

## Bi214 General Biology IV: Mechanisms, Summer 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	BTUs/BULAs
Dr. Connolly (Lecture) amyc@uoregon.edu	Gracie Cao gcao@uoregon.edu
Katie Pérez (Lab Instructor) kperez@uoregon.edu	Eric Chang echang3@uoregon.edu
Emily Gustin (Lab Preparator) egustin@uoregon.edu	Ananya Chowdhury ananyac@uoregon.edu

### Lecture

Monday, Tuesday, Wednesday, Thursday 9:00-10:50 pm, in 111 Lillis

Friday, Sept 1: exam 1

Friday Sept 15: final exam

- **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 notes. You will need a scientific calculator for at 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

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

- **Lab Reports:** A pdf of the lab handout 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 will be **due the beginning of the next lab.**
- **Lab Quizzes:** You will have a lab quiz due **the night before lab at 11:59 PM.** The lab quiz will contain questions meant to prepare you for the upcoming lab, plus (starting lab 2) questions that will quiz you over the previous week’s lab. 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	Lab Instructor	BULA
Tues/Thurs 1:00-2:50 PM	Katie	Gracie
Tues/Thurs 3:00-4:50 PM	Katie	Eric

## Office Hours/Help Sessions

We will have office hours offered a number of times throughout the week. 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 student, 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 or use slack to ask a question. (The teaching team will be monitoring it frequently). Slack Link for Spring 2023 is here: [https://join.slack.com/t/uoregon-gnq1453/shared\\_invite/zt-20vx6d56u-jXe3\\_VviKd2W6YzDbI4YGA](https://join.slack.com/t/uoregon-gnq1453/shared_invite/zt-20vx6d56u-jXe3_VviKd2W6YzDbI4YGA)
  2. 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. Use our slack page: : [https://join.slack.com/t/uoregon-gnq1453/shared\\_invite/zt-20vx6d56u-jXe3\\_VviKd2W6YzDbI4YGA](https://join.slack.com/t/uoregon-gnq1453/shared_invite/zt-20vx6d56u-jXe3_VviKd2W6YzDbI4YGA)
  3. Email your GE/lab instructor
  4. Email Dr. Connolly
- **Personal matters or grading questions:** Please email directly the instructors for these matters. Please do not use slack.
  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.

- **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 (What Canvas shows)	Method 2
Module Quizzes (one a day) with lowest two dropped.	10%	10%
Exam 1	20%	Dropped
Final	30%	50%
Lab Attendance, Courtesy, & Participation (lowest dropped)	5%	5%
Pre-Lab Quiz (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 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 your 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 as a whole, 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% dedeuction. 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 by 11:59 PM as follows: Fall/Spring: Friday of Week 10; Summer: Thursday of Week 4. 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 have to miss a lab for some reason, the grading structure is set up so you can drop the lowest grade for each component of the lab (attendance, lab quiz, report). If some situation arises, contact your GE/lab instructor immediately
- **Make up exams:** Summer Policy: Exam 1: No make-up exam will be given, instead student will need to be graded by Method 2 (see above). Final: Since the final contains material you must be tested over it can't be dropped. So if you miss the final, either a 0 will be given or a flat penalty of 15%.

### **Accommodations for students with disabilities:**

If you have a documented disability and anticipate needing accommodations in this course, please provide Dr. Connolly 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.

### **Class Conduct and Academic Honesty**

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 a student may run into a 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>

### **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.

Week	Date	Agenda
1	<b>Amino Acid Properties</b>	
	Mon Aug 21 by 11:59 PM (normally would be Sunday night)	<u>Module 1-1: Amino Acid Properties</u> <ul style="list-style-type: none"> <li>• Video or Reading #1 Amino Acid Structure</li> <li>• Video or Reading # 2 Amino Acid Polarity and Solubility</li> <li>• Reading: Margaret Oakley Dayhoff</li> <li>• <b>MODULE QUIZ 1-1 DUE</b></li> </ul>
	Mon Aug 21	<u>Class:</u> <ul style="list-style-type: none"> <li>• Syllabus Overview</li> <li>• Topics in Polarity/Solubility</li> <li>• Review Module 1-1 Quiz</li> </ul>
	<b>Acid/Base Chemistry Review</b>	
	Mon Aug 21 by 11:59 PM	<u>Module 1-2: Acid/Base Chemistry Review</u> <ul style="list-style-type: none"> <li>• Video #1 Acid-Base Chemistry Review</li> <li>• Video #2 Acid-Base Chemistry Review Cont</li> <li>• <b>MODULE QUIZ 1-2 DUE</b></li> </ul>

