Term Information

Effective Term	Autumn 2025

General Information

Course Bulletin Listing/Subject Area	Biology
Fiscal Unit/Academic Org	Introductory Biology - D0326
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	1112
Course Title	Biological Foundations 2: Molecular Machinery & Genetics
Transcript Abbreviation	Bio Foundations 2
Course Description	An introductory exploration of life's cellular and genetic mechanisms, molecular biology, and metacognitive strategies. Includes a required weekly Peer Led Team Learning Workshop. Intended for student Majoring in STEM fields. Combined with Bio 1111, these courses will address content at similar depth and breadth as Bio 1113x.
Semester Credit Hours/Units	Fixed: 4

Offering Information

Length Of Course	14 Week, 12 Week, 8 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Laboratory, Lecture, Workshop
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus, Lima, Mansfield, Marion, Newark, Wooster

Prerequisites and Exclusions

Prerequisites/Corequisites	1111; Coreq/Prereq: Math 1148
Exclusions	Not open to students with credit for 1113x
Electronically Enforced	Yes

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	26.0101
Subsidy Level	Baccalaureate Course
Intended Rank	Freshman, Sophomore

Requirement/Elective Designation

General Education course:

Natural Sciences

The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes

- explain the mechanisms and structures involved in mitotic and meiotic cell division and explain the different roles for and consequences of each.
- describe how the loss/failure of cellular control mechanisms can lead to disease.
- describe how genotypes and the environment influence the genetics of cancer.
- explain the transfer and modification of heritable traits from parents to offspring via Mendelian inheritance.
- apply principles of Mendelian and non-Mendelian genetics to predict the outcomes of a variety of genetic crosses.
- explain the basis of and identify examples of non-Mendelian patterns of inheritance.
- describe the nature and expression of heritable information at the molecular level, including: the Central Dogma, DNA replication, transcription, protein synthesis (translation).
- explain how gene expression is controlled in prokaryotes and eukaryotes (at transcription, post-transcription, translation, and post-translation levels).
- identify mutations in DNA and assess their impact on gene expression and diversity.
- explain chromatin structure, the histone code, and epigenetic inheritance.
- explain how differential gene expression relates to organismal development, including cellular reproduction, growth, and differentiation
- describe characteristics of viruses and bacteria (e.g., life history, genome type and content, exchange of genetic material).
- describe the experimental basis and select applications of recombinant DNA technology, including gene cloning, genetically modified organisms (GMOs), and gene editing (CRISPR)
- describe the development and evaluation of scientific explanations of natural phenomena.
- apply biological concepts in the assessment of contemporary issues.
- reflect on ethical implications of emerging biotechnology.
- explain how evolution accounts for the unity and diversity of life.
- apply the process of science to research questions, presented scenarios, historical experiments, and course lab experiments.
- design an experiment
- collect and organize both qualitative and quantitative data.
- support or refute an argument or conclusion using experimental results.
- refer to primary literature articles using proper paraphrasing and citation (compare and contrast primary, secondary, etc).
- create properly formatted graphs, figures, and tables using data.
- analyze and interpret qualitative and quantitative data
- create discipline-appropriate documents (poster, presentation, or paper).
- identify plagiarism and avoid plagiarizing when writing.
- evaluate the quality and accuracy of a written source.
- locate scholarly articles using electronic databases.
- distinguish between primary literature, secondary literature, and content created for mass media.
- employ safe laboratory practices.
- use a compound light microscope to view microorganisms; maintain microscope cleanliness.
- use a pipette to measure small volumes.

- understand the key steps and reagents in PCR.
- explain how gel electrophoresis works and interpret DNA separation on a gel.
- prepare a dilution series.
- demonstrate the ability to work effectively as a team.
- determine effective study strategies to better prepare for assessments.
- evaluate the effectiveness of study strategies and modify them as needed.

Content Topic List

- Cell division
- Cellular control mechanisms
- Mendelian genetics
- Non-Mendelian Genetics
- Central Dogma
- Transcription
- Translation
- Gene Expression
- Viruses
- Biotechnology

Sought Concurrence

No

Attachments

- Biology 1112 GE NS Cover Sheet.docx

  (Other Supporting Documentation. Owner: Andrews,Adam Lee)

- Biology 1111 - 1112 Requested Changes Memo.pdf: Requested revision memo

  (Cover Letter. Owner: Andrews,Adam Lee)

- Biology 1112 Syllabus.pdf

  (Syllabus. Owner: Andrews,Adam Lee)

- Proposal to Create Biology 1111 and 1112 20241203.docx: Full combined proposal

  (Other Supporting Documentation. Owner: Andrews,Adam Lee)

Comments

- Please see Subcommittee feedback email sent 12/2/24. *(by Neff,Jennifer on 12/02/2024 02:01 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Andrews,Adam Lee	10/28/2024 11:48 AM	Submitted for Approval
Approved	Kulesza,Amy Elizabeth	10/28/2024 01:41 PM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	11/18/2024 10:22 AM	College Approval
Revision Requested	Neff,Jennifer	12/02/2024 02:01 PM	ASCCAO Approval
Submitted	Andrews,Adam Lee	12/03/2024 03:54 PM	Submitted for Approval
Approved	Kulesza,Amy Elizabeth	12/04/2024 08:20 AM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	01/15/2025 04:28 AM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Hilty,Michael Neff,Jennifer Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	01/15/2025 04:28 AM	ASCCAO Approval

THE OHIO STATE UNIVERSITY

College of Arts and Sciences

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3 December 2024

Dr. Hadad & Members of the NMS Panel,

The Center for Life Sciences Education thanks the Panel for their feedback on our recent course proposals to create Biology 1111 and 1112. At the request of the Panel, we have made the following modifications to the proposal and have uploaded revised documents:

- For both courses, the absence policy has been modified to address only critical expectations, making it more readable and streamlined.
- For both courses, the makeup policy requiring materials to be submitted within one week has been removed.
- For both courses, the statements for Disability Services and Diversity have been updated to reflect current language found on the College's website.
- For Biology 1112, the point discrepancy has been corrected.

