Laboratory Syllabus

Instructors: Mr. Steve Sundby (*Office: Olin-Rice 214; x6444*)
Dr. Michael Anderson (*Office: Olin-Rice 115; x6230*)
Laboratory: Olin-Rice 285
Computer Lab: Olin-Rice 287

Welcome to Cell Biology and Genetics lab! This laboratory course has been designed as an introduction to the process of science, as well as to make you an active participant in the study (and practice!) of science, which includes mastering theory, applying the scientific method to problem-solving, and acquiring expertise in several laboratory and computer skills. Upon successful completion of the lab portion of BIOL255, you should:

1. be able to use your knowledge of the scientific method to form a hypothesis, design and experiment, analyze some forms of data, draw conclusions about your observations, and then communicate your results to others.
2. have acquired an appreciation of, and some practice in, the variety of methods that scientists use to communicate their work to different audiences (e.g. colleagues, press, government representatives, etc.)
3. be able to demonstrate that you can perform several basic skills needed to perform "benchwork" required for research in the field of cell biology. These skills include micropipetting, proper use of balances, centrifuges, spectrophotometers, and microscopes. In addition, you should be able to use various computer software packages to create graphs, and perform statistical analysis of data
4. be able to discuss the theory that under-pins the techniques used in the course

***Grades*:** Your laboratory grade is based on multiple assignments throughout the semester. Below is a tentative schedule of assignments with approximate points and when they are due.

Work	**Due Date**	**Points**
Graphing Data and Statistical Analysis	Week 2	32
Solutions and DNA Gel Electrophoresis	Week 3	22
Fluorescence/ Spectroscopy	Week 4	18
Microscopy	Week 5	13
Bioinformatics	Week 6	10
Experimental design for B-galactosidase	Week 6	10
Lab Practical Exam I	Week 7	70
B-galactosidase std curve	Week 7	12
Powerpoint presentation on B-galactosidase	Week9	40
Abstract on B-galactosidase/ summary graph	Week 10	20
Roundup Ready informatics expdesign/ worksheet	Week 10/ 11	19
Lab Practical Exam II	Dec 9-11	71
Quizzes	??	0-30
Total Points		~350

Lab Exams: These exams will be an individual grade based on activities done throughout the semester. Therefore, it is vitally important that you participate in all experimental techniques and thinking processes to be prepared for this exam. This exam will be open lab manual and open lab notebook, so take good, detailed notes during the semester!
Quizzes: It is fundamental that you read the appropriate handouts beforehand for a positive laboratory experience. Therefore, do not be surprised if there are unannounced quizzes in the first ten minutes of lab during the course of the semester. **NOTE: These cannot be made up!**
Assignments turned in late: Points will usually be deducted for work turned in late (exceptions sometimes being made for reasonable problems discussed in advance with the instructor). We will usually deduct 10% of the point total per day for late work.
Active Participation: Because discussion will be a significant portion of what we do in lab, you will be expected to actively participate. Your reward for this will primarily be your own intellectual advancement, but in addition, your active involvement could raise your final score by 1/2 of a letter grade.

Attendance: If you must miss a lab, make arrangements with me IN ADVANCE. If you are ill the day of lab, please call my office (leave a voice mail if I don't answer) and let me know so that I can let your lab partners know, and make alternative arrangements.

***Group Work*:** Because scientists almost always work in collaborative groups, the labs in this course involve participating in a collaborative group. Typically you will work in groups of four and you will have the opportunity to work in different groups during the semester. Most of your graded work will be as a group grade, so it is important that you learn how to interact with others in a productive manner.

The ability to work well collaboratively is of paramount importance to scientists and professionals in many other fields as well. Therefore, we will spend some time in this course talking about the skills required for successful group work. In addition, we hope that you will give some thought to the contributions you are making to your group and work to improve your collaborative skills.