Tues Aug 22	<u>Class</u> <ul style="list-style-type: none"> <li>Review Module 1-2 Quiz</li> <li>Work through more challenging problems pertaining to acid/base chemistry</li> </ul>
Tues Aug 22	<b>No Lab</b>
<b>Amino Acid Chemistry</b>	
Tues Aug 22 by 11:59 PM	<u>Module 1-3: Amino Acid Chemistry</u> <ul style="list-style-type: none"> <li>Video #1: Diprotic Amino Acids</li> <li>Video #2: Amino Acid Charge</li> <li>Video #3: Calculating Charge of Amino Acids</li> </ul> <b>MODULE QUIZ 1-3 DUE</b>
Wed Aug 23	<u>Class</u> <ul style="list-style-type: none"> <li>Review Module 1-3 Quiz</li> <li>Work through more challenging problems pertaining to amino acid chemistry</li> </ul>
<b>Amino Acid Chemistry and Polypeptides</b>	
Wed Aug 23 by 11:59 PM	<u>Module 1-4: Amino Acid Chemistry and Polypeptides</u> <ul style="list-style-type: none"> <li>Video #1: Triprotic Amino Acids</li> <li>Video #2: Polypeptides</li> </ul> <b>MODULE QUIZ 2-2 DUE</b>
Thursday Aug 24	<u>Class</u> <ul style="list-style-type: none"> <li>Review Module 1-4 Quiz</li> <li>Work through more challenging problems pertaining to amino acid chemistry and polypeptides</li> </ul>
Wed Aug 23 by 11:59 PM	<b>PRE-LAB 1 QUIZ DUE</b>
Thursday Aug 24	<b>Lab 1: Amino Acids</b> <b>BRING YOUR AMINO ACID FLASH CARDS TO LAB</b> (See Pre-lab for instructions)
<b>Protein Structure</b>	
Sun Aug 27 by 11:59 PM	<u>Module 2-1: Protein Structure</u> <ul style="list-style-type: none"> <li>Video #1: Primary Structure</li> <li>Video #2: Intro to Secondary Structure</li> </ul> <b>MODULE QUIZ 2-1 DUE</b>
Mon Aug 28	<u>Class</u> <ul style="list-style-type: none"> <li>Review Module 2-1 Quiz</li> <li>Work through more challenging problems pertaining to protein structure</li> </ul>
<b>Protein Structure continued</b>	
Mon Aug 28 by 11:59 PM	<u>Module 2-2:</u> <ul style="list-style-type: none"> <li>Video #1: Secondary Structure Cont.</li> <li>Video #2: Tertiary and Quaternary Structure</li> <li>Reading: G.N. Ramachandran</li> </ul> <b>MODULE QUIZ 2-2 DUE</b>
Tues Aug 29	<ul style="list-style-type: none"> <li>Review Module 2-2 Quiz</li> <li>Work through more challenging problems pertaining to protein structure</li> </ul>
Mon Aug 28 by 11:59 PM	<b>PRE-LAB 2 QUIZ DUE</b>
Tues Aug 29	<b>Lab 2 Protein Structure</b> <b>LAB 1 REPORT DUE IN CLASS</b>
<b>Hemoglobin</b>	
Tues Aug 29 by 11:59 PM	Module 3-3: <ul style="list-style-type: none"> <li>Video #1: Structure and Function in Hemoglobin</li> <li>Video #2: Oxygen Binding and Conformation Change in Hemoglobin</li> <li>Reading</li> </ul> <b>MODULE QUIZ 3-3 DUE</b>

	Wed Aug 30	<u>Class</u> <ul style="list-style-type: none"> <li>Review Module 3-3 Quiz</li> <li>Work through more challenging problems pertaining to hemoglobin</li> </ul>
<b>Hemoglobin Allostery</b>		
	Wed Aug 30 by 11:59 PM	Module 3-4: <ul style="list-style-type: none"> <li>Video #1: Negatie Allosteric Effectors in Hemoglobin</li> <li>Reading: Ruth Benesch</li> </ul> <b>MODULE QUIZ 3-4 DUE</b>
	Thurs Aug 31	<u>Class</u> <ul style="list-style-type: none"> <li>Review Module 3-4 Quiz</li> <li>Concepts and more challenging problems pertaining to Hemoglobin</li> </ul>
	Wed Aug 30	<b>PRE-LAB 3 QUIZ DUE</b>
	Thurs Aug 31	<b>Lab 3 Hemoglobin Cooperativity &amp; Allostery</b>
		<b>LAB 2 REPORT DUE IN CLASS</b>
	Fri Sept 1	<b>EXAM 1</b> Bring calculator and #2 pencil
<b>DNA Structure</b>		
3	Sun Sept 3 by 11:59 PM	<u>Module 3-1:</u> <ul style="list-style-type: none"> <li>Video #1: DNA Structure</li> <li>Video #2: Discovery of DNA Double Helix</li> <li>Reading</li> </ul> <b>MODULE QUIZ 3-1 DUE</b>
	Mon Sept 4	<b>LABOR DAY- NO CLASS</b>
	Mon Sept 4 by 11:59 PM	<u>Module 3-2:</u> <ul style="list-style-type: none"> <li>Video #1: Tautomer Shifts</li> <li>Reading</li> </ul> <b>MODULE QUIZ 3-2 DUE</b>
	Tues Sept 5	<u>Class</u> <ul style="list-style-type: none"> <li>Review Module 3-1 and 3-2 Quiz</li> <li>Concepts and more challenging problems pertaining to DNA</li> </ul>
	Mon Sept 4 by 11:59 PM	<b>PRE-LAB 4 QUIZ DUE</b>
	Tues Sept 5	<b>Lab 4 DNA structure</b>
		<b>LAB 3 REPORT DUE IN CLASS</b>
<b>Review of Genetics and Metabolic Pathways</b>		
	Tues Sept 5 by 11:59 PM	Module 3-3: Genetics Review <ul style="list-style-type: none"> <li>Video #1: Overview/Review in Genetics</li> <li>Video #2: Metabolic Pathways</li> </ul> <b>MODULE QUIZ 3-3 DUE</b>
	Wed Sept 6	<ul style="list-style-type: none"> <li>Review 3-3 Quiz</li> <li>Compare independent/dependent pathways in polygenic inheritance</li> <li>Review tautomer problems from DNA structure unit</li> </ul>
<b>Conditional Mutants</b>		
	Wed Sept 6 by 11:59 PM	Module 3-4: Conditional Mutants <ul style="list-style-type: none"> <li>Conditional Mutants</li> <li>Reading</li> </ul> <b>MODULE QUIZ 3-4 DUE</b>
	Thurs Sept 7	<ul style="list-style-type: none"> <li>Expand on concepts: classical forward genetics</li> <li>Review Module 3-4 Quiz</li> <li>Concepts and more challenging problems pertaining to conditional mutants</li> </ul>
	Wed Sept 6 by 11:59 PM	<b>PRE-LAB 5 QUIZ DUE</b>