The Panel requested clarification on two other points. Regarding the course prerequisites, the CLSE's team of academic advisors were actively engaged throughout this course development process. The proposed math prerequisites were at the recommendation of the advisors, from which the Faculty and Course Coordinators worked to ensure the content would be addressed appropriately for the expectations. It was the universal sentiment that the proposed minimal prerequisites would strike the balance for students to be successful in the courses while allowing students to begin their Biology courses as early as possible in their academic career.

The Panel also inquired about the consequences of a student transferring in credit for Biology 1111. In my experience as the Biology transfer credit coordinator, this would be an extraordinarily rare situation as the content of Biology 1111 alone would not resemble any typical 'Biology 1' course, and would thus fall far short of the threshold for equivalency. Were another institution to create a split version of *Biology 1* such as we are proposing, the content would likely be split at the same natural break point we have done with all of the biochemical topics addressed in Biology 1111 and the cell and molecular biology addressed in 1112. While we believe such a circumstance to be very rare, we have designed the content split to provide transfer students with the greatest probability of course equivalency.

We respectfully submit the course proposals for the Panel's reconsideration and are happy to address any future questions or concerns.

Sincerely,

Adam L. Andrews

Adam Andrews
Assistant Director for Curriculum & Instruction

Appendix B: Biology 1112 Syllabus

THE OHIO STATE UNIVERSITY

Biology 1112
Biological Foundations 2: Molecular Machinery & Genetics
Autumn 2025 – 4 Credit Hours

Lecturer:
Email:
Office:
Student Hours:
other times scheduled by appointment

Course Coordinator:
Center for Life Sciences Education
Email:
Office:
Phone:

Class Meeting Schedule:
Lecture: Twice Weekly for 55 minutes
Laboratory: Once weekly for 165 minutes; *consult your BuckeyeLink schedule for specific time and day*
PLTL Workshop: Once weekly for 80 minutes; *consult your BuckeyeLink schedule for specific time and day*

Prerequisites:
1111; Prereq or concurrent: Math 1148. Not open to students with credit for 1113x

Required Course Materials:
- Biological Science (8th Edition), 2024, by Freeman et al. ISBN: **978-0138224028.**
- Biology 1112 Laboratory Manual

Credit Hours and Work Expectation:
This is a 4-credit-hour laboratory course. According to Ohio State policy, students should expect around 6 hours per week of time spent on direct instruction in addition to 6 hours of homework to receive a grade of C average. *ASC Honors* provides an excellent guide to scheduling and study expectations.

Course Description:
An introductory exploration of life's cellular and genetic mechanisms, molecular biology, and metacognitive strategies. Includes a required weekly Peer Led Team Learning Workshop. Intended for student Majoring in STEM fields. Combined with Bio 1111, these courses will address content at similar depth and breadth as Bio 1113x.

General Education Natural Science (GEN) Expected Learning Outcomes
Students who successfully complete this course will fulfill the following GE Natural Science learning outcomes:

Foundations: Foundations: Natural Sciences	
Goals	**Expected Learning Outcomes**
GOAL 1: Successful students will engage in theoretical and empirical study within the natural sciences, while gaining an appreciation of the modern principles, theories, methods, and	**Successful students are able to …** **1.1** Explain basic facts, principles, theories and methods of modern natural sciences; describe and analyze the process of scientific inquiry.

modes of inquiry used generally across the natural sciences.	**1.2** Identify how key events in the development of science contribute to the ongoing and changing nature of scientific knowledge and methods.
	1.3 Employ the processes of science through exploration, discovery, and collaboration to interact directly with the natural world when feasible, using appropriate tools, models, and analysis of data
GOAL 2: Successful students will discern the relationship between the theoretical and applied sciences, while appreciating the implications of scientific discoveries and the potential impacts of science and technology.	**2.1** Analyze the inter-dependence and potential impacts of scientific and technological developments
	2.2 Evaluate social and ethical implications of natural scientific discoveries.
	2.3 Critically evaluate and responsibly use information from the natural sciences.

General Education Natural and Biological Science (GEL) Goals & Objectives

Goals/Rationale: Courses in natural sciences foster an understanding of the principles, theories and methods of modern science, the relationship between science and technology, and the effects of science and technology on the environment.

1. Students understand the basic facts, principles, theories and methods of modern science.
2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
3. Students describe the inter-dependence of scientific and technological developments.
4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

In Biology 1112, students meet the GEN Foundations: Natural Sciences Learning Objectives in multiple ways. The course (especially when combined with Biology 1111 & 1114) is an in-depth study of the basic facts, principles, theories, and interrelationships within biology. Students gain an understanding of the foundations of modern biology by studying life, cell structure and function, bioenergetics, and genetics. Students explore the nonlinear process of science and how science relates and applies to contemporary issues and ethics. During the laboratory activities, students not only apply the biological concepts introduced in lecture, but also learn scientific reasoning and methods, collect and analyze qualitative and quantitative data, and practice scientific literacy and communication. While attaining these learning objectives students will gain an appreciation of the implications and impacts of scientific discoveries on science and technology.

Course Learning Outcomes:

Successful students will be able to…

1. The Cell
    a. explain the mechanisms and structures involved in mitotic and meiotic cell division and explain the different roles for and consequences of each.
    b. describe the functionality of cellular control mechanisms.
        i. describe how the loss/failure of cellular control mechanisms can lead to disease.
        ii. describe how genotypes and the environment influence the genetics of cancer.
2. Genetics
    a. explain the transfer and modification of heritable traits from parents to offspring via Mendelian inheritance.
    b. apply principles of Mendelian and non-Mendelian genetics to predict the outcomes of a variety of genetic crosses.
    c. explain the basis of and identify examples of non-Mendelian patterns of inheritance.
    d. describe the nature and expression of heritable information at the molecular level, including:

