Instructor: Farida Safadi-Chamberlain, PH.D. Office: Yates 314

Office hours: Thursday and Friday 12-1 pm in Yates 314 or by appointment.

Office Phone: (970) 491-1771 E-Mail address: fsafadi@colostate.edu

RECITATION: Monday, 4:00pm to 4:50pm in Yates 104 (attendance mandatory)

LABs:

LAB sections 2 and 6	**Tues 9:00 - 11:50 AM**	**LAB sections 1 and 5**	**Tues 2:00 - 4:50 PM**
LAB section 3	**Wed 2:00 - 4:50 PM**		
LAB sections 7 and 8	**Thu 9:00 – 11:50 AM**	**LAB sections 4 and 9**	**Thu 2:00 - 4:50 PM**

Lab Rooms: Yates 311; Yates 316

Graduate Teaching Assistants:

TA name	Lab Section	Office hours	Location	Email address
Pardis M-Zadeh	L02 Tue 9-11:50 am	Monday 10-11 AM	Yates 308	pardis.mohammadzadeh@colostate.edu
Ryan S Czarny	L06 Tue 9-11:50 am	Monday 2-3 pm	Yates 308	ryan.czarny@colostate.edu
Emily Maverick	L01 Tue 2-4:50 pm	Monday 11-12 pm	Yates 308	emily.maverick@colostate.edu
Kristin Scott	L05 Tue 2-4:50 pm	Monday 1-2pm	Yates 308	kristin.scott@colostate.edu
Robert Williams	L03 Wed 2-4:50 pm	Wednesday 10-11 am	Yates 308	beto.williams@colostate.edu
Ben Johnson	L07 Thu 9-11:50 am	Thursday 4:30-5:30 pm	Yates 308	benj.johnson@colostate.edu
Julie Sun	L08 Thu 9-11:50 am	Monday 12-1 pm	Yates 308	julianna.sun@colostate.edu
Chih-Feng Tien	L04 Thurs 2-4:50 pm	Monday 1-2 pm	Yates 308	chih.tien@colostate.edu
Zihao Zhao	L09 Thurs 2-4:50 pm	Sunday 2:30 - 3:30 pm	Yates 308	zihao.zhao@colostate.edu

COURSE DESCRIPTION

This laboratory course is designed to equip students with hands-on skills in the molecular methods and tools employed in modern genetics research. The labs will introduce methods for studying DNA in Recombinant DNA Technology and molecular methods for studying development of organisms. The course is composed of lab exercises and assignments that are designed to teach students how to run experiments, problem solve and critically evaluate and communicate their experimental results.

Upon completion of this course students will be able to:

- Implement sterile techniques to grow and handle bacteria
- Grow, handle and analyze bacteria used in DNA transfer and analysis
- Isolate, transfer and analyze DNA prepared from bacteria using recombinant DNA technology
- Synthesize and amplify DNA using Polymerase Chain Reaction (PCR)
- Analyze gene expression and regulation.
- Examine model organisms used in genetics research such as *Drosophila*, yeast, and *Arabidopsis*.

No Textbook is assigned to this course, Lab exercises and report forms will be posted prior to the lab period on CANVAS, CSU online instruction system. It is your responsibility to print them out and to bring them to the lab. Using the lab printer for printing is NOT allowed.

SCHEDULE

Week of **LECTURE AND LABORATORY**

COURSE OBJECTIVE 1: Recombinant DNA technology

1. Jan 21 **No Recitation**: Martin Luther King Day
Jan 22 Lecture in Yates 308: Course overview, Data measurement; Optical Density of Bacteria
Lab session 1: Units, data measurement and pipetting; Optical density of bacteria in suspension.

2. Jan 28 **Recitation**; Sterile techniques; Quiz 1
Lab session 2: Introduction to Microorganisms and Sterile Techniques; Control of Bacterial Growth

3. Feb 4 **Recitation** ; Cloning techniques and plasmid DNA; Quiz 2
Lab session 3: Isolation and analysis of plasmid DNA.

4. Feb 11 **Recitation**; Restriction Enzymes; Quiz 3
Lab session 4: Cleavage of Plasmid DNA with Restriction Enzymes; Dephosphorylation of Linearized Plasmid DNA.

5. Feb 18 **Recitation**: Transformation of bacterial DNA; Quiz 4
Lab session 5: Construction of Recombinant Plasmid: DNA Ligation and Transformation of Competent *E. coli* Cells.

6. Feb 25 **Recitation**: Analysis of transformed bacteria and recombinant DNA; Quiz 5
Lab session 6: Isolation of Recombinant Plasmid DNA and Digestion with Restriction Enzymes.

7. March 4 **Recitation**: Analysis of recombinant plasmid DNA; Quiz 6
Lab session 7: Characterization and Analysis of students' recombinant plasmid DNA.

8. TBD Review for EXAM I
March 11 **EXAM I, Lab notebooks** due, Library sessions

9. March 16-24 **Spring Recess**

COURSE OBJECTIVE 2: Genetic Model Organisms

10. March 25 **Recitation**: Introducing gene expression;
Lab session 8: Gene Expression and Transcription Regulation in yeast.