	Thurs Sept 7	<b>Lab 5: Conditional Mutants and Complementation</b> You will need to return to lab <i>twice</i> . First return: Return on <u>Friday</u> to complete Activity 2 step 5; Activity 3 step 6 and 7. Second return: <u>Monday</u> Activity 3 step 8 <b>LAB 4 REPORT DUE IN CLASS</b>	
<b>Complementation Tests</b>			
4	Sun Sept 10 by 11:59 PM	<u>Module 4-1: Complementation Tests</u> <ul style="list-style-type: none"> <li>• Video #1 Complementation Tests</li> </ul> <b>MODULE QUIZ 4-1 DUE</b>	
	Mon Sept 11	<u>Class</u> <ul style="list-style-type: none"> <li>• Review 4-1 Module Quiz</li> <li>• Discuss complementation tests as a way to check unknown mutants against known mutants</li> </ul>	
	Mon Sept 11 by 11:59 PM	Module 4-2: Complementation Tests <ul style="list-style-type: none"> <li>• Video #1</li> <li>• Video #2</li> <li>• Video #3</li> <li>• Video #4</li> <li>• <b>MODULE QUIZ 4-2 DUE</b></li> </ul>	
	Tues Sept 12	<ul style="list-style-type: none"> <li>• Review 4-2 Quiz</li> </ul> Solidify topics in Complementation <b>Begin Lab 6</b> <b>LAB 5 REPORT DUE IN CLASS</b>	
	<b>Transcription in Prokaryotes</b>		
	Mon Sept 11 by 11:59 PM	<u>Module 4-3: Transcription in Prokaryotes</u> <ul style="list-style-type: none"> <li>• Video #1</li> <li>• Video #2</li> </ul> <b>MODULE QUIZ 4-2 DUE</b>	
	Tues Sept 12	<u>Class</u> <ul style="list-style-type: none"> <li>• Review 4-3 Quiz</li> <li>• More challenging problems in this topic plus complementation tests</li> </ul>	
	<b>Lac Operon (Negative Regulation)</b>		
	Tues Sept 12 by 11:59 PM	<u>Module 4-4: Lac Operon: Negative Regulation</u> <ul style="list-style-type: none"> <li>• Video #1</li> <li>• Video #2</li> <li>• Reading</li> </ul> <b>MODULE QUIZ 4-4 DUE</b>	
	Wed Sept 13	<u>Class</u> <ul style="list-style-type: none"> <li>• Review Module 4-4 Quiz</li> <li>• Work through more challenging problems pertaining to lac operon</li> </ul>	
<b>Lac Operon (Positive Regulation)</b>			
Wed Sept 13 by 11:59 PM	<ul style="list-style-type: none"> <li>• Module 4-5: Lac Operon: Positive Regulation</li> <li>• Video #1</li> </ul> <b>MODULE QUIZ 4-5 DUE</b>		
Thur Sept 14	<u>Class</u> <ul style="list-style-type: none"> <li>• Review 4-5 Quiz</li> <li>• Practice Lac Operon problems</li> <li>• Combine negative and positive regulation and think about it all together</li> </ul>		
Wed Sept 13 by 11:59 PM	<b>PRE-LAB 5 QUIZ DUE</b>		
Thurs Sept 14	<b>Lab 6: Lac Operon</b> <b>LAB 6 REPORT DUE IN CLASS</b>		
	Fri Sept 15	<b>FINAL EXAM</b> *Bring Calculator and #2 pencil	