



Biology Department

BIO6062-1-SU24_Molecular biology and Genetics

3 Units

Summer 2024

Meeting: MW 6:00-9:00 PM in-person every week*

***In May, one class of each week will be on zoom.**

(See zoom link on Canvas)

Laboratory meeting location: Sator 105

Information	Specifics for the Course
Instructor title and name:	Dr Helen Goodluck
Phone:	9515883206
Email:	hgoodluc@pointloma.edu
Office location and hours:	Emails preferable to make an appointment

PLNU Mission

To Teach ~ To Shape ~ To Send

Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Course Description

Molecular biology and genetics are two branches of biology that provide an understanding of the molecular basis of life. It is the study of how molecules (DNA, RNA, proteins, macromolecules, antibodies, and peptides) interact with one another. We would be looking at different applications of biochemical and molecular processes within the cell and their importance in science. This course is divided into two sections - labs (Wednesdays) and lectures (Mondays). During the lab classes we would learn and practice molecular biology techniques while during lectures we would study the principles of and mechanisms behind these techniques and why they are essential in science.

Course Learning Outcomes

Students will be able to:

1. Identify the major components of molecular biology and genetics and their importance in understanding our genetic makeup.
2. Understand and explain the major biochemical and molecular processes occurring within a cell (involving DNA, RNA, proteins, and peptides) and their interaction with each other.
3. Learn hands-on techniques that can be applied in research and industry.
4. Comprehend, critically evaluate, and present current research from primary literature in the topics of molecular biology and genetics.
5. Utilize self-learning techniques to help themselves and others understand how to obtain, understand, and apply information about molecular biology and genetics.
6. Identify the importance of molecular biology and techniques in genetics and how they contribute to science in drug discovery, vaccines, treatment, and cures.
7. Identify and explore the molecular mechanisms behind current disease detection and treatment measures.
8. Identify and describe an aspect of molecular biology, genetics, and its importance in science.

Required Texts and Recommended Study Resources

NOTE: *Students are responsible to have the required textbooks and are encouraged to begin reading the books in preparation for the class as soon as possible.*

Lab reading: Molecular Cloning (vol 1-3); Sambrook, Fritsch and Maniasis:

(This information may also be in Alberts: Molecular Biology of the Cell..... more recent edition)

All other reading materials (or links to them) will be posted on Canvas.

Class sessions and attendance:

Attendance in class and lab sessions is required. Absence from a lab and class results in a zero for any work done on that day. Extenuating circumstances will be considered if the instructor is notified up front. Class will meet in person only once in a week in May (Class attendance will be kept and the school's policy will be enforced as outlined in the university catalog). Missing classes will need to be discussed with the instructor and made up for. Students missing 3 sessions of lab classes will be dropped except if this has been pre-approved by instructor.

Laboratory Work – Brief Introduction

There will be four main pieces of laboratory work for this course. For each of them, you will be working as part of a group of 2 to 3 students. Your group may split the efforts equally, but you are always expected to perform the work at least in pairs to minimize errors. Handouts with pertinent background information and procedural details for each lab can be found on canvas. There will be a quiz at the beginning of the lab period, which will cover the material in this introductory handout. The goal is to ensure that you have put some effort into reading and digesting the handout material, so that a high-quality lab experience results. At the conclusion of a body of laboratory work, you will be responsible for turning in a “summary product” for me to evaluate. There will be an opportunity for each student to evaluate the quality of the group experience (by evaluating yourself and other group members) as we reach major assignment “milestones” for the semester. The intent is to ensure that there is accountability within each group.

(1) DNA and Agarose gel electrophoresis (20% of lab grade)

We will be practicing an important technique used by molecular biologists to study the genetic composition of an organism, the function and structure of genes, and its importance in science. I will provide some cells and mouse tail snips and groups will extract plasmid DNA from these samples and run the PCR to check the genotypes of the mouse (sample A) and to confirm if there is a Mycoplasma contamination in sample B. We will then be running the samples on agarose gel to view and confirm our PCR products by sizes. Your grade will be based on the success of the agarose gel result which is the confirmation of the 3 steps, and your individual lab report.