11. April 1 **Recitation**: DNA diversity and Polymerase Chain Reaction (PCR); Quiz 7
Lab session 9: Nuclear DNA Polymorphism and Polymerase Chain Reaction (PCR).

12. April 8 **Recitation**: *Drosophila* and Polytene Chromosomes; Quiz 8
Lab session 10: PCR gel electrophoresis/continued; 2) *Drosophila* Polytene chromosome squashes

13. April 15 **Recitation**: *Drosophila*: a model organism in molecular genetics; Quiz 9
Lab session 11: *Drosophila* life cycle and mutants.

14. April 22 **Lab session 12** Small Project Poster Presentations and Assessments; Quiz 10

15. April 29 **Recitation**: Plant Development; *Arabidopsis thaliana*: a model system in plant genetics; Quiz 11
Lab session 13: Plant Development: *Arabidopsis thaliana*, Pollen tube germination.

16. TBD Review for EXAM II
May 6 **EXAM II, Lab notebooks due**

Note: A library instruction session will be scheduled during the semester to help you with searching the library database. Library database is needed for answering lab report questions and conducting and writing your projects.

TEACHING METHOD:

- **Recitation:** Attendance is mandatory. During the recitation, a mixture of PowerPoint presentations and learning activities will be presented to explain the theoretical background and the protocol behind the week's experiments. Discussions and questions about the previous lab and report writing will be addressed here. An open-notebook (not handouts) quiz will be given at the end of the recitation period.

- **Labs:** Graduate Teaching Assistants (GTAs), aided by Undergraduate Teaching Assistants l(UTAs), lead the instruction and supervision of lab experiments in the labs. Additional pointers and potential changes to the protocol will be discussed at the beginning of the labs. Students work in groups of two, and conduct experiments using instrumentation and equipment found in a typical molecular genetics research laboratory. The laboratory exercises do not necessarily follow closely the lecture material in LIFE 201B. Some labs use biological material that is subject to availability, in cases when a biological material is not accessible, an exercise substitute will be used and the syllabus and the handouts will be modified. Due to the constraints of biological life cycles and protocols, some experiments require that you follow up on the results at a later time, your cooperation in this matter counts towards your grades.

All experimental material used by students should be labeled clearly: LABELS should include: **1) *what* is in the tube**, **2) *concentration*** (if applicable), **3) *date; including the year*, 4)** student ***names*** or ***initials***, and **5) *course* number**.

ASSESSMENTS:

- Weekly open-notebook quizzes at the end of recitation either in class or online
- Weekly or experiment-based Lab reports
- One term project/poster
- Lab notebook checks: twice a semester
- Two exams: a midterm and a final exam
- Assignments that engage students in learning.
- Lab technique grade: assesses the prelab notebook write-up and student performance in the lab
- Extra Credit assignments to enforce understanding of concepts

LABORATORY NOTEBOOKS

Students need to follow the specific instructions outlined below in writing in their lab notebooks. Lab notebooks will be collected twice during the semester for grading. Legible handwriting and neatness is crucial for good grades.

A) A secure spine-bound notebook is required:
- Not spiral bound, NO tear out page perforations.
- The laboratory notebook of a scientist is a legal document: outlines daily progress of experiments.
- Written in Ink: Calculations, notes, and results should be recorded directly into the notebook.
- Nothing should be erased or obliterated. Mistakes are crossed out with a single line so the original work is still visible.

B) Pre-laboratory write-up and preparation:
Written before recitation on Monday in the student's wording and not copied directly from the handouts. This will help you do well on the quizzes and finish lab on time. Prelab write-up includes
- **Title & Date of the experiment,**
- **Introduction**
- **Materials and Methods**.

C) Specific Instructions for Lab notebook write-ups: Using legible handwriting, lab notebook writeups must follow the following format:
1. Table of Contents: at the beginning of your notebook, dedicate a few pages for use as a table of contents; this should include title of each experiment and the page numbers for each experiment. Keep it up to date as you write in your notebook.

2. Title and Date: this section should be written before class. The title of each experiment should be descriptive yet concise. Record the date (and what time, if applicable) the experiment was carried out.

3. Introduction: This section should be written with your own wording before the lab period. Cutting and pasting from handouts' material is NOT allowed. The introduction should contain
    - **the theory or background** behind the experiment (not more than 2 to 3 sentences)
    - **the question** to be investigated based upon the background (one sentence)
    - **hypothesis** which includes the predicted results (one to two sentences maximum)
    - **the objectives** of the experiment (one to two sentences).

4. Materials and Methods: This section should be written before the lab period and then modified as needed during the execution of the experiment. You are required to write this section as a **flow Chart** of the protocol to avoid lengthy write-ups. You should be able to follow the flow chart steps easily and allow others to repeat the experiment using only the protocol you have charted in your notebook.

5. Results and discussion: For teaching purposes only, this section is replaced by a "report handout" that students fill with their experimental data and answers to questions. The reports will be collected weekly by the instructor, graded and handed back to students the following week. The graded lab reports are then stapled to the notebook to serve as a "Results and Discussion" section. In research labs, the results section contains observations, sketches of biological specimens, raw data, calculations, tables and graphs that are generated from the data, as well as any other notes. In research labs, and for legal reasons such as patents of experimental results, the raw data should go **directly** into the notebook.

