CONTENT SUBJECT TO MINOR CHANGES UNTIL THE FIRST DAY OF CLASSES

## BIOL 2302: Genetics Lab Fall 2024

# Welcome to Genetics Lab!

**Instructor**: Please see Canvas for information introducing your instructor, their expectations around how assignments are to be submitted, and how to contact them.

**Format:** This course is fully in-person and is described as a "dry lab" as opposed to a "wet lab". This means that instead of pipetting (wet) liquids from tube to tube in a lab, you'll be using your (dry, hopefully) laptop to interact with databases and online programs and perform analyses. Each session will include instruction followed by some group work.

**Attendance/participation:** Collaboration is an important skill in science, so group work is taken seriously and, along with attendance, counts as 10% of your grade. Working through projects in class with other students bolsters learning and mastery of skills and assures that questions can be addressed efficiently by your TA. Most students find that they can complete most of each assignment during class, so attendance is also good time management. The two lowest attendance/participation scores will be dropped, regardless of the reason for them (emergency, Wellness Day, bad mood, etc.). Each subsequent absence will count as a zero.

**Quizzes**: In order to work efficiently through the projects with their group, students need to prepare by going over specific material prior to class. Each class session will include a five-question quiz and these will count for another 5% of your grade. There are **NO MAKEUP QUIZZES**. Instead, in keeping with the attendance/participation policy, the two lowest quiz scores will be dropped, including any quiz missed due to an absence for any reason.

**Materials**: All instructional material will be posted to Canvas site by your trusty TA. It is your responsibility to familiarize yourself with the site so that you do not miss assignments or important information. Additionally, please bring a laptop to class for those projects requiring one.

**Projects**: The course consists of ten projects. Each project includes three sections: a section that you are to prepare before class and on which you'll be given a quiz at the start of class, followed by group work, and ending with a segment you are to do on your own. Due dates for project submission are a few days after class (see dates, below).

**Learning objectives**: Please see the description of Projects at the end of the syllabus.

**Course grading:**

| | |
|---|---|
| Attendance/participation (in group work): | 10% |
| In-class quizzes: | 5% |
| Projects: | 85% |

You must complete **all** ten projects. Your final grade is determined by the % you earned of the total points possible. Please note: decimal points are NOT rounded up. Therefore, the absolute minimum required for an A is 93. A score of 92.75 is an A-minus, so please plan accordingly.

| | | | | | |
|---|---|---|---|---|---|
| A | 93% | B- | 80% | D+ | 67% |
| A- | 90% | C+ | 77% | D | 63% |
| B+ | 87% | C | 73% | D- | 60% |
| B | 83% | C- | 70% | | |

**Late assignments:** Assignments need to be submitted according to the instructions of your TA by the due dates given below. Late work: your score will be **reduced by 10%** within the first 24 hours and **by 25%** within the second 24 hours beyond the due date. **Any work submitted more than 48 hours** after the due date will receive no credit.

**"What if I have a question about the material or the course?"** Any question or point of confusion you have is almost certainly shared by at least one other student. Therefore, unless your question is of a personal nature, please ask it on the Discussion forum. Your TA will monitor the forum and answer questions there as needed. Likewise, if you see a question for which you know the answer, please jump in and answer it! Think of the Discussion forum as an open room that you can enter anytime and look for help.

**Honor code:** Scientists' reputations and the progress of research depend heavily on following an honor code. You may collaborate with your classmates in working through exercises, but all submitted work must be your own, in your own words. **Any student found to have copied answers from another source will receive a zero for the assignment. A second violation will result in a report made to the Office of Student Conduct and Conflict Resolution (OSCCR).**

**Note: Your hard work will not go unnoticed! Students who do well in the course, show up consistently for class, and work well with their groups can apply to serve as TA's in future semesters.**