the Central Dogma, DNA replication, transcription, protein synthesis (translation).
    e. explain how gene expression is controlled in prokaryotes and eukaryotes (at transcription, post-transcription, translation, and post-translation levels).
    f. identify mutations in DNA and assess their impact on gene expression and diversity.
    g. explain chromatin structure, the histone code, and epigenetic inheritance.
    h. explain how differential gene expression relates to organismal development, including cellular reproduction, growth, and differentiation
    i. describe characteristics of viruses and bacteria (e.g., life history, genome type and content, exchange of genetic material).
    j. describe the experimental basis and select applications of recombinant DNA technology, including gene cloning, genetically modified organisms (GMOs), and gene editing (CRISPR)
3. Nature of biological science and society
    a. describe the development and evaluation of scientific explanations of natural phenomena.
    b. apply biological concepts in the assessment of contemporary issues.
    c. reflect on ethical implications of emerging biotechnology.
    d. explain how evolution accounts for the unity and diversity of life.
4. Skills & Competencies
    a. Process of Science
        i. apply the process of science to research questions, presented scenarios, historical experiments, and course lab experiments.
        ii. design an experiment
        iii. collect and organize both qualitative and quantitative data.
        iv. support or refute an argument or conclusion using experimental results.
    b. Scientific Communication
        i. refer to primary literature articles using proper paraphrasing and citation (compare and contrast primary, secondary, etc).
        ii. create properly formatted graphs, figures, and tables using data.
        iii. analyze and interpret qualitative and quantitative data
        iv. create discipline-appropriate documents (poster, presentation, or paper).
        v. identify plagiarism and avoid plagiarizing when writing.
    c. Literature
        i. evaluate the quality and accuracy of a written source.
        ii. locate scholarly articles using electronic databases.
        iii. distinguish between primary literature, secondary literature, and content created for mass media.
    d. Laboratory
        i. employ safe laboratory practices.
        ii. use a compound light microscope to view microorganisms; maintain microscope cleanliness.
        iii. use a pipette to measure small volumes.
        iv. understand the key steps and reagents in PCR.
        v. explain how gel electrophoresis works and interpret DNA separation on a gel.
        vi. prepare a dilution series.
        vii. demonstrate the ability to work effectively as a team.
    e. Metacognition
        i. determine effective study strategies to better prepare for assessments.
        ii. evaluate the effectiveness of study strategies and modify them as needed.

Grading and Evaluation:

Graded assignments may come in three forms, and students should note the expectations for each in the descriptions of our class assignments below:

- **Independent Work ( )**: Strictly non-collaborative, original-individual work. You may discuss this assignment only with your instructor. Discussions with other individuals, either in person or electronically, are strictly prohibited and constitute academic misconduct.
- **Required Collaboration ( )**: An explicit expectation for collaboration among students either in-class or outside (i.e., group work).
- **Optional Collaboration ( )**: Students are permitted, but not required, to discuss the assignment or ideas with each other. However, all submitted work must be one's original and individual creation.

Assignment	Points	Assignment Type
Midterm Exam	100	
Final Exam	100	
Quizzes (4 @ 25 pts)	100	
Mastering Biology Homework	100	
Top Hat	75	
In-class Activities	50	
SALG	5	
Lab Assignments	265	
PLTL Workshops (10 @ 10 pts)	100	
Total Points Possible	**895**	

Exams (200 points):

There will be one midterm exam during class at the midpoint of the semester and one final exam during finals week following the semester. The final exam will only cover material following the midterm exam. Material will be drawn from the lectures, lecture activities, Mastering Biology assignments, and Quizzes. All questions will be multiple-choice style and will focus on application of the course material.

Quizzes (100 points):

There will be four 25-point quizzes evenly distributed throughout the semester, with the purpose of providing students practice opportunities for the exams. Quizzes will be taken outside of class but must be completed individually. Quizzes will be available over a three-day period, but each quiz is timed and must be completed in one session. Questions will be short-answer style and will focus on application of the course material.

Mastering Biology homework (100 points):

Weekly homework assignments will be available within Mastering Biology. Each weekly assignment will become available one week in advance and must be completed by Sunday evening at 11:59PM (see lecture schedule for exact dates). Mastering Biology assignments are designed to reinforce material covered in lecture throughout the week and may require you to apply and synthesize material learned throughout previous weeks. Most assignments will take 45-60 minutes to complete and can be worked on incrementally. Plan in advance– loss of power or internet access is not an excuse for a makeup or extension. Additional optional Mastering Biology assignments (ungraded) will also be available throughout the semester. The percentage of points you earn within Mastering Biology throughout the semester will be converted to course points at the end of the semester. (e.g. 100% in Mastering = 100 points).

Top Hat (75 points):

Top Hat questions will be administered in every lecture throughout the semester. Questions will typically be worth 1 point each, graded for participation, correctness, or a combination of both.

Proper registration is required prior to the second lecture of the semester. At least 90 total questions will be administered, providing ample leeway in earning the total points. As such, no make-up opportunities will be available for missed lectures or nonfunctional technology. Points will be updated on Carmen at the end of the semester. Prior to that, current points can always be viewed in the Top Hat gradebook.

In-class Activities (50 points):

During most lectures throughout the semester, we will complete various additional learning activities that either provide extra practice on lecture material or are designed to enhance scientific literacy. Selected activities will be submitted to Carmen and graded for participation, correctness, or a combination of both. All graded activities must be submitted to Carmen individually, but you may work on them with other students in the class. You will be given until 11:59PM the day the activity is assigned to complete it and turn it in. No make-up opportunities will be available for missed lecture activities, but more than 50 total points will be available throughout the semester.

Laboratory/Recitation Assignments (265 points):

The laboratory portion of this course is integral to the learning experience and **is mandatory**. The laboratory experience includes a combination of both inquiry-based traditional labs and a DNA Barcoding Course Based Undergraduate Research Experience (CURE). The DNA Barcoding CURE is an authentic research project in which students collect live specimens, characterize them using common genetic research techniques, and ultimately submit the results to a public database. You must come prepared to all lab sessions. This includes wearing appropriate clothing and footwear, having completed the pre-lab assignment, and having read and understood the lab you will be conducting that day. (See schedule below, as labs are not in the same order that they appear in the lab manual)

Pre-lab assignments (11 @ 2pts each):

Most labs will have a pre-lab that must be submitted on Carmen by the start of the lab period. These questions may be answered using your lab manual and any provided materials. Once laboratory has begun, no further pre-lab activities will be accepted.