(2) Bacterial Cloning (20% of lab grade)

The laboratory student teams as constituted above will conduct the work involving the cloning of a gene responsible for ferric reductase in *E. coli* (and certain Enterobacteriaceae) into bacterial competent cells and transformation. This work will stretch over 2-3 weeks. You will also be responsible for plasmid extractions, purification, and agarose gel electrophoresis. You will also be responsible for taking photographs of your LB-agar plate and agarose gel, and including them, with your analytical comments. I will give you a handout later with more details on this. Grades will be based on successful progress on these steps over the course of the weeks, success during digestion, ligation and transformation resulting in the correct DNA product, and your electronic lab notebook that you keep throughout the project.

(3) Antibody-dependent cell-mediated cytotoxicity-reporter gene assay (20% of lab grade)

You and your lab group will set up your ADCC assay using an effector and a target cell in an appropriate ratio. All experiments would be carried out using aseptic techniques.

(4) Cell Cytotoxicity and Viability (20% of lab grade)

You and your lab group will analyze the data from your ADCC assay and present it in a graph form. You will include the data in your electronic lab notebook and your conclusion of the assay (details further below).

Lab Quizzes: (20% of lab grade)

There will be several short quizzes that will be given at the beginning of the lab. These quizzes will cover material from the lab handout for that day to ensure that you have read the handout thoroughly and come prepared to perform the lab activities. You should come to the lab prepared and knowledgeable of the experiment you are about to begin. Some of the questions will also cover activities and material from previous laboratories to ensure that you are understanding and maintain the desired material.

Electronic Lab Notebook (end of semester)

Keeping a detailed notebook procedures performed, data accumulated, and analyses of the data and subsequent next steps is critical for any researcher. Be sure to keep this updated as we go, and make sure that you write exactly what was done and how (don't just copy and paste the protocol from the lab handout). Things do not always go perfectly according to the protocol, so you need to keep good, detailed notes on exactly what was done (concentrations, timing of incubations, etc.) for both the parts that corresponded perfectly with the protocol as well as mistakes or necessary alterations. Sometimes, changes to the protocol are the reason that the lab does not work, and sometimes they turn out to be what helps a particular procedure work. You need to note exactly what was done so that you can either replicate it at some later date or determine areas that need improvement for a protocol to work. I suggest keeping a written lab book to take notes on, followed by completing an electronic lab book. Your lab notebook should contain:

- 1) A section describing the purpose (what are we trying to do, and why). Be sure to relate the lab procedure to its relevance and importance in broader Molecular biology experimentation and/or clinical techniques.
- 2) A detailed log of the procedures performed including the date, exact methods used, and any pertinent notes or results of that work. For procedures that were repeated multiple times (plasmid DNA extraction, purification, and agarose gel electrophoresis), you should include the detailed protocol once, and then any problems and/or deviations from the standard procedure (and the reason for changes) should be noted each time.
- 3) Results of the lab including any images obtained pertinent to the lab (such as image of gels, image of plates, etc.). Be sure to directly reference the images along with a thorough description of what is being observed and the relevance of this. What do the bands represent? Is it the result you would expect? Why or why not? Etc. Finally, discuss conclusions and next steps based on that data.

Your final grade will be based on the lab notebook (than a standard lab report). I would strongly suggest that your group set up a GoogleDocs or OfficeLive file online so that each member can access and add to the same file as appropriate. Further information on the electronic lab notebook will be given throughout the course. If you have any questions at all, please ask.

Lab Report (Mid semester).

- The introduction should start broad and become more specific as you go along. The analogy I like to use is that of an hourglass. Start with general information about the techniques or lab and its purpose and get more specific as you go. For example, in the DNA extraction and PCR lab report, you should start by

introducing plasmid DNA extraction, followed by polymerase chain reaction and its purpose / advantage, and then get more specific by discussing the type of samples, and what you expect to observe.