## Schedule

***Friday labs do not meet until the second week of classes***

C=class date; D=due date; Tue=labs that meet Tuesdays; Fri=labs that meet Fridays

| | Tue | | | Fri | |
|---|---|---|---|---|---|
| Project | C | D | | C | D |
| 1 | Sep 10 | Sep 16 | | Sep 13 | Sep 19 |
| 2 | Sep 17 | Sep 23 | | Sep 20 | Sep 26 |
| 3 | Sep 24 | Sep 30 | | Sep 27 | Oct 3 |
| 4 | Oct 1 | Oct 7 | | Oct 4 | Oct 10 |
| 5 | Oct 8 | *Oct 15 | | Oct 11 | *Oct 18 |

| | | | | | |
|---|---|---|---|---|---|
| 6 | Oct 15 | Oct 21 | | Oct 18 | Oct 24 |
| 7 | Oct 22 | Oct 28 | | Oct 25 | Oct 31 |
| 8 | Oct 29 | Nov 4 | | Nov 1 | Nov 7 |
| 9 | Nov 5 | *Nov 12 | | Nov 8 | *Nov 15 |
| 10 | Nov 12 | Nov 19 | | Nov 15 | Nov 22 |

*Delayed due dates due to holidays

# Project descriptions

## Project One: The ABCs (or ACGTs) of Life

Life revolves around an unbroken chain of transmission of information, encoded in molecules and containing the instructions to build and maintain the code's housing (the organism), and replicate and transmit the message the code carries to keep the chain going. In this lab session you'll review the basics of the message and its molecules, then explore how information about particular messages (genes) is represented in a GenBank record.

## Project Two: Analyzing alleles

In genetics, knowing the information content of DNA is important in understanding its influence on phenotype. In particular, mutant versions of gene content (alleles) are associated with disease. The problem is, we can't "see" the DNA molecules and their sequences of bases so we have to use wily methods to trick the DNA into giving up its secrets. One of the most basic techniques for distinguishing between alleles of a gene involves running fragments of the gene on a DNA gel and examining band patterns.

## Project Three: Probs, Stats, and Gametes

The alleles we inherit come from our biological parents, but there are many different combinations possible. Chance has a large role to play in the particular hand we each are dealt. In this project you'll learn about some uses of basic probability in genetics, such as how to estimate the probability of specific outcomes in genetic crosses. You'll also practice the very important exercise of drawing the various possible products of meiosis

## Project Four: Gene mapping and linkage

In this project, you'll learn how restriction enzymes can be used to gain information into whether a mutation is present, and where some of the features in the code are positioned with respect to one another on the DNA strand. Even more information on gene positions can be gained from analyzing the results of crosses involving multiple traits. Sounds confusing? Dive in and hopefully it will start making some sense!

## Project Five: PCR and primers

The polymerase chain reaction (PCR) is the most important and commonly used tool in any molecular biology lab as well as most clinical settings. It makes use of the enzymes that synthesize DNA in cells and the natural tendency of DNA strands to anneal to their complementary strands. From these basic principles, one can amplify billions of copies of

any region of the genome, like being able to magically pull a needle out of a haystack and make a billion more needles to boot!

## Project Six: Cloning

In this two-part project you will explore the basic principles of cloning including primer design and finding compatible restriction enzyme sites between a cloning vector and an insert. These are widely used techniques in molecular biology labs.

## Project Seven: Cloning, continued

In this second part of a two-part project you will explore the basic principles of cloning including primer design and finding compatible restriction enzyme sites between a cloning vector and an insert. These are widely used techniques in molecular biology labs.

## Project Eight: Chi-square analysis

This week you'll learn some basics about how researchers determine whether the data they observe supports a particular hypothesis – a concept known as "goodness of fit".

## Project Nine: Gene regulation and the *lac* operon

Of the many genes encoded in an organism's genome, only specific subsets are being expressed at any given time or in response to a particular context, much like the players in an orchestra. Researchers worked out the fundamentals of how genes are regulated in response to the environment by studying an operon in *E. coli* that turns certain genes on or off in response to the presence of glucose or lactose. Students can still learn a lot about gene regulation in general by mastering the details of this lac operon (plus, it's a topic on the MCAT).

## Project Ten: Human Genetic Variation and a Dash of Forensics

This project lets you channel your inner detective. You'll learn about a common type of human genetic variation – short tandem repeats (STRs) – that allow the FBI to match crime scene samples with suspects in a database. You'll use your *in silico* PCR skills to amplify STRs from three suspects and compare their profiles to that from a crime scene sample to identify the perpetrator. You'll finish up by determining the statistical strength of the match you found and making an announcement of your findings to the press!