6. Graphs: Students may use either provided graph paper or Excel to generate graphs. Hand drawn graphs on regular paper are unacceptable. Keep e-copies of your graphs.

7. Conclusions This section is written right after the experiment is completed or after you write your report and before you submit it for grading. The conclusion should include:
    - Brief summary of the results of the experiment
    - Brief interpretation of the results
    - Significance of the findings
    - What you learned from this experiment
    - Future Directions: suggest would you do next! ("different" organism is NOT an option)
    - Answer the question: "did I achieve my objective/s?"

    Be critical in evaluating your data. Just because you may have followed the protocol does not mean that your experiment succeeded. Analyze your results and comment on why an experiment failed, state what you might do differently to derive a successful or improved outcome.

8. Instructor's and/or TA's signatures for signing in and out of the lab.

Quizzes (30 points each)

A weekly open notebook quiz is administered in recitation. Quizzes will cover the current week's pre-lab preparation and the previous lab's principles and results. Students who come prepared, who maintain a well-organized notebook, and who are conscientious in their observations and data evaluation/processing will do well on the quizzes.

Exams (200 points each): There will be a midterm Exam and a final non-comprehensive Exam.

Laboratory Reports (50 points each)

Lab results with accompanying sketches of observations, tables, and/or graphs, and their analyses are reported in a weekly laboratory report. Group discussions with your peers and the TAs regarding questions in the report are highly encouraged, but students are required **to write reports independently**. Copied reports will be treated as cheating and will get a ZERO grade. Laboratory reports from the previous week will be due at the end of recitation on Monday of the following week. **NO LATE REPORTS. 10 points per day will be deducted for late reports.**

Laboratory Technique Grade (10 points each)

Laboratory technique grade applies 10 points per lab to assess the students' preparedness for the labs and their performance during the lab. Students will be assessed 5 points for prelab write-up at the beginning of each lab. The remaining five points will assess the students' participation in the experiment, accuracy in following the experimental protocols and obtaining data, tidiness of the bench and the careful use of the lab supplies and materials. These points will be assessed by the instructors upon the students' signing out of the lab. The lab period is about 3 hours and the students are expected to fill the lab period with the experimentation and writing the report. Note that due to the nature of biological research, **some experiments require that you come during a later time of the day or week to finish up some steps or take some observations**. Your seriousness about these observations counts towards the lab technique grade.

GRADING

Student evaluation will be based upon the weekly quizzes, two exams, lab reports, lab notebooks, assignments and the lab technique grade. Additional extra credit questions will count towards the grade. Letter grade scheme is as follows:

A+ = 95.1% and above A = 90 or greater and less than 95.1 A$^-$ = 89 or greater and less than 90
B+ = 85.1 or greater and less than 89. B = 80 or greater and less than 85.1 B$^-$=79 or greater and less than 80
C = 70 or greater and less than 79 D = 55 or greater and less than 70 F = less than 55

POINT ALLOCATION:

Pre-laboratory Quizzes:	30 points each	total of 11 quizzes	330 points	19.8%
Laboratory Reports:	50 -100 points each	total of 10 reports	550 points	32.9%
Exams	200 points/exam	total of 2 exams	400 points	23.9%
Laboratory Notebook	100 points each	2 grades	200 points	12 %
Lab technique grade	10 points/lab	13 labs	130 points	7.8 %
Lab assignements		6	60 points	3.6%
Total			**1670 points**	**100.00%**

STUDENT ACADEMIC MISCONDUCT:

The weekly quizzes, reports, assignments and extra credit exercises must be your individual work and cannot be copied from your friend or partner in the lab. Submitting copied work will be treated as cheating and the students committing the cheating will be subject to disciplinary actions according to the university policies and procedures regarding student academic misconduct. Acts of student misconduct are defined as: cheating, plagiarism, unauthorized possession or disposition of academic materials, falsification, or facilitation of facts are acts of misconduct. These acts are subject to disciplinary action by the instructor and the CSU Office of Conflict Resolution and Student Conduct Services. For more information see: https://tilt.colostate.edu/integrity/

MISSING LABORATORY SESSIONS:

MISSING LAB ACTIVITIES CANNOT BE MADE UP; IF YOU MISS A LAB YOUR LAB REPORT GRADE WILL BE ZERO. Submitting a lab report using your partner results will NOT be accepted. If you cannot attend a lab for a very good reason email or see the instructor (not the TA**) before** the laboratory session to arrange to attend another laboratory section**.**

Addendum to the Syllabus
Small projects/Poster Presentations

Small Projects that are related to the topics of the labs will be chosen by assigned groups of students. Students will conduct these experiments in groups during the second half of the semester under the mentorship of the instructors. Parts of the project will be submitted as small write-ups in stages that will be made available in a schedule on CANVAS. Small projects will culminate in a poster presentation at the end of the semester. Detailed instructions for the project assignments and the poster will be announced and posted on CANVAS.