

Course Lab Syllabus

Physics 123: Electricity and Magnetism

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Lab Syllabus for Introductory Calculus-based Physics

Welcome! The labs for this course provide opportunities for you to develop an in-depth understanding of basic physics through direct experience with phenomena. You will work collaboratively with partners and have the opportunity for individual discussion with instructors. The emphasis is not on the manipulation of sophisticated equipment or complicated error-analysis calculations, but rather, on observations and data that you collect with simple equipment, on making predictions, and on constructing explanations and making sense of the physics.

Most labs start with some guided experiments or exercises in which you will be asked to predict, observe, and explain as you consider a specific physical situation. You and your partners should collaborate together actively, discussing your ideas as you work toward a consensus understanding. The goal is to recognize *how* you know what you know, rather than just getting “the answer.” Effort has been made to create questions with just the right spacing – close enough together so that you can move from one idea to the next, yet far enough apart that you will feel challenged and engaged, rather than bored. Of course, this spacing will not always be optimal for every student. Consider the overall direction in which a line of questioning is headed, rather than treating the questions as disconnected or unrelated. Keep in mind that the current question builds on the previous question and leads to what is coming next.

Each lab will ask you to review what you have done and reflect on what you have learned, to form a learning cycle that can be summarized as *predict, observe, explain, reflect*. The intent of the reflection piece is to help you cement your understanding of the big ideas. Reflective thinking is a skill we hope you find useful for your learning in other academic and professional settings.

Most labs conclude with the “Synthesis Challenge”. This is a chance to apply what you have learned and use your own creativity to tackle a difficult, open-ended task. It will require you and your partners to problem solve, collect and analyze data, and clearly communicate your results. The guided inquiry part of the lab should lay a foundation that will help you tackle the synthesis challenge.

During lab, your instructor will often ask questions rather than give answers. Teaching by questioning is intended to provide support for you to figure things out for yourself. This may be different than other lab experiences you have had, and may even be frustrating at times. Please engage with the questions, but also do not hesitate to ask your instructor to rephrase a question or try another approach if the dialogue isn’t helping you make sense of the ideas.

Think of your lab as 2 hours for thinking about physics with your classmates and with the support of your instructors. You have no other place you are supposed to be and no other commitments. This is time set aside for you to learn. We hope that you enjoy the intellectual challenge of learning physics!

Lab components and Grading guidelines

Three written documents are posted on the course website for each week's lab: the pre-lab, the lab worksheet, and the lab homework. Lab HW is required and will be due in your TA's box 1-4 days after lab (details to be announced in your lab section).

Below, each component of the lab is described in detail, along with a discussion of how credit is assigned.

Pre-lab: A short set of questions designed to get you thinking about the important concepts for the week's lab, and to let you gauge what you do and don't understand about those concepts. You might find that the prelab initially feels fairly challenging. Toward the end of each lab, you will be asked to revisit the prelab and come to agreement with your partners on how to answer it. Before walking out the door, we want you to be able to explain the prelab questions with confidence. The lab homework will include "postlab" questions that follow up on the prelab and lab. The postlab questions will require you to apply the concepts and reasoning from the prelab and the lab to a new situation.

The prelab is due at the beginning of the lab session. Your TA will collect the prelabs as you come in the door; no time will be available to complete the prelab during the lab period itself. You will be given participation credit for working out your explanations for the prelab questions. You will not be graded down on the prelab for incorrect explanations or answers. To receive full credit, however, you need to provide an explanation, not just the final answer.

Lab handout: Each lab has three parts.

The first part focuses on the development of concepts and reasoning. Guided questions and experiments will provide "stepping stones" for you to build understanding of the key ideas. You are expected to work through these questions and experiments with your partners, discussing your ideas until you reach consensus, and recording your ideas in writing on your lab handout. **Completing this guided inquiry work is worth participation credit each week.**

The second section is a reflection activity in which you and your partners review the prelab. You will "annotate" your original prelab to identify the parts that were incorrect or incomplete. This exercise is designed to help solidify your learning. After completing the annotation activity with your partners, you are expected to check your thinking with an instructor. He or she will initial your prelab. **The prelab annotation activity is worth participation credit each week, as indicated by obtaining your instructor's initials.**

The third section is the "Synthesis Challenge." This task will often involve a quantitative prediction that you check with an experiment. In general, it will be more open-ended than the first two parts of the lab. During lab, you will conduct experimental tests and/or collect data that you will need later when writing up a "mini-report" about your work on the synthesis challenge. The mini-report is part of the required lab homework (see below)

The three sections of the lab described above complement one another and give you multiple opportunities to develop understanding of the core ideas. **THE LAB PACKET ITSELF WILL NOT BE COLLECTED OR GRADED.** However, students are expected to work through all of the questions and experiments in detail, collaborating with their partners to reach a consensus understanding. Your lab instructor will assign participation credit for this at the time of the prelab checkout discussion (see above). If you have not completed the questions and experiments, you will be asked to revisit those experiments before you receive lab participation credit. Each week, you will take your completed lab packet with you at the end of lab. It will be a useful reference in completing the lab HW.

