Syllabus

The General Physics Laboratory is designed as introduction to research methods. It focuses on applications of physics relevant to the life sciences. Students learn how to design experiments to answer physical question, learn how to summarize and present their methods, findings and conclusions, and how to present their conclusions both in written and oral form. Students also learn how to discuss their findings and be able to defend their conclusions.

Instructor **(see lab schedule)**

Name: _____

Email: _____

Office: _____

Office hours: _____

Learning Outcomes

By completing this lab course, students will be able to

- Design experiments, and measure & analyze data to answer physical questions in the life sciences and related areas.
- Use modern experimental equipment and computer analysis to measure various physical phenomena.
- Present and discuss methods, findings and interpretation of data both in written and oral form.
- Collaborate on a research project in a team.

How to be successful in this course

These labs are different from what you might be used to. They are designed to model the actual process of science as an interactive, community-based experience.

If you have done science labs before, you were probably told exactly what to do. Such 'cookbook' labs showed you how to use equipment, tested your ability to follow instructions, and often were designed to test a theory learned in lecture. But that's not the way real experimental science happens. In this lab course you will have an opportunity to develop your skills as an experimental scientist.

Sometimes the lab comes before the material appears in lecture. In real life, you often have no idea what will happen and need to explore a phenomenon experimentally first. The idea here is to do an experiment to try to find out what the behavior is without knowing the answer beforehand — just like many real scientific experiments.

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 clarify the real answer and purge the "wishful thinking" to which we all are prone.

The main goal of these labs is to give you experience in designing an experiment to answer a question. We give you a question; you and your team think about how you can make a good measurement to answer the question. If you get stuck, try to work out another solution together before you go to the TA; the TA's job is to provide support with operating the equipment and help you understand the phenomenon you are investigating, they are not there to lead you through an investigation. Additionally, you will need to consider how the design of the experiment affects the certainty of your result.

The key to being successful in this course is to focus on teamwork. By working together to efficiently gather and analyze the data, your team will be free to spend more time discussing your results. This is the true focus of this lab class: using your data to draw appropriate conclusions about the phenomena that you are investigating.

A few more tips:

- **Before you come to lab:** Read over the entire lab. Spend some time thinking about what is involved and how you might do the experiment. Read through any relevant sections in the textbook even if the lecture class hasn't reached them yet. Communicate with your lab team to begin planning out the way you will carry out the experiment.
- **While you are in the lab:** Focus on your goals and tasks in the lab, don't waste time. If you take a lot of time on irrelevancies, you may have trouble finishing. Remember to document what you are doing in a lab report created as you go.
- **Before you leave the lab:** Be sure each team member has a copy of the data. You don't want to arrive for 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...). At the end of a one-week lab or the last week of a multi-week lab, hand in your finished lab report before you leave.

Roles

In order to facilitate the preparation of the lab report, you will be working in groups of two or three. There are three roles that your group members will fill; while each member takes primary responsibility for one role and for the portion of the lab report related to that role, please keep in mind that the experiment is a group effort and you should all be aware of the dilemmas faced by your peers and the decisions that they make. Also, except when writing the report, these lab experiments often involve "all hands on deck" – with every group member contributing to the construction, execution, and analysis of an experimental protocol. The division of labor will be as follows:

The Journalist: This person is primarily responsible for taking notes of everything that happens during the experiment and writing up the "Introduction" section of the lab report.

The Data Interpreter: This person primarily deals with tabulating and displaying the data, operating the computer, and writing up the "Graphs & Analysis" section of the lab report. While all members of the group are expected to be involved in the collection and analysis of the results, this person is responsible for making them presentable.

The Checker: This person is responsible for making sure that the group is properly following the experiment plan, and makes sure that all requirements from the lab manual are being met. They are in charge of writing the "Conclusion" section. This person also acts as a "manager" of the lab tasks, stepping in where help is needed and coordinating the group's efforts to ensure the lab is completed efficiently and on-time.