- The methods section describes the procedures by which this was accomplished (in past tense; this should always be formatted in a “blank was done” manner). This should not be in the form of a bulleted protocol, but rather a paragraph. Avoid the first or third person (don’t say “we did this”, say “this was done)
- The brief results section should include the labeled images from your slides, complete with figure legends. This section should also have a short 1-2 paragraph description of what the results show within the body. Describe your observations thoroughly in the main paragraph and reference the figures appropriately. The separate figure legends should briefly describe the image being shown.
- The discussion should relate what you see in your images to what was expected, along with some modifications that could be made to improve the results, and future directions for similar experiments (be creative and show some understanding of the utility of this method). This is the bottom of the hourglass. You start specifically describing and analyzing the meaning of the observations / results. Then put them into broader context and discuss issues / future directions, etc.

Assessment and Grading: Evaluation and grading; Letter grades will be assigned at the end of the course based on your percentage of total possible points, according to the following approximate scale:

A 90 – 100%

B 80 – 89%

C 70 – 79%

D 60 – 69%

NC/F < 60%

Generally, +/- 2-3% from the cutoff grades will usually be given +/- grades. However, plusses and minuses (e.g., B+/A-) will be determined at the instructor’s discretion. A major factor in this decision will be class participation and preparation.

Grading scale: Points Breakdown for lab work

Quizzes (6 x 5 pts each)	30 points
DNA extraction and Agarose gel electrophoresis	30 points
Quality of work	10 points
Lab report (not a lab notebook)	20 points
ADCC	70 points
Quality of work	20 points

Electronic lab book	30 points
Group participation / effort	20 points
Data analysis	40 points
Group participation / effort	10 points

Total 280 pts

Points Breakdown for class

Paper review	20 points
Seminar	40 points
Participation	20 points
Attendance	40 points

Total 120 pts

Total points: 400

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Class and Lab syllabus and schedule

Date	Class	Class activity	Text	Due	Groups
5-13	Class	1. Introduction to course, outline, and Schedule 2. Gene expression (transcription, RNA processing, translation).	Control of Gene Expression (Chapter 9, pages 401-408; 450-469)		Professor

5-15	Class/Lab	<ul style="list-style-type: none"> • Introduction to Molecular biology and genetics Labs • Introduction to course outline and Schedule. • Mol Bio- Research or Industry? • DNA extraction from cells and PCR (1). 	<p>Read: PCR and Agarose gel electrophoresis handout 1. Quiz on handout</p>		All
5-20	Class	Principles of genetic engineering (cloning and recombinant DNA technology)	Recombinant DNA Technology (Chapter 7, pages 291-318)		Group 1
5-22	Lab	<p>Introduction to Bacteria cloning; Ligation Transformation (Ecoli)</p> <p>PCR cont. (2) and Agarose gel electrophoresis</p>	<p>Read Bacteria Cloning/Ligation/Transformation</p> <p>Quiz on handout II</p> <p>Run Gels from 5-15</p>		All
5-27	Class	Genetic analysis of gene structure (mutations and their analysis, complementation, and recombination)	<p>Class assignment and paper</p> <p>No class</p> <p>Basic Genetic Mechanisms (Chapter 6, page 223-235; 263-272)</p> <p>Review of classical genetics page 1073-1073</p>	12 midnight 5-29	All groups individual submission
5-29	Lab	Finish and submit report on DNA extraction, PCR and agarose gel electrophoresis.	<p>Read: Transformation</p> <p>Finish lab report and submit.</p>	12 midnight	All groups; group lab report submission
6-3	Class	Regulation of gene expression in selected model systems (viral, prokaryotic, organellar, eukaryotic)	Basic Genetics Mechanisms (Chapter 6, pages 235-262; 273-286)		Group 2

6-5	Class	Functional and structural biology Proteins and peptides	Protein structure (Chapter 3, pages 111-128; 162-176)		Group 3
6-10	Class	Small scale protein expression, overexpression, and purification	-Read: Protein expression handout 1 -Read: Protein expression handout 2		All
6-12	Class	<ul style="list-style-type: none"> Genetics, Its implication, and its impact in life ADCs and Molecular biology 	Recombinant DNA Technology (Chapter 7, page 319-331) Handout		Group 4
6-17	Lab	ADCC			
6-19	Lab	<ol style="list-style-type: none"> Data analysis Cell cytotoxicity Cell viability 	- Group analysis		All
6-24	Class	Importance and uses of CRISPR Cas-system	Research		All
6-26	Class/Lab	Class discussion Complete and submit lab Notebook all lab classes	Exam Discussion	12 midnight	Group submission

