites is not allowed

Posting course material including videos, lecture notes, problems, and solutions, on any platform that is not officially affiliated with the course is prohibited and will be treated as academic misconduct, reported to the Dean of Students Office, and may result in an F grade in the course. This applies during the course and retroactively. If you have questions about what is appropriate and what is not, please ask; ignorance will not be an acceptable defense.

Mental Health Resources

If you are struggling and need someone to talk to, there are mental health resources available to you as a UO student. Please follow the links here.

<https://counseling.uoregon.edu>

<https://counseling.uoregon.edu/mental-health-resources>

Academic Disruption

In the event of a campus emergency that disrupts academic activities, course requirements, deadlines, and grading percentages are subject to change. Information about changes in this course will be communicated as soon as possible by email, and on Canvas. If we are not able to meet face-to-face for labs, students should immediately log onto Canvas and read any announcements and/or access alternative assignments. Students are also expected to continue coursework as outlined in this syllabus or other instructions on Canvas.

Class Schedule

The topics below are open to change, but the exam times and lab and module due dates will stay constant unless some unforeseen event arises.

Date	Agenda
Week 1: Amino Acid Properties and Acid/Base Chemistry Review	
Mon Sept 25	NO CLASS
Wed Sept 27 by 11:59 PM (normally would be night before)	<u>Module 1-1: Amino Acid Properties</u> <ul style="list-style-type: none"> • Video or Reading #1 Amino Acid Structure • Video or Reading # 2 Amino Acid Polarity and Solubility • Reading: Margaret Oakley Dayhoff • MODULE QUIZ 1-1 DUE
Wed Sept 27	<u>Class:</u> <ul style="list-style-type: none"> • Syllabus Overview • Topics in Polarity/Solubility • Review Module 1-1 Quiz
Wed Sept 27 by 11:59 PM	<u>Module 1-2: Acid/Base Chemistry Review</u> <ul style="list-style-type: none"> • Video #1 Acid-Base Chemistry Review • Video #2 Acid-Base Chemistry Review Cont • MODULE QUIZ 1-2 DUE
LAB time Thurs/Fri Sept 28/29	<u>Normally would be in class but will be in Lab</u> <ul style="list-style-type: none"> • Review Module 1-2 Quiz • Work through more challenging problems pertaining to acid/base chemistry
Week 2: Amino Acid Chemistry	
Sun Oct 1 by 11:59 PM	<u>Module 2-1: Amino Acid Chemistry</u> <ul style="list-style-type: none"> • Video #1: Diprotic Amino Acids • Video #2: Amino Acid Charge • Video #3: Calculating Charge of Amino Acids • MODULE QUIZ 2-1 DUE
Mon Oct 2	<u>Class</u> <ul style="list-style-type: none"> • Review Module 2-1 Quiz • Work through more challenging problems pertaining to amino acid chemistry
Tues Oct 3 by 11:59 PM	<u>Module 2-2: Amino Acid Chemistry and Polypeptides</u> <ul style="list-style-type: none"> • Video #1: Triprotic Amino Acids • Video #2: Polypeptides • MODULE QUIZ 2-2 DUE
Wed Oct 4	<u>Class</u> <ul style="list-style-type: none"> • Review Module 2-2 Quiz • Work through more challenging problems pertaining to amino acid chemistry and polypeptides
Wed Oct 4 by 11:59 PM	Week 2 PRE-LAB QUIZ DUE
Thurs/Fri Oct 5/6	Week 2 Lab: Amino Acids BRING YOUR AMINO ACID FLASH CARDS TO LAB (See Pre-lab for instructions)
Week 3 Protein Structure	