Lab Assignments/Exercises (11 @ 10-15 pts each):

Students will complete lab exercises in cooperative groups, based on the lab manual and other lab exercises related to the DNA Barcoding project. All group members are expected to contribute equally. Groups are required to turn in one lab summary. All lab group members will receive the same score for each graded lab summary as long as all members participated equally in the work each day. Not contributing equally may result in loss of some or all credit for a lab. These lab summaries are due by 1 hour after the end of the lab period unless otherwise stated in the syllabus or announced by your Lab Instructor.

Lab Quizzes (30 pts) and Lab Exam (40pts):

The lab quizzes and exams will be taken individually, not as part of your lab group. Lab quizzes and the lab exam will be administered at the beginning of lab/recitation on the days listed in the schedule below. The lowest lab quiz score will be dropped.

DNA Barcoding Poster (40pts):

Students will work in groups to design and present a poster on their findings throughout the DNA Barcoding CURE, including methods used, results obtained, and discussion and interpretation of results. This research-style poster is intended to provide students experience with authentic scientific communication. The poster project and associated assignments are explained in detail in the Research Poster Guidelines document on Carmen and will be discussed by your instructor in lab.

PLTL Workshops (100 points):

Each week in PLTL, you will work with 7-10 other students in your course to solve carefully designed biology problems with the help of a peer leader. Your peer leader is an undergraduate student who previously excelled in Biology and has been trained to facilitate collaborative problem-solving. The work you do in PLTL each week will be integrated with your lecture and laboratory activities, and vice versa.

PLTL Learning Outcomes: In addition to achieving the Biology 1112 learning outcomes in PLTL, students in PLTL can expect to:

1. Develop and strengthen a suite of logical problem-solving skills including scientific argumentation, metacognitive thinking, and creative thinking
2. Develop and strengthen skills necessary for success in the sciences such as communication, collaboration, and conflict resolution
3. Learn to more accurately self-evaluate their course content mastery and learning achievements
4. Learn to effectively identify and achieve personalized learning goals

In total, there are 10 PLTL workshops throughout the semester. Each workshop consists of 3 activities, a pre-workshop, workshop, and post-workshop activities. In preparation for PLTL workshops, there is an assignment "Introduction to Peer-led Team Learning (PLTL)" (worth 10 points) to be completed by the end of week 1.

PLTL Grading:

- Pre-workshop activities (2.5 pts each) → Due before the start of workshop. These should be submitted individually to Carmen.
- Workshop activities (5 pts each) → Completed as a group during the PLTL workshop session. Students will submit their answer sheets to Carmen at the end of their workshop. Note: If you are more than 20 minutes late to the workshop, you will not be permitted to attend and will be marked absent.
- Post-workshop activities (2.5 pts each) → Due by Sunday at 11:59 pm following the workshop and submitted individually to Carmen. This activity includes reflecting on the knowledge gained in the workshop, identifying knowledge still desired, and an extension of the workshop material. **Note: You must attend the workshop in order to earn credit for completing the post-workshop assignment.**
- Attendance to PLTL workshops is REQUIRED.
  - If you miss more than 2 unexcused workshops, then your final grade will drop by 1/3rd of a letter grade. Example: Final grade will change from B- to C+.
  - If you miss 5 or more unexcused workshops, then your final grade will drop by 2/3rds of a letter grade. Example: Final grade will change from B- to C.
- We will automatically drop the lowest score for each type of assignment (pre-workshop, workshop, and post-workshop).

SALG (5 points):

At the end of the course, 5 points will be assigned based on participation in a survey, the Student Assessment of Learning Gains (SALG). Grades on the SALG will be based solely on completion.

Your Final Grade:

Your final grade will be based on the percentage of the 895 points that you earn during the course of the semester as described above. Please note that we do not grade the course on a curve and Carmen does not round averages up to the next nearest percentage point, so 92.11% and 92.97% both earn the grade of A-. Final letter grades will be determined by the grade scale below:

Grade Scale:

A	A-	B+	B	B-	C+	C	C-	D+	D	E
100 – 93.0%	92.9 – 90.0%	89.9 – 87.0%	86.9 – 83.0%	82.9 – 80.0%	79.9 – 77.0%	76.9 – 73.0%	72.9 – 70.0%	69.9 – 67.0%	66.9 – 60.0%	59.9 – 0%

Posting of Grades:

All grades will be posted on Carmen. After grades are posted you have 10 working days to challenge any grade or inquire regarding an unposted or missing grade. **After that time, grades are final.** To challenge or inquire about a missing grade, contact your laboratory instructor.

*****IMPORTANT*****

Make sure that all of your grades are properly posted on Carmen as you receive them. Challenges about grades, particularly after the end of the semester, will not be entertained after the 10-day grace period.

Late Assignments:

All assignments are due on the date and time prescribed in the course schedule. Late work will not be accepted except in rare (and documentable) circumstances.

Absences:

Exams:

If you are too ill to take an exam or must miss for another legitimate unscheduled reason, you must contact the Course Coordinator within 24 hours of the exam. Make up exams will be given only to students who produce, at the make up or before, documentation of a legitimate reason (at the time of the absence) for missing the exam. Valid excuses are limited to problems that are beyond the student's control, such as military duty, intercollegiate athletic or academic activities, funerals, etc. Medical excuses will be considered only if you have been treated by a medical professional on the day of the exam (excuses from the student health center website will not be accepted). Lack of transportation, loss of electricity, travel plans, etc. are not considered valid excuses. If you anticipate having to miss an exam due to attendance at a university sanctioned event or other qualifying conflict, you must contact the Course Coordinator at least one week in advance of the exam.

If you have no documentation to support your absence, or your absence from the exam is not for an excused reason, you will still be offered the opportunity for a makeup exam, with a 25% overall deduction on your exam score if arrangements are made within 24 hours of the original exam.
The format of makeup exams is at the discretion of the instructors. All makeup exams must be made up within one week of when the original exam was given.

Note: Check the date and time of the final examination now and make sure that this time does not conflict with your future plans. No early final exams will be given. The only makeup exam will be held on Wednesday, December xx at 9:00 a.m. and is available only in emergency situations and with prior approval of the Course Coordinator.