Classroom participation / Jigsaw learning / Paper Review:

Students will be assigned to one of 4 different pair groups. For each unit, different groups will be assigned portions of the content (rotating throughout the course). The paired groups will be responsible for their content research and will lead group and class discussions. The instructor will oversee learning portions of each unit and then teach that portion for each class. The information obtained by the group will be used to answer various questions and solve different problems both in and out of class. The goals of this type of learning process include:

- 1) Becoming a self-driven student (access and understand information)

- 2) Gaining foundational knowledge about Molecular biology and Genetics.
- 3) Learning to effectively work, learn, and teach within a group setting amongst scientists
- 4) Integrating different topics, knowledge, and ideas to solve single goals
- 5) Applying knowledge to similar, but distinct tasks related to learned content

Seminar Presentation.

Students are required to submit 3 seminar topics each in the second week of which one would be picked by instructor. Students would submit a 4-page write-up on their topic with at least 4 references before their assigned seminar presentation date (on the Friday prior to a Wednesday). Late submission will be penalized 20% for being up to 24 hours late. The class would do the grading of each presentation according to a worksheet provided by the professor. Following the presentation, the presenters will entertain questions from other class members and/or professor for approximately 5 minutes. Questions must be cleared by the professor to ensure that they are specific enough and to make sure that there is a diversity of topics. Each presentation must be supported by four research articles, and an explanation of the results and discussion sections (data tables/graphs/figures) must be a central component of the presentation.

Course Format

The Course Format is based on 3 Units or major Topics. These are some of the most important overall concepts needed to understand the molecular bases of life. We will utilize lecture and much discussion for concept clarification of each topic. Students will be assigned to one of 4 different groups. For each unit, different groups will be assigned portions of the content (rotating throughout the course). The groups will be responsible for the content of their Unit and will lead group and class discussions.

General course schedule runs within 8 weeks (note that week 1 is a review unit led by the instructor).

Course schedule – all details can be found on Canvas.

Incompletes and Late Assignments

All assignments are to be submitted/turned in as stated on Canvas otherwise by instructor. Inability to turn in assignments should be discussed prior to deadlines with Instructor.

PLNU Spiritual Care

Mission Valley:

PLNU strives to be a place where you grow as a whole person. To this end, we provide resources for our Graduate students to encounter God and grow in their Christian faith. At the Mission Valley (MV) campus we have an onsite chaplain who is available during class break times across the week. If you have questions for, a desire to meet or share any prayer requests with the onsite chaplain, you may email them at mcvhaplain@pointloma.edu.

In addition, on the MV campus there is a prayer chapel on the third floor. It is open for use as a space set apart for quiet reflection and prayer.

PLNU Copyright Policy

Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

PLNU Academic Honesty Policy

Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See [Graduate Academic and General Policies](#) for definitions of kinds of academic dishonesty and for further policy information.

During the first week of class, you will be asked to submit an Academic Honesty Verification Statement. Submitting the statement is a requirement of this course. By submitting the Academic Honesty Verification Statement, you will be verifying all assignments completed in this course were completed by you. Carefully review the Academic Honesty Statement below.

Statement: "In submitting this form, I am verifying all the assignments in this course will be completed by me and will be my own work."

Artificial Intelligence (AI) Policy

Use of Artificial Intelligence (AI) tools (e.g., ChatGPT, iA Writer, Marmot, Botowski) is not permitted, and use of these tools will be treated as plagiarism.

PLNU Academic Accommodations Policy

PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities. Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center (EAC@pointloma.edu or 619-849-2486). Once a student's eligibility for an accommodation has been determined, the EAC will issue an academic accommodation plan ("AP") to all faculty who teach courses in which the student is enrolled each semester.

PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their AP in that particular course and/or if they do not wish to utilize some or all of the elements of their AP in that course.

Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student's responsibility to make the first contact with the EAC.