Sun Oct 8 by 11:59 PM	<u>Module 3-1: Protein Structure</u> <ul style="list-style-type: none"> • Video #1: Primary Structure • Video #2: Intro to Secondary Structure • Reading: G.N. Ramachandran MODULE QUIZ 3-1 DUE
Mon Oct 9	<u>Class</u> <ul style="list-style-type: none"> • Review Module 3-1 Quiz • Work through more challenging problems pertaining to protein structure
Tues Oct 10 by 11:59 PM	<u>Module 3-2:</u> <ul style="list-style-type: none"> • Video #1: Secondary Structure Cont. • Video #2: Tertiary and Quaternary Structure • MODULE QUIZ 3-2 DUE
Wed Oct 11	<u>Class</u> <ul style="list-style-type: none"> • Review Module 2-2 Quiz • Work through more challenging problems pertaining to protein structure
Wed Oct 11 by 11:59 PM	Week 3 PRE-LAB QUIZ DUE
Thurs/Fri Oct 12/13	Week 3 Lab: Protein Structure
Amino Acids LAB REPORT DUE AT THE BEGINING OF LAB	
Week 4 Hemoglobin	
Sun Oct 15 by 11:59 PM	<u>Module 4-1:</u> <ul style="list-style-type: none"> • Video #1: Structure and Function in Hemoglobin • Video #2: Oxygen Binding and Conformation Change in Hemoglobin • Reading MODULE QUIZ 4-1 DUE
Mon Oct 16	<u>Class</u> <ul style="list-style-type: none"> • Review Module 4-1 Quiz • Work through more challenging problems pertaining to hemoglobin
Tues Oct 17 11:59 PM	<u>Module 4-2:</u> <ul style="list-style-type: none"> • Video #1: Negatie Allosteric Effectors in Hemoglobin • Reading: Ruth Benesch MODULE QUIZ 4-2 DUE
Wed Oct 18	<u>Class</u> <ul style="list-style-type: none"> • Review Module 4-2 Quiz • Concepts and more challenging problems pertaining to Hemoglobin
Wed Oct 18	Week 4 PRE-LAB QUIZ DUE
Thurs/Fri Oct 19/20	Week 4 Lab: Hemoglobin Cooperativity & Allostery
Protein Structure LAB REPORT DUE AT THE BEGINING OF LAB	
Week 5 DNA Structure	
Mon Oct 23	Exam 1
Tues Oct 24 by 11:59 PM	<u>Module 5-1 (Part 1):</u> <ul style="list-style-type: none"> • Video #1: DNA Structure • Video #2: Discovery of DNA Double Helix • Reading MODULE QUIZ 5-1 (1) DUE <u>Module 5-1 (Part 2):</u> <ul style="list-style-type: none"> • Video #1: Tautomer Shifts • Reading MODULE QUIZ 5-1 (2) DUE
Wed Oct 25	<u>Class</u> <ul style="list-style-type: none"> • Review Module 5-1 quizzes • Concepts and more challenging problems pertaining to DNA
Wed Oct 25 by 11:59 PM	Week 5 PRE-LAB QUIZ DUE