Make-Up Workshops and Lecture Activities:

Both the lecture and workshop are integral parts of this course. If you miss a class, you must contact your instructor (lecture or workshop, as appropriate) within 48 hours of their missed class in order to be eligible to complete a make-up assignment. All make-up work requires a valid written excuse from a doctor, therapist, athletic coach, or other person involved with the absence (preferably before the event occurs, if it's a planned absence). We will consider one absence for every student to be excused without documentation, however students must contact their instructor within 48 **hours** of their missed workshop to receive the make-up exercise. Therefore, it is essential that you contact your instructor immediately if you miss a workshop, or if you know in advance that you cannot attend class on a specific date.

Laboratory:
Lab is an integral part of this course. If you miss a lab, you must contact your lab instructor within **48 hours** of the missed lab to be eligible to complete a make-up assignment. ***Anyone who misses three or more labs/recitations (excused or unexcused) in a given semester will receive a failing grade for the course.***

Lab Policies

Laboratory and Recitation:
Laboratory and recitation are an integral part of course. They are designed to complement as well as supplement the lecture. You may first encounter something in lab before you have it in lecture or vice versa. It is expected that you come prepared to lab having read the chapter in the lab manual that will be presented. Labs do not necessarily go in the order presented in the manual—check the schedule on the syllabus. Recitation is a scheduled opportunity for students to ask questions and have concepts and information clarified by the laboratory instructor. Students should be prepared with questions about lecture and/or lab. Make the most of recitation by bringing your lecture notes to lab and taking additional notes over material presented by the laboratory instructor.

Lab Safety:
Eating, drinking, and the use of cell phones (including text messaging) are all prohibited in the lab room. Open-toe shoes and flip-flops cannot be worn in the lab room.

Lab Worksheets:
All Pre-lab assignments are due in Carmen BEFORE your lab starts.
The lab worksheets are typically due 48 hours after lab is held (48hrs after your lab's start time). Worksheets submitted late will be penalized 25% of the worksheet's total points per 24-hr period starting immediately after the deadline (**0-24 hours late** – 25%; **24-48 hours** – 50%, **48-72 hours** – 75%; **72+ hours** – 0 points earned). Lab worksheets are typically submitted as a group, and always to the appropriate assignment in Carmen.

You are expected to attend each lab for the *full lab period:**

- If you arrive 15 minutes late or more, you will be considered absent.
- Students who are less than 15 minutes late to lab/recitation repeatedly (3+) will have one absence counted toward the lab attendance (failure) policy.

****Class scheduling conflicts (e.g., inadequate transit times) are not valid excuses to arrive late to lab and/or to leave lab early.***

Disability Services:

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let the Course Coordinator know immediately so that we can privately discuss

options. To establish reasonable accommodations, we may request that you register with Student Life Disability Services. After registration, make arrangements with the Course Coordinator as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. Only the course coordinator is authorized to complete SLDS accommodations. This will help us ensure that your individual needs will be met appropriately and fairly.

If you are ill and need to miss class, including if you are staying home and away from others while experiencing symptoms of a viral infection or fever, please let your instructor know immediately. In cases where illness interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations. You can connect with them at slds@osu.edu; 614-292-3307; or slds.osu.edu.

Religious Accommodations:

Ohio State has had a longstanding practice of making reasonable academic accommodations for students' religious beliefs and practices in accordance with applicable law. In 2023, Ohio State updated its practice to align with new state legislation. Under this new provision, students must be in early communication with their instructors regarding any known accommodation requests for religious beliefs and practices, providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course. Instructors in turn shall not question the sincerity of a student's religious or spiritual belief system in reviewing such requests and shall keep requests for accommodations confidential.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities. If concerns arise about a requested accommodation, instructors are to consult their tenure initiating unit head for assistance.

A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement and the student has notified their instructor, in writing during the first 14 days after the course begins, of the date of each absence. Although students are required to provide notice within the first 14 days after a course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the Office of Institutional Equity.

Policy: Religious Holidays, Holy Days and Observances

Weather or Other Short-Term Closing:

Should in-person classes be canceled, students will be notified as to which alternative methods of teaching will be offered to ensure continuity of instruction for this class. Communication will be via Carmen announcements and course-wide email.

Section Changes:

All section changes and adds are completed by the course coordinator. Due to the need to keep up-to-minute availability of seats in each workshop, the lecturer and workshop instructors are unable to sign any permission forms.

Instructor Feedback and Response Expectations

- **Email response**: The CLSE's expectation of instructors is that emails will be responded to within one business day. If your email is sent during the evening or over the weekend, you may not receive a response until the next business day.
- **Class announcements**: I will send important class-wide messages through the Announcements tool in Carmen. Please check your notification preferences (go.osu.edu/canvas-notifications) to ensure you receive these messages.
- **Graded assignments:** Assignments will be graded and returned to you within one week after they were due. All scores are posted on Carmen no later than the day the graded assignment is returned.

Course Technology

For help with your password, university e-mail, Carmen, or any other technology issues, questions, or requests, contact the OSU IT Service Desk. Standard support hours are available at https://ocio.osu.edu/help/hours, and support for urgent issues is available 24x7.

- **Self-Service and Chat support:** http://ocio.osu.edu/selfservice
- **Phone:** 614-688-HELP (4357)
- **Email:** 8help@osu.edu
- **TDD:** 614-688-8743

Carmen

- Carmen, Ohio State's Learning Management System, will be used to host materials and activities throughout this course. To access Carmen, visit Carmen.osu.edu. Log in to Carmen using your name.# and password. If you have not setup a name.# and password, visit my.osu.edu.
- Help guides on the use of Carmen can be found at https://resourcecenter.odee.osu.edu/carmen
- **This online course requires use of Carmen (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request ac56commodations with your instructor.**
- Carmen accessibility

CarmenZoom

- Office hours will be held through Ohio State's conferencing platform, CarmenZoom. A separate guide to accessing CarmenZoom and our office hours is posted on the course Carmen page under Files.
- Students may use the audio and video functions if a webcam and microphone are available. If not, there is still a chat function within CarmenZoom for the student to live chat with the professor or TA in the virtual office hours room.
- Carmen Zoom help guide

TurnItIn

- Students at The Ohio State University are accountable for the integrity of the work they submit. Therefore, you should be familiar with the guidelines provided by the Committee on Academic Misconduct (COAM) and Section A of OSU's Code of Student Conduct in order to meet the academic expectations concerning appropriate documentation of sources. In addition, OSU has made TurnItIn, a learning tool and plagiarism prevention system, available to instructors. For this class, you will submit your papers to TurnItIn from Carmen. When grading your work, I will interpret the originality report, following Section A of OSU's Code of Student Conduct as appropriate. For more information about TurnItIn, please see the vendor's guide for students. Note that submitted final papers become part of the OSU database.
- Please know that I view TurnItIn first and foremost as a teaching tool to make you a better writer. You will see in your individual originality reports exactly what the instructors see. We WANT you to look at this report as soon as you submit your assignments. If you see an issue, please correct it right away, before we start grading the assignment. You can resubmit without penalty as many times as you want prior to the established due date for any assignment. After the due date, the late policy is in effect.