Language and Belonging

Point Loma Nazarene University faculty are committed to helping create a safe and hospitable learning environment for all students. As Christian scholars we are keenly aware of the power of language and believe in treating others with dignity. As such, it is important that our language be equitable, inclusive, and prejudice free. Inclusive/Bias-free language is the standard outlined by all major academic style guides, including MLA, APA, and Chicago, and it is the expected norm in university-level work. Good writing and speaking do not use unsubstantiated or irrelevant generalizations about personal qualities such as age, disability, economic class, ethnicity, marital status, parentage, political or religious beliefs, race, gender, sex, or sexual orientation. Inclusive language also avoids using stereotypes or terminology that demeans persons or groups based on age, disability, class, ethnicity, gender, race, language, or national origin. Respectful use of language is particularly important when referring to those outside of the religious and lifestyle commitments of those in the PLNU community. By working toward precision and clarity of language, we mark ourselves as serious and respectful scholars, and we model the Christ-like quality of hospitality.

You may report an incident(s) using the [Bias Incident Reporting Form](#).

Sexual Misconduct and Discrimination*

In support of a safe learning environment, if you (or someone you know) have experienced any form of sexual discrimination or misconduct, including sexual assault, dating or domestic violence, or stalking, know that accommodations and resources are available through the Title IX Office at pointloma.edu/Title-IX. Please be aware that under Title IX of the Education Amendments of 1972, faculty and staff are required to disclose information about such misconduct to the Title IX Office.

If you wish to speak to a confidential employee who does not have this reporting responsibility, you can contact Counseling Services at counselingservices@pointloma.edu or find a list of campus pastors at pointloma.edu/title-ix.

PLNU Attendance and Participation Policy

Regular and punctual attendance at all class sessions is considered essential to optimum academic achievement. Therefore, regular attendance and participation in each course are minimal requirements.

If the student is absent for more than 10 percent of class sessions, the faculty member will issue a written warning of de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university withdrawal date or, after that date, receive an "F" grade.

Students who anticipate being absent for an entire week of a course should contact the instructor in advance for approval and make arrangements to complete the required coursework and/or alternative assignments assigned at the discretion of the instructor. Acceptance of late work is at the discretion of the instructor and does not waive attendance requirements.

Refer to [Academic Policies](#) for additional detail.

Synchronous Attendance/Participation Definition

For synchronous courses that have specific scheduled meeting times (including in-person, hybrid, and synchronous online courses), absences are counted from the first official meeting of the class regardless of the date of the student's enrollment. For courses with specific attendance requirements, those requirements are outlined in the course syllabus.

Note: For synchronous courses with an online asynchronous week, refer to the Online Asynchronous Class Attendance policy listed below.

Online Asynchronous Attendance/Participation Definition

Students taking online courses with no specific scheduled meeting times are expected to actively engage throughout each week of the course. Attendance is defined as participating in an academic activity within the online classroom which includes, but is not limited to:

- Engaging in an online discussion
- Submitting an assignment
- Taking an exam
- Participating in online labs
- Initiating contact with faculty member within the learning management system to discuss course content

Note: Logging into the course does not qualify as participation and will not be counted as meeting the attendance requirement.

GPS Academic Resources

PLNU offers the following free academic resources virtually for Graduate Professional Studies (GPS) Students. Visit myPLNU through the links below for more information.

- [The GPS Writing Center](#) offers:
 - **Zoom Writers Workshops** offered each quad on a variety of helpful topics
 - **One-to-one appointments** with the Writing Coach
 - **Microlearning YouTube Video Library** for helpful tips anytime
 - [Research Help Guide](#) to help you start your research
 - The physical office is located on the third floor of the [Mission Valley Regional Center](#) off the student lounge
- [Academic Writing Resources Course](#): Found on your Canvas Dashboard, this course is non-credit with 24/7 access, no time limits, and self-paced content. [Watch a quick video run-through](#) and take time now to explore!
- [Tutoring](#): Students have access to 24/7 live or scheduled subject tutoring through Tutor.com, including a Paper Drop-Off Service with feedback within 12 hours.

We are here to support you! Contact us anytime: GPSWritingCenter@pointloma.edu