

# Everything You've Ever Wanted To Know About Lab... But Were Afraid To Ask

## Mission Statement

*You are going to learn three basic things this semester:*

1. **How to recognize *relationships*.** All the complicated stuff that goes on in a physics lab can be boiled down to a simple premise: if you change one thing, another thing changes too. First we identify *what* changes. Then we try and decide *in what way* it changes. This is what we call “functional dependence”. That’s all physics equations are, really, a precise statement about how changing one thing will affect another thing. In this lab, we will explore many different kinds of physical phenomena and try to figure out *what affects what and how*.
2. **How to make a persuasive case for your data.** In physics, answers don’t just pop up out of the ground, ready to be printed in a textbook. Data from an experiment doesn’t make much sense at a first glance. First you must be able to understand what data *means*. Then you need to be able to *present* this data to others in such a way that it will persuade them that the *conclusions* you’ve drawn from this data are correct. In order to do these things, you must have a good understanding of the limitations of your observations and *how precise your data is* and *how well you can trust it*. For this, we will try to develop quantitative estimates of how accurate our results are.
3. **How to make a computer do the hard stuff.** We will be using the *Microsoft Excel* spreadsheet to tabulate data, crunch numbers, and construct graphical representations of our data. Not that we can’t do these things by hand, it’s just that a computer can do it a lot faster, relieving us of a lot of busy-work and leaving us more time for more interesting activities. If you plan on going into research, it is essential to know how to use a computer spreadsheet.

## The Experiments

*This semester we will be doing five experiments, each of which will span two weeks. The first week is devoted to **data collecting**, while the second week is devoting to **data analysis**. This is what you’ll be doing:*

### Week One

- *Brainstorming and Planning:* You will not be given step-by-step instructions on how to do the experiment. You will receive a short description of what you’ll be investigating, and it will be up to you to design your *own* experiment. There are many ways to do this, so be creative and work with the physics that you know.
- *Data Collecting:* You will be given ample time to collect as much data as will be useful for you.

- *Presentation and Discussion:* Here you have an opportunity to show the rest of the class your method, and to see what other groups did.

### **Week Two**

- *Analyzing Data:* Using Excel, you will be taking a close look at your data in order to decide what it means and how you can *prove* to others what it means.
- *Presentation and Discussion:* Different groups will frequently have contradictory results. This is your chance to present your case, observe other groups' cases, engage in healthy debate, and possibly reconsider your conclusions.
- *Class Consensus:* In some cases, each lab section will be trying to come to a single consensus conclusion.

## **Materials**

Please bring with you to class each week:

- Looseleaf paper for writing your lab reports. These will be collected by the TA and each group member will be given a copy. You may want to keep a folder or notebook for these labs, as they will be a useful reference for future labs and lab quizzes. (Papers torn out of a bound NB will not be accepted.)
- A calculator.
- Anything at all that you think will be useful. Our lab room has a huge supply of odds and ends for you to use in designing your experiment, however, feel free to bring in anything from outside that you feel may help your group out.

## **Grading**

The lab grade makes up 20% of your total course grade. This grade will be based on:

- Lab reports
- Participation in the planning, experiment, presentation, and class discussion
- Lab quizzes

## **Lab Reports**

At the end of the two-week experiment, you will hand in a complete lab report. This report will include:

- *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.

Your lab TA will not be grading your lab reports. They will be graded by another 122 TA, and a different one for each experiment. Since the person grading your report will not be present to observe what you're doing *while you're doing it*, it is important to consider the following things:

- 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, make constructive changes, or if this is the case, explain why your experiment was better than those of your classmates?

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

## Roles

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.

## Participation

A portion of your grade will depend on your participation in the class activities. This includes taking an active role in presenting to the class and participating in the class discussions. Your TA will be observing your activity throughout the semester.

## **Lab Practicals**

There will be two lab practicals this semester, the weeks of March 15 and April 26. As opposed to other lab activities, the lab practical will be taken individually. More details will be given later on in the semester.

## **Attendance**

The labs are an integral part of this physics course, so missing a lab will affect your comprehension of the course material and impair your progress through both the lab and the lecture part of this course. There are no makeup labs. If you miss or have missed a lab, contact your TA immediately. If have a VALID WRITTEN EXCUSE, you will be allowed to do a makeup activity that will take at least two hours. If you do not have an acceptable written excuse, you will get a zero for that lab.