TopHat

- TopHat is a web-based response system that allows students to use their own devices provide responses in the classroom. This course uses Top Hat to promote active engagement, allow for synchronous feedback, and monitor attendance.
- TopHat help guide

Discussion and Communication Guidelines

The following are expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online and is not always appreciated in-person. The instructional team work very hard to provide a positive learning experience. Please keep this in mind and remain civilized and respectful in your class communications.
- **Citing your sources**: When we have academic discussions, please cite your sources to back up what you say.

Issue Resolution:

The CLSE believes that student concerns are usually most effectively addressed by the staff closest to the situation. Therefore, students are ordinarily expected to address issues or concerns first with their instructors. If the issue cannot be resolved by your instructor, or for some reason you feel that you absolutely cannot address your concern with your instructor, please feel free to contact the Course Coordinator or Assistant Director Adam Andrews (andrews.171@osu.edu).

Building Emergency Action Plan:

Each building on campus has a Building Emergency Action Plan (BEAP) outlining that specific building's specific procedures to be followed in the event of a range of emergency situations, including fire, weather, terrorism, chemical spills, etc. It is the role of every Buckeye to help keep each other safe and to be aware of these procedures. You can find all of the campus BEAPs at https://dps.osu.edu/beap.

Lyft Ride Smart:

Lyft Ride Smart at Ohio State offers eligible students discounted rides, inside the university-designated service area, from 7 p.m. to 7 a.m. Prices may be impacted by distance, traffic, time of day, special events and prime time surcharges. To qualify for program discounts, users must select "shared ride" when booking in the Lyft app. For more information, visit: https://ttm.osu.edu/ride-smart.

Mental Health:

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

Title IX:

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at http://titleix.osu.edu or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu.

Diversity:

The Ohio State University affirms the importance and value of diversity of people and ideas. We believe in creating equitable research opportunities for all students and to providing programs and curricula that allow our students to understand critical societal challenges from diverse perspectives and aspire to use research to promote sustainable solutions for all. We are committed to maintaining an inclusive community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among all members; and encourages each individual to strive to reach their own potential. The Ohio State University does not discriminate on the basis of age, ancestry, color, disability, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, race, religion, sex, gender, sexual orientation, pregnancy, protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment. (To learn more about diversity, equity, and inclusion and for opportunities to get involved, please visit: **https://odi.osu.edu/** or **https://cbsc.osu.edu**)

Academic Misconduct:

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed, illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/. We will adhere to this policy.

- Unless otherwise specified for a particular assignment, all submitted work should be a student's own unique effort. Collaborative efforts are not permitted unless expressly sanctioned for a particular assignment.
- Unless otherwise specified for a particular assignment, use of AI-generated materials for course submissions is not permitted.
- Reusing past work: In general, you are prohibited in university courses from turning in work from a past class to your current class, even if you modify it. If you want to build on past research or revisit a topic you've explored in previous courses, please discuss the situation with me.
- Using others' verbatim words without the use of quotation marks *and* citation is plagiarism. Paraphrased work requires citation to denote the use of others' ideas. Copying other's words without quotation while using citations is still considered plagiarism.

- Use of any technology during a quiz or exam (including but not limited to cell phones, smart watches, headphones, electronic dictionaries, etc.) is strictly prohibited.

Copyrighted Class Materials:

© The Instructor's lectures and all course materials, including power point presentations, tests, outlines, assignments, and similar materials, are protected by copyright. You may take notes and make copies of course materials for your own use. You may not and may not allow others to reproduce or distribute lecture notes and course materials publicly whether or not a fee is charged without the express written consent of the course instructor or course coordinator.

Course Schedule: Spring 2026

Schedule and assignments subject to change with as much advance notice as possible

Week	Lecture Topic	PLTL Workshop	Assignments Due
1	Course Intro and Ch12 – Mitosis and the Cell Cycle	None	
2	Ch12 – Cancer and Ch13 - Meiosis	1111 Wrapper & Metacognition	HW1 due Sunday
3	Ch13 (cont.) and Ch14 – Mendelian Genetics	Cancer & Mitosis	**Quiz 1 (Ch12-13) open Tues-Fri** HW2 due Sunday
4	Ch14 (cont.) – Extensions of Mendelian Genetics	Meiosis & Inheritance	HW3 due Sunday
5	Ch15 – DNA Replication and Repair	History of DNA	HW4 due Sunday
6	Ch16 – The Central Dogma	Exam Review	**Quiz 2 (Ch14-16) open Tues-Fri** HW5 due Sunday
7	**Midterm Exam (Chapters 12-16)** and Ch17 - Transcription	None	
8	Ch17 – RNA Processing and Translation	Transcription/Translation	HW6 due Sunday
9	Ch18 – Control of Gene Expression in Bacteria	Gene Regulation & Expression Pt1	HW7 due Sunday
	Spring Break	None	
10	Ch19 – Control of Gene Expression in Eukaryotes	Gene Regulation & Expression Pt2	HW8 due Sunday
11	Ch20 - Biotechnology	Gene Regulation & Expression Pt3	**Quiz 3 (Ch17-19) open Tues-Fri** HW9 due Sunday
12	Ch20 – Biotechnology (cont.)	Biotechnology/GMOs Pt1; Connect to DNA Barcoding Lab	HW10 due Sunday
13	Ch21 – Genes and Development	Biotechnology/GMOs Pt2	HW11 due Sunday
14	Ch33 - Viruses	Exam Review	**Quiz 4 (Ch 20-21,33) open Tues-Fri** HW12 due Sunday
Finals	**Final Exam**		