Thurs/Fri Oct 26/27	Week 5 Lab: DNA structure Hemoglobin LAB REPORT DUE AT THE BEGINING OF LAB
Week 6 Genetics and Conditional Mutants	
Sun Oct 29 by 11:59 PM	<u>Module 6-1: Genetics Review</u> <ul style="list-style-type: none"> • Video #1: Overview/Review in Genetics • Video #2: Metabolic Pathways • MODULE QUIZ 6-1 DUE
Mon Oct 30	<u>Class</u> <ul style="list-style-type: none"> • Review 6-1 Quiz • Compare independent/dependent pathways in polygenic inheritance • Review tautomer problems from DNA structure unit
Tues Oct 31 by 11:59 PM	<u>Module 6-2: Conditional Mutants</u> <ul style="list-style-type: none"> • Conditional Mutants • Reading • MODULE QUIZ 6-2 DUE
Wed Nov 1	<u>Class</u> <ul style="list-style-type: none"> • Expand on concepts: classical forward genetics • Review Module 6-2 Quiz • Concepts and more challenging problems pertaining to conditional mutants
Wed Nov 1 by 11:59 PM	Week 6 PRE-LAB QUIZ DUE
Thurs/Fri Nov 2/3	Week 6 Lab: Conditional Mutants You will need to return to lab. <u>Thurs Lab</u> : Return on Friday; <u>Fri Lab</u> : Return on Monday DNA Structure LAB REPORT DUE AT THE BEGINING OF LAB
Week 7 Complementation Tests	
Sun Nov 5 by 11:59 PM	<u>Module 7-1: Complementation Tests</u> <ul style="list-style-type: none"> • Video #1 Complementation Tests MODULE QUIZ 7-1 DUE
Mon Nov 6	<u>Class</u> <ul style="list-style-type: none"> • Review 7-1 Module Quiz • Discuss complementation tests as a way to check unknown mutants against known mutants
Tues Nov 7 by 11:59 PM	<u>Module 7-2: Complementation Tests</u> <ul style="list-style-type: none"> • Video #1 • Video #2 • Video #3 • Video #4 MODULE QUIZ 7-2 DUE
Wed Nov 8	<u>Class</u> <ul style="list-style-type: none"> • Review 7-2 Module Quiz • Discuss more in-depth
Thurs/Fri Nov 9/10	NO LAB! Veteran's Day
Week 8 Transcription in Prokaryotes and Begin Lac Operon	
Sun Nov 12 by 11:59 PM	<u>Module 8-1: Transcription in Prokaryotes</u> <ul style="list-style-type: none"> • Video #1 • Video #2 MODULE QUIZ 8-1 DUE
Mon Nov 13	<u>Class</u> <ul style="list-style-type: none"> • Review 8-1 Quiz

Tues Nov 14 by 11:59 PM	<u>Module 8-2: Lac Operon: Negative Regulation</u> <ul style="list-style-type: none"> • Video #1 • Video #2 • Reading MODULE QUIZ 8-2 DUE
Wed Nov 15	<u>Class</u> <ul style="list-style-type: none"> • Review Module 8-2 Quiz • Work through more challenging problems pertaining to lac operon
Wed Nov 15 by 11:59 PM	Week 8 PRE-LAB QUIZ DUE
Thurs/Fri Nov 16/17	Week 8 Lab: Complementation Test You will need to return to the lab twice. <u>Thurs Lab:</u> Return on Friday and Monday; <u>Fri Lab:</u> Return on Monday and Tuesday Conditional Mutants LAB REPORT DUE AT THE BEGINING OF LAB
Week 9 Lac Operon	
Sun Nov 19 by 11:59 PM	<u>Module 9-1: Lac Operon: Positive Regulation</u> <ul style="list-style-type: none"> • Video #1 MODULE QUIZ 9-1 DUE
Mon Nov 20	<u>Class</u> <ul style="list-style-type: none"> • Review 9-1 Quiz • Practice Lac Operon problems • Combine negative and positive regulation and think about it all together
Tues Nov 21 by 11:59 PM	<u>Module 9-2: Practice problems in Transcription Regulation/Lac Operon</u> <ul style="list-style-type: none"> • Video #1 • Video #2 MODULE QUIZ 9-2 DUE
Wed Nov 22	<u>Class</u> <ul style="list-style-type: none"> • Review 9-2 Quiz • Practice Lac Operon/Gene Expression problems • Complementation test LAB REPORT DUE AT THE BEGINING OF CLASS
	Week 9 Lab: NO LAB (Thanksgiving break!)
Mon Nov 27	Exam 2
Wed Nov 29	Final Review Session
Wed Nov 29 by 11:59 PM	Week 10 PRE-LAB QUIZ DUE
Thurs/Fri Nov 30/Dec 1	Week 10 Lab: Lac Operon LAST LAB REPORT DUE AT THE END OF LAB
Mon Dec 4 at 10:15	FINAL EXAM *Bring Calculator and #2 pencil