Honesty: The requirement for honesty (on your part) and trust (on our part) comes in several forms in this course. For instance, the written work you turn in should be your own and not plagiarized from another source or obtained unfairly through the exploitation of your classmates. I also assume that you will not cheat on exams. In addition, we will assume that the data and results you report in your papers is what actually happened and not what you wish happened. It is very important that you be completely honest about what you did in lab and the results you obtained. Many times you make mistakes in a protocol and/or your data doesn't look very good. It must be reported exactly the way it happened. Failure to do so is called scientific fraud.

Although we deal with the very rare cases of dishonesty on an individual basis, we reserve the right to severely reduce your grade in this course for any act of dishonesty. Honesty is the foundation of scientific inquiry and also the foundation of good working relationships with others. Its practice is far more important than anything else you might learn in this course, and therefore failure to practice it will result in the most serious penalty.

Clean up: Keeping your lab bench neat during an experiment will really help you in staying organized. Extra books, backpacks, etc. should be placed off to the side in lab. The actual working bench should contain only the materials you are using for the experiment. Although

everyone has his or her own work habits, we may occasionally make a suggestion that you should straighten up and/or organize your work area.

Because many other lab sections form other courses use this same room, it is important that you leave your lab bench as clean and organized as you found it. We will remind you to do this if you neglect this important task.

***Laboratory Notebook*:**

General Organization

You are expected to maintain a laboratory notebook and bring that notebook to each laboratory session. Your lab notebook should be a 3-ring notebook that may be organized in any manner that will be useful to you. It should have at least 4 main sections:

A. Table of Contents: This 1-2 page summary of what your notebook contains will simplify your finding of information. These pages should list the general order of things from the front to the back of your notebook (and page numbers if you choose to place numbers on the pages you place in your notebook).

B. Laboratory Overview: This section would consist of items such as the laboratory syllabus and schedule.

C. General Techniques and Equipment: This section could contain handouts and notes on procedures and instruments that will be used in numerous experiments. Examples would be information on the computer lab and computer programs, balances, centrifuges, micropipettors and other common laboratory equipment.

D. Experiments: Information such as protocols and handouts specific for each experiment could be contained here. In addition, your notes, rough drafts, data, final reports, etc. should be kept in this section. Include everything you do, including your "scratch" notes and calculations. Anything needed to perform, interpret or understand a particular experiment should be here (This is really for your benefit, so everything is consolidated in one place for a specific experiment).

Specific Experimental Entries

Everything from your "scratch" notes to detailed protocols and calculations should be recorded in it. For each particular experiment, it is important that you record as much information as possible, such that five years from now, another person could come along and do the experiment just as you did it. In addition, this person should be able to understand why you did the experiment, and why the experiment was designed and performed the way you did it. Why did you include certain controls? Why did you choose particular doses of a reagent? Virtually everything you plan and perform has a reason behind it, and by recording your thought process, you will help anyone reviewing the experiment (including yourself!) to understand your frame of mind when you performed it. In summary: write down everything!

We suggest that you use a format, often used for recording experiments, which closely parallels the organization of a scientific paper as outlined in the section Guidelines for Scientific Papers. Use at least 4 main sections: Introduction (or Purpose), Materials and Methods, Results, and Conclusions. After writing down the title and an initial entry of information, leave plenty of room below for notes. Write down everything, because more often than you know, that seemingly stray thought or observation becomes vital for understanding what happened.
Example:

Purpose/Introduction

1) State why you are doing this experiment, possibly referring to previous results from an experiment, readings or discussions with others, etc.
2) State your hypothesis and your reasoning behind its development.

The more background information you include, the better, because when someone looks back at this experiment, it's usually this section that explains why you planned this experiment the way you did.

Materials and Methods

Many things should be entered here.