Laboratory Schedule:

Week	Lab Experiment	Assignments Due
1	Lab Safety & Introduction and Ex. 1: Introduction to Microscope Use	**Pre-Lab**: Questions for Ex. 1 (2pts) Lab Safety Quiz (5 pts) Ex. 1 Worksheet (10 pts) Microscope proficiency (3 pts)
2	Ex. 5: Cell Division and the Eukaryotic Cell Cycle	**Pre-Lab**: Questions from Ex. 5 (*2 pts*) Exercise 5 Assignment (*15 pts*)
3	Ex. 2: Properties of Biological Membranes	**Pre-lab**: questions from Exercise 2 (*2pts*) Exercise 2 Assignment (*15 pts*)
4	Ex. 3: Characterizing the Relative Activity Rates of Enzymes	**Pre-Lab**: questions from Ex. 3 (*2 pts*) Exercise 3 Assignment (*15 pts*) **LAB QUIZ #1**
5	Ex. 6: Mendelian Genetics with Statistical Analysis	**Pre-Lab**: Questions for Ex. 6 (*2 pts*) Exercise 6 Assignment (*15 pts*)
6	Ex. 7: Human Genetics; DNA Barcoding Overview	**Pre-Lab**: Complete the pre-lab for Ex. 7 (2pts) Exercise 7 Assignment (15 pts)
7	Pipetting and DNA Extraction	**Pre-Lab**: Complete the Virtual DNA Extractions lab and answer the questions (*2 pts*) Associated Worksheet (*10 pts*) Bring Sample to Lab
8	Polymerase Chain Reaction and Primary Literature Activity	**Pre-Lab**: Complete the Virtual lab on PCR and answer the questions (*2 pts*) PCR Assignment (10 *pts*) **LAB QUIZ #2**
9	Gel Electrophoresis	**Pre-Lab**: Questions for lab exercise *(2pts)* Gel Electrophoresis Assignment (10 *pts*)
	Spring Break	
10	DNA Extraction and PCR Re-dos Poster Work Session	
11	Gel Electrophoresis Re-dos and DNA Sequencing	LAB QUIZ #3 **Pre-Lab**: questions for DNA sequencing (*2 pts*) DNA Sequencing Assignment *(10 pts)*
12	Bioinformatics (DNA Subway)	**Pre-Lab**: questions for Bioinformatics (*2 pts*) Bioinformatics Assignment *(10 pts)*
13	Poster Presentations iNaturalist Upload	LAB QUIZ #4 Completed Poster Due Before Lab *(40pts)*
14	Lab Final Exam	Lab Final Exam (*40 pts*)
Finals		

GE Rationale: Foundations: Natural Science (4 credits)

Requesting a GE category for a course implies that the course fulfills **all** expected learning outcomes (ELOs) of that GE category. To help the reviewing panel evaluate the appropriateness of your course for the Foundations: Natural Sciences, please answer the following questions for each ELO.

A. Foundations

Please explain in 50-500 words why or how this course is introductory or foundational in the study of Natural Science.

In combination with the proposed Biology 1111, Biology 1112 will share identical course outcomes with Biology 1113, a TAG course taken as an introduction to the biological sciences by STEM majors. The course is taught from a traditional introductory biology textbook and has only a co / prerequisite of college algebra. The course is intended as a foundation to further study in the life sciences.

Course Subject & Number: Biology 1112

B. Specific Goals for Natural Sciences

GOAL 1: Successful students will engage in theoretical and empirical study within the natural sciences, gaining an appreciation of the modern principles, theories, methods, and modes of inquiry used generally across the natural sciences.

Expected Learning Outcome 1.1: Successful students are able to explain basic facts, principles, theories and methods of modern natural sciences; describe and analyze the process of scientific inquiry. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

As shown in the course outcomes, the content and approach of this course is significantly, but not entirely, based around the foundational biological information students need as a foundation for upper-level life science courses. Successful students will be able to...

1. The Cell
    a. explain the mechanisms and structures involved in mitotic and meiotic cell division and explain the different roles for and consequences of each.
    b. describe the functionality of cellular control mechanisms.
        i. describe how the loss/failure of cellular control mechanisms can lead to disease.
        ii. describe how genotypes and the environment influence the genetics of cancer.
2. Genetics
    a. explain the transfer and modification of heritable traits from parents to offspring via Mendelian inheritance.
    b. apply principles of Mendelian and non-Mendelian genetics to predict the outcomes of a variety of genetic crosses.
    c. explain the basis of and identify examples of non-Mendelian patterns of inheritance.
    d. describe the nature and expression of heritable information at the molecular level, including: the Central Dogma, DNA replication, transcription, protein synthesis (translation).
    e. explain how gene expression is controlled in prokaryotes and eukaryotes (at transcription, post-transcription, translation, and post-translation levels).
    f. identify mutations in DNA and assess their impact on gene expression and diversity.
    g. explain chromatin structure, the histone code, and epigenetic inheritance.
    h. explain how differential gene expression relates to organismal development, including cellular reproduction, growth, and differentiation
    i. describe characteristics of viruses and bacteria (e.g., life history, genome type and content, exchange of genetic material).
    j. describe the experimental basis and select applications of recombinant DNA technology, including gene cloning, genetically modified organisms (GMOs), and gene editing (CRISPR)

Students will be assessed on these outcomes through summative assessments such as exams and quizzes, and through formative assessment included in the weekly lab activities, Mastering Biology, PLTL Workshops, TopHat questions and other in-class activities.