Homework: Each lab has required homework. This homework has two parts: the postlab and the synthesis challenge “mini-report.”

Postlab. The questions on the postlab will be similar to those on the prelab. You are welcome to talk to other students, your TA, your professor, etc. about the postlab questions, but submitted written responses must be in your own words.

Mini-report. The mini-report is a one-page writeup of your work on the synthesis challenge. It must include three sections: describing the problem, planning and carrying out a solution, and evaluating your results. A template for the mini-report is posted on the course website. You are encouraged to print a blank copy of the template on which to write your mini-report. (You can use your own paper if you prefer, but must clearly identify each section.)

The lab homework is due in your TA’s box on a day and time to be announced in your lab section.

Assignment of weekly lab grade

Each week’s lab is worth 15 pts total, broken into five components, each worth 3 pts:

- *On time submission of completed prelab (3 pts possible).* The prelab is due at the beginning of the lab period. Responses must include a written explanation of reasoning. Credit will not be taken off for inaccurate physics, conceptual or reasoning errors, etc. However, each question must have a complete response for full credit. One word or single phrase answers will generally not be worth full credit. Prelabs turned in after the top of the hour may be subject to a deduction in credit, or may not receive any credit.
- *In-lab participation (3 pts possible).* This credit is assigned for attending lab, working through the questions and experiments in the lab packet, collaborating productively with your lab partners, and writing explanations in your lab packet. Students who leave early without finishing one or more parts of the lab may not receive full credit. Students who work productively during the entire lab period but do not complete the lab will NOT be subject to any deduction in credit.
- *Prelab annotation (3 pts possible).* This credit is assigned for reviewing the prelab with your partners during lab, discussing your revised prelab with your lab TA, and making corrections and annotations in colored pencil on your original prelab. Your TA will initial your prelab to indicate that you discussed it with him or her. You will then submit the initialed, annotated prelab. Part of the credit will be assigned for accuracy and completeness of the physics on the annotated prelab.
- *Postlab questions (3 pts possible).* These lab homework questions will be graded for accuracy and completeness of the physics.
- *Mini-report (3 pts possible).* The mini-report has three required sections:
 - Describe the problem.* Draw a picture showing the physical set up. Label key objects, variables, coordinate system, etc. Define variables, list knowns and unknowns, state the goal. Draw diagrams or graphs (e.g., a free body diagram).
 - Make a plan and carry it out.* Assemble important principles and equations. Outline a plan. Carry out the plan. Work symbolically first, and plug in numbers at the end.
 - Evaluate the result.* Did you reach the goal? Were the units correct? Is the value reasonable? Can you check it for any limiting cases?

In addition, the mini-report must describe the relevant physics accurately. Even if your group does not complete the challenge successfully on the first try, you should identify and correct any errors and eventually achieve success. The mini-report should reflect a correct analysis of the underlying physics.

The postlab and mini-report will be generally be graded on the following scale:

- 3: High quality. Work is complete and accurate, with all parts described above present and clearly expressed. (One or two *minor* errors or omissions may be present.)
- 2: Work is on the right track, but has multiple minor flaws or omissions, or a single flaw in or omission of a key idea.
- 1: Work has multiple major errors or omissions, and fails to demonstrate a basic understanding of the relevant physics.

Lab attendance

There are 7 labs total, and no makeup labs are offered. You are allowed one excused absence from lab for a medical reason or a family emergency authorized by the Office of Student Life. If you miss one lab with an unexcused absence, you will receive a zero for that lab. If you miss two or more labs, for whatever reason, then the course will need to be retaken.

Pre-assessment

There will be a pre-instructional assessment given in the first week of class. This assessment will be graded on completion but not on correctness. It will be worth 5% of your lab grade.

Post-assessment

There will be a post-assessment given during the last week of the quarter. This assessment will also be worth 5% of your lab grade.