1) Experimental design. You should record both your design and the reasoning behind it. For details on developing an experimental design, refer to the section on Scientific Investigation. Three integral parts of an experimental design are: 1. identification of your control conditions, 2. identification of your experimental conditions, and 3. the number of trials that will be carried out. You should also write down the reasoning for each of your choices. Why are these controls appropriate? Why did you choose those experimental conditions? Why 2 trials instead of 10?
2) Procedures. This means writing down every step such that someone else could exactly retrace them. Don't assume people know how to do things-write it down! For example, techniques change over short periods of time, so just because you think everyone purifies DNA the same way, it may be totally different when someone tries to repeat your experiment.
3) Reagents and calculations. Do them all right here in this section so that if things don't work out the way you thought, you can recheck them later. Maybe a mistake was made, or maybe the result you got was real! It is not enough to say " I used 3M NaCl", you need to say how you made this: was it from a more concentrated stock that an instructor provided? Did you weigh out a specific amount and dissolve it in a certain amount of solvent? DETAILS!
4) Corrections/ mistakes. Scribble these in right next to the "proper" way you wrote down to do things. THERE IS NOTHING WRONG WITH MAKING MISTAKES, what's wrong is not recording them so that they are not repeated in the future.

Results

1) Record your data. This is obvious, but try to do it in an organized manner-a table for instance. Don't forget to include units of measurement.
2) Record your observations. You may notice that one sample appears different from the other "identical" samples. Make a note of this, and explain it if you can. Try to observe all of what is happening, and don't limit yourself to just the exact measurement you are making at the time. These observations may be crucial in explaining an unusual outcome or could be the basis for a decision to omit a data point.

Conclusions

1) It is important to make some summary statements, even before you've analyzed your data. They may range from general to specific, but any thoughts you have are worth writing down as they occur. Go ahead and write down that "gut impression" of yours! So what if the data contradicts it after you analyzed it? You had some reason for believing what you did, and it may form the basis of a future experiment.

2) Future experiments. It may be immediately obvious what to do next, or it may not occur to you until after you've had a chance to analyze your data, but be sure and propose what you think should be done next. ***The best notebooks have words that show a train of thought!***
3) Final conclusions. Write down your final thoughts and conclusions after analyzing your data.

General Lab Safety Guidelines

Some of the reagents and equipment used in courses are hazardous. In addition, even the most benign chemical or instrument can be dangerous if common sense is not used in its handling. Therefore, you should adhere to the following guidelines for lab safety:

1. No eating or drinking is allowed in the lab. Never ingest any chemical from lab and, if a chemical is spilled on your hands, wash them immediately.

2. Keep your work area neat and free of items that could be accidentally tripped over (backpacks of books under foot), spilled (open, unstable containers), or dislodged (equipment cords).

3. Never hesitate to ask for assistance if you are unsure of how to use a piece of equipment or a reagent.

4. Glass – Broken glass should be swept up, using a broom and dustpan. Broken glass goes in the broken glass boxes.

5. Anyone working in a lab should be familiar with the location and *proper* operation of emergency eyewash and shower equipment. You should also be familiar with the location of all the exits available from the lab, as well as the location of the nearest fire alarm.
   -The lab is equipped with an eyewash for spattering of caustic chemicals into the eyes and a shower for major spills on skin.
   -The lab is equipped with a first aid kit for cuts or burns. If you are injured, notify a staff member immediately.
   -You have a right to know about any chemicals or reagents you are using. There are Material and Safety Data Sheets (MSDS) available for every chemical that describe how to handle and dispose of any chemical you are using. These are in notebook folders located in Olin Rice Hall Room 285.

6. Follow the specific safety rules for each hazardous chemical and organism. Each hazardous chemical and organism will be given to you with specific instructions for its handling. Follow these instructions exactly, including disposal, and ask for assistance if you are unsure about how to proceed. Also available is a "Hazard Communication Hotline", (612) 617-0995, which can give you additional information. This information can also be accessed by the Internet at website http://www.macalester.edu/security/Msds/MsdsLinks.html.

7. It's always a good idea to wash your hands before leaving lab.

8. **After reading through these instructions and getting information from your lab instructor, please sign the Course Safety Training Sheet.**

Fun, Imagination, Risks: Although we hope you will perform responsibly in lab, the lab is designed to allow you to exercise your creativity, imagination, reasoning skills and, if you want, your sense of humor. Besides being educational, the lab can be enjoyable. We hope you will feel free to take some intellectual risks in your work and dare to enjoy yourselves as you learn about a process that professional scientists love -- designing and performing experiments and sharing their findings with their peers.