CONTENT SUBJECT TO MINOR CHANGES UNTIL THE FIRST DAY OF CLASSES

BIOL 2302: Genetics Lab **Summer 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 the majority of an 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 10% of your grade. There are **NO MAKEUP QUIZZES**. Instead, in keeping with the attendance/participation policy, the two lowest quiz scores will be dropped.

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: If you successfully work through and understand each Project, you'll be able to list the following items on your resumé and impress your interviewer when applying for co-op positions:

- Used NCBI databases and sequence analysis tools such as BLAST to perform homolog searches and examine protein domains and structures

- Gained understanding of basic concepts and workflow of genome sequencing, assembly, and annotation
- Used the UCSC Genome Browser for locating and interpreting various types of sequence information
- Designed primers and carried out "*in silico*" PCR using NCBI and UCSC Genome Browser tools
- Generated phylogenetic trees and tested their confidence using online tools
- Used chi-square tests to evaluate the fit of data to particular hypotheses

Additionally, this course will provide practice in working through problems to extend and solidify your understanding of inheritance, gene expression, and gene regulation.

Course grading:

Attendance/participation (in group work):	10%
In-class quizzes:	10%
Projects:	80%

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).**

Schedule

C=class date; D=due date; MW=labs that meet Mon and Wed; TR=labs that meet Tue and Thu; TW=labs that meet Tue and Wed

	MW			TR			TW	
Project	C	D		C	D		C	D
1	May 13	May 16		May 14	May 17		May 14	May 17
2	May 15	May 18		May 16	May 19		May 15	May 18
3	May 20	May 23		May 21	May 24		May 21	May 24
4	May 22	May 25		May 23	May 26		May 22	May 25
5	May 29	Jun 1		May 28	May 31		May 28	May 31
6	Jun 3	Jun 6		May 30	Jun 2		May 29	Jun 1
7	Jun 5	Jun 8		Jun 4	Jun 7		Jun 4	Jun 7
8	Jun 10	Jun 13		Jun 6	Jun 9		Jun 5	Jun 8
9	Jun 12	Jun 15		Jun 11	Jun 14		Jun 11	Jun 14
10	Jun 17	Jun 20		Jun 13	Jun 16		Jun 12	Jun 15

Project descriptions

Project One: The ABCs (or ACGTs) of Life (23 pts possible)

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.

Learning goals:

~Given a DNA sequence, analyze the six potential reading frames to predict the mRNA and peptide sequences.

~Use the NCBI website to obtain specific information on a given protein and its nucleotide sequences.

Project Two: Analyzing alleles (38 pts possible)

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.

Learning goals:
~Become familiar with basic terminology describing traits and alleles.
~Infer alleles from DNA gel patterns.
~Link diseases to their specific mutations.

Project Three: Probs and Stats (36 pts possible)

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, and a method for determining whether observed data fit what is predicted with respect to some hypothesis – a concept known as "goodness of fit".

Learning goals:
~Use basic rules of probability to estimate odds.
~Understand how these rules play out with respect to inheritance.
~Apply the chi-square test to determine how well the data fit a hypothesis.

Project Four: Gene mapping and linkage (29 points)

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!

Learning goals:
~Use restriction enzyme sites are used to map features of DNA
~Analyze results of a cross to infer map positions of genes
~Estimate the likelihood of a disease based on the restriction enzyme patterns of various family members

Project Five: PCR and primers: IN PREP
(PCR app at Utah/learn genetics plus primer problems)

Project Six: Cloning (24 points)

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.

Learning goals:
~Explain what cloning is and how it is done
~Design primers to amplify specific regions of DNA

Project Seven: Cloning, continued (15 points)

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.

Learning goals:

~Explain what cloning is and how it is done
~Design primers to amplify specific regions of DNA

Project Eight: Microarrays and gene expression: IN PREP

Project Nine: Gene regulation: IN PREP

Project Ten: Human Genetic Variation and a Dash of Forensics (37 pts)

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!

Learning goals:

~Describe a common type of variation that distinguishes among humans
~Practice using an *in silico* PCR tool
~Have fun!