Course Subject & Number: Biology 1112

Expected Learning Outcome 1.2: Successful students are able to identify how key events in the development of science contribute to the ongoing and changing nature of scientific knowledge and methods. Please link this ELO to the course goals and topics and indicate specific activities/assignments through which it will be met. *(50-700 words)*

Students will learn about the key events in history through examination of multiple areas of study, including but not limited to, Gregor Mendel's work in developing the modern theory of heredity, and the progression of experiments that led to Gene Theory. Griffith's experiments with bacteriophage led Hershey and Chase to hypothesize the nature of the gene which eventually led to Watson and Crick discovering the structure of DNA. This close examination of four decades' work then continues though more modern experiments leading up to CRISPR and other examples of modern biotechnology. Students will experience this walk through almost a century of historical experimentation, looking at those foundational experiments as well as some that offered insights but ultimately proved to be incorrect, modeling for students the true nature of scientific development.

Summative assessment will happen through exams and quizzes, while formative assessment will happen utilizing the PLTL Workshops, TopHat and other in-class lecture activities.

Course Subject & Number: Biology 1112

Expected Learning Outcome 1.3: Successful students are able to employ the processes of science through exploration, discovery, and collaboration to interact directly with the natural world when feasible, using appropriate tools, models, and analysis of data. Please explain the 1-credit hour equivalent experiential component included in the course: e.g., traditional lab, course-based research experiences, directed observations, or simulations. Please note that students are expected to analyze data and report on outcomes as part of this experiential component. *(50-1000 words)*

This course will include a 165-minute weekly in-person laboratory experience led by either a faculty member or teaching associate that will be correlated with the content of the lecture. Approximately 30 minutes per week will be devoted to a recitation or lecture review.

Weekly activities will come in two varieties: approximately half of the weekly activities will follow a traditional inquiry approach utilizing the existing lab activities from Biology 1113 while the other half of the lab experience will be a *Course-Based Undergraduate Research Experience (CURE)*. The CURE is an authentic research experience that allows students to participate in a novel process, develop their own hypotheses, design an experiment, collect and analyze data, and ultimately present their findings in an appropriate scientific context over the span of six weeks. The instructor in a CURE course serves more as a research mentor than a traditional instructor.

While the traditional laboratory activities are more structured, we strive to ensure our labs are not 'cookbook', but rather endeavor in each to have students practice the art of developing hypotheses, designing small-scale experiments and collecting data through a genuine inquiry process.

Students will submit pre-lab activities before each lab session and a group-written laboratory report at the end of the lab. Lab quizzes will assess students' knowledge of appropriate laboratory terminology and practices.

The skills and competencies outcomes will largely be a feature of the laboratory portion of the course.

1. Skills & Competencies
    a. Process of Science
        i. apply the process of science to research questions, presented scenarios, historical experiments, and course lab experiments.
        ii. design an experiment
        iii. collect and organize both qualitative and quantitative data.
        iv. support or refute an argument or conclusion using experimental results.
    b. Scientific Communication
        i. refer to primary literature articles using proper paraphrasing and citation (compare and contrast primary, secondary, etc).
        ii. create properly formatted graphs, figures, and tables using data.
        iii. analyze and interpret qualitative and quantitative data
        iv. create discipline-appropriate documents (poster, presentation, or paper).
        v. identify plagiarism and avoid plagiarizing when writing.
    c. Literature
        i. evaluate the quality and accuracy of a written source.
        ii. locate scholarly articles using electronic databases.
        iii. distinguish between primary literature, secondary literature, and content created for mass media.
    d. Laboratory
        i. employ safe laboratory practices.
        ii. use a compound light microscope to view microorganisms; maintain microscope cleanliness.
        iii. use a pipette to measure small volumes.
        iv. understand the key steps and reagents in PCR.
        v. explain how gel electrophoresis works and interpret DNA separation on a gel.
        vi. prepare a dilution series.
        vii. demonstrate the ability to work effectively as a team.

GOAL 2: Successful students will discern the relationship between the theoretical and applied sciences, while appreciating the implications of scientific discoveries and the potential impacts of science and technology.

Expected Learning Outcome 2.1: Successful students are able to analyze the inter-dependence and potential impacts of scientific and technological developments. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

The course's progression through the historical understanding of the nature of DNA and the theoretical concepts of Gene Theory will progress to its applications in various examples of modern biotechnology.

2j. describe the experimental basis and select applications of recombinant DNA technology, including gene cloning, genetically modified organisms (GMOs), and gene editing (CRISPR)

3. Nature of biological science and society
    a. describe the development and evaluation of scientific explanations of natural phenomena.
    b. apply biological concepts in the assessment of contemporary issues.
    c. reflect on ethical implications of emerging biotechnology.

Assessment will happen summatively though course exams and quizzes, and formatively through PLTL Workshops, and in-lecture discussions and activities.

Expected Learning Outcome 2.2: Successful students are able to evaluate social and ethical implications of natural scientific discoveries. Please link this ELO to the course goals and topics and indicate *specific* activities/ assignments through which it will be met. *(50-700 words)*

A topic like biotechnology lends itself perfectly to the discussion of ethical implications for society. With CRISPR advancements seemingly coming almost daily, students will explore the consequences of genetic manipulation at various levels: is it acceptable to cure diseases, to change one's phenotypic appearance, to design the 'perfect' offspring? Historical context to the eugenics movement will be discussed.

3. Nature of biological science and society
    b. apply biological concepts in the assessment of contemporary issues.
    c. reflect on ethical implications of emerging biotechnology.

Students will be assessed through formative assignments such as the PLTL workshops, as well as in-lecture discussion and activities.

Expected Learning Outcome 2.3: Successful students are able to critically evaluate and responsibly use information from the natural sciences. Please link this ELO to the course goals and topics and indicate *specific* activities/ assignments through which it will be met. *(50-700 words)*

As part of the DNA Barcoding CURE, students will be expected to generate a scientific-style poster to communicate their results. The poster project will require students to identify and evaluate appropriate background information as relevant to their project.

4. Skills & Competencies
    b. Scientific Communication
        i. refer to primary literature articles using proper paraphrasing and citation (compare and contrast primary, secondary, etc).
        ii. create properly formatted graphs, figures, and tables using data.
        iii. analyze and interpret qualitative and quantitative data
        iv. create discipline-appropriate documents (poster, presentation, or paper).
        v. identify plagiarism and avoid plagiarizing when writing.
    c. Literature
        i. evaluate the quality and accuracy of a written source.
        ii. locate scholarly articles using electronic databases.
        iii. distinguish between primary literature, secondary literature, and content created for mass media.