Everything you've ever wanted to know about the Scientific Community Lab… but were afraid to ask

These labs are designed to model the actual process of science:
Most labs show you how to use equipment or follow instructions. Sometimes their goal is to have you carry out a demonstration with your own hands instead of watching a lecturer do it – to convince you that something told to you is really the way things work. None of this resembles real experimental science. And since experiment is fundamental to science, we have created some labs that are trying to get you to get the flavor of a real scientific experiment.

Here are some unusual features of these labs:

1. **The main goal of these labs are to give you experience in designing an experiment to answer a question.** Your goal will be to think about how you can make a good measurement that answers the question. And you will need to think about how the design of the experiment affects the certainty of your result.
2. **In some cases in this lab, you will do the experiment before it's talked about in lecture.** Sometimes in real life you don't know what will happen and you have to explore experimentally first. The idea here is to do an experimental to try to find out what the behavior is without knowing the answer beforehand – just like many real scientific experiments.
3. **It's not only your result that matters; it's how good do you think it is – quantitatively.** No experiment gives an exact result or the same exact result every time it is repeated. You will have to decide not just "the answer" but what range of values are that you think are possible given how you did the experiment.
4. **You will have to present your results to the rest of the class, have them comment on your results, and comment on theirs.** Real science is a community process. Every experiment is considered by others and often challenged. The process of many people analyzing and thinking about everyone's work helps get to the real answer and purge the "wishful thinking" we are all prone to.

Here are some of the things you will not be doing in these labs.

1. **These labs are not meant to demonstrate the perfect truth of some idealized theory.** Most of the rules you learn in physics are idealizations. They only work if certain assumptions are true (for example, there is no friction). When those assumptions are not true, we can ask the question: are the results "almost true"? How can we correct them, either by changing our experiment or adding more to our theory?
2. **These labs are not meant to teach you some particular concepts in support of what you are learning in lecture.** You are likely to have to use the concepts and equations you learn in lecture so it might help, but that is not their main point.

The Experiments

Before you come to lab:

Designing, carrying out, and presenting your results can be time consuming.
Therefore, you will have two weeks to do most of the labs.
Even with 4 hours, there is still a lot to do.

It will help a lot if you read over the lab before you come in and spend some time thinking about what is involved and how you might do the experiment.

While you are in lab:

Since there is a lot to do, it is very important to keep to a schedule. The lab handouts suggest a time plan.

It will help a lot if you focus on your goals and tasks in the lab and don't waste time. If you take a lot of time on irrelevancies you may have trouble finishing.

You need to document what you are doing in a lab writeup carried out as you go. This will be facilitated by the division of labor described under "roles" below.

When you leave the lab:

If you are ending the first week of a two-week lab, be sure each person has a copy of the data. You don't want to arrive in the second week and find the only person with your data has dropped the course (or is sick, or is away at a sports event, or forgot it, or …).

If you are ending a one-week lab or the second week of a two-week lab, be sure to hand in your finished lab report before you leave. There is no out-of-class lab work permitted.

Grading

The lab grade makes up part of your total course grade. This grade will be based on:

- Lab reports
- Participation in the class discussion. ”

Lab Reports

At the end of the experiment, you will hand in a complete lab report. This report will include three components:

- *The Journal:* A discussion of what you did, how you designed your experiment, and what results you got, written so that an absent student could understand what you did.
- *Data and Interpretation:* Your data, in a form that would be easy for an absent student to understand. Here is also where you discuss what your data means, what conclusions you've drawn from it, and a persuasive *case* proving that your conclusion is valid.
- *Evaluation:* After you've had a chance to see what data and conclusions other groups have gotten, it's important to go back and reconsider what you've done. Here is where you discuss how you could improve upon your experiment, in light of what you learned during lab and during the class presentations.

In writing your lab report, it is important to consider the following things. Each will be worth 5 points for a total of 20 for a two-week lab and half that for a one-week lab.

- Design and thoughtfulness. Did you do a careful and thoughtful job in creating your experiment, and was this thought reflected in the journal?

- Clarity and completeness. Were you able to clearly explain your experiment so that someone could reproduce it?

- Persuasiveness. What conclusions did you draw from your data, and were you able to back up these conclusions with this data, in a convincing way?

- Evaluation. After observing the experiments of other groups, were you able to critique your own lab, propose constructive changes, or explain why your experiment was better than those of your classmates? (The question you are answering in your evaluation is, “If I got to re-do this experiment next week, how would I do it differently?”)

Your grade will not depend on whether or not your conclusions agree with some accepted standard.

Participation

It's often hard to see how you could improve your experiment by yourself. If you could do that, you would have done it the better way in the first place! That's why we have the end of class discussion – to help you write your evaluation.

A portion of your grade will depend on your participation in these class presentations and discussions at the end of the laboratory. Here, we are looking for significant contributions to other groups' understanding of their lab, not just raising your hand and asking "why didn't you take more data? Your TA will be assigning participation points for each discussion session and will let you know how you are doing at midsemester.

Roles

In order to facilitate the preparation of the lab report, you will be working in groups of *four*. The division of labor will be as follows:

1. *The Journalist:* This person is responsible for taking notes of everything that happens during the experiment, and writing up the "Journal" section of the lab report.
2. *The Data Interpreter:* This person deals with tabulating and displaying the data, operating the computer, and writing up the "Data and Interpretation" section of the lab report.
3. *The Critic:* This person is responsible for taking notes during the class presentations and discussions, and for writing the "Evaluation" section of the lab report.
4. *The Checker:* This person is responsible for checking all sections of the lab report before it is turned in, and reading the comments made by the grader on past lab reports, and suggesting ways to improve.

You must rotate roles every week so that each person gets a chance to do every task at least twice. While the lab report is a group grade, it is necessary that you show that you are pulling your own weight in the group work. But working on lab reports is *group* work. Part of the goal is to give you practice working together in a group. Not every group works smoothly together at all times. Part of your task here is to find ways to cooperate to cover difficulties. For example, if one person is having trouble with their particular task in a given week, the checker should serve as a support person and collaborator to help out.