Expectations for Students Participating in a Cooperative Classroom

Learning in a cooperative environment should be stimulating, demanding, and fair. Because this approach to learning is different from the competitive classroom structure that many other courses are base on, it is important for us to be clear about mutual expectations. Below are the expectations for students in PHY2131/2141. This set of expectations is intended to maximize the exchange of ideas in an atmosphere of mutual respect while preserving individual ownership of ideas and fairness of work.[1]

1. Students are expected to work cooperatively with other members of the class and show respect for ideas and contributions of others.
2. When working as part of a group, students should strive to be good contributors to the group, listen to others, not dominate, and recognize the contributions of others.
3. Students should ensure that everyone in the group makes a contribution, and recognize that everyone contributes in different ways to a group process.

I have read and understood the expectations of students in this class. If I am uncertain about appropriate behavior in the class, I will ask one of the instructors for clarification.

Signed,

_____

Please print your name here:

Keep one copy for yourself and return the other copy to your instructor

[1] Adapted from *Scientific Teaching*, Handelsman, Miller, and Pfund, 2004

Schedule

The table below shows the typical schedules for Physics 2131 & 2141. This schedule is subject to change due to unforeseen circumstances, any changes will be announced via blackboard.

Week	PHY 2131	PHY 2141
1	Excel Intro.	Error Analysis
2	Experiment 1	Experiment 6
3		
4	Experiment 2	Experiment 7
5		
6	Experiment 3	Experiment 8
7		
8	Experiment 4	Experiment 9
9		
10	Experiment 5	Experiment 10
11		
12	Final Presentations	

Late/Absentee Policy

If you anticipate missing a lab session, try to arrange ahead of time to attend another lab section for that session or for the entire lab unit. If it is not possible to attend a different lab session, contact your TA as soon as you are aware of your impending absence.

There are no make-ups for missed work. The grading scale is set to account for unforeseen circumstances that would result in you missing a class. If your schedule will result in missing multiple days, you should take this course during some other term.

Each absence will remove a proportional amount from your lab grade, i.e., for a two week experiment, missing one of the days means that your grade for that experiment will be reduced by half. This policy is not open to negotiation. If you miss more than one experiment, you may receive a failing grade for the entire class.

A student who fails to attend the final presentation will receive no credit for the "Final Presentation" portion of their grade. Note: This will not impact the grades of the members of the group who do attend the final presentation.

Grading

- **Quiz:** Before the first day of an experiment, each student will complete a online quiz about the upcoming experiment. The quiz is due the night before the class, and will contain questions covering the concepts under investigation, lab techniques, units, meaning of results, etc. The answers to some of the questions will not be found in the lab manual, and may require you to do a bit of outside research.
  - **20%** of grade (Individual)
- **Leading a discussion:** Every student will lead a discussion 1-2 times per semester. On the fist day of an experiment, a student will go over the solutions to the quiz questions. On the second day of an experiment, a student can introduce a question, problem, or idea that they encountered during the previous class, or they can discuss how they propose to complete their data analysis. Total time 5-7 minutes.
  - **10%** of grade (Individual)
- **Lab reports**(see below)**:** For the final approximately 30 minutes of the last day of an experiment, your lab team will work on finalizing a write-up of the experiment that you performed following the format listed below.
  - **40%** of grade (Group)
- **Final presentations:** Give complete overview of one of the experiments, with methods, data, discussion, questions, ideas, conclusions – 10 minutes each group.
  - **30%** of grade (Group)

Grading Scale

Percent	Letter Grade
85 - 100	A
75 - 85	B
65 - 75	C
55 - 65	D
0 - 55	F

Lab Reports

Each group will work together to submit one lab report for each experiment they complete. The lab report must be submitted electronically to your lab TA at the end of each experiment, late submissions will not be accepted unless under extenuating circumstances. It is recommended that students not actively engaged in recording or analyzing data should spend time working on other areas of the report.

Introduction & Methods

This section should begin with a description of the process you are investigating. Describe what data you plan to gather and explain how it will be useful in your investigation. Briefly describe the steps you took to gather that data and the methods you used to analyze your results.

Requirements

- At least one paragraph in length.
- Simple figures may be used to illustrate the experimental setup.
- Explain any equations that you will be using in the course of your data analysis.
- Be detailed but avoid minutia! No one needs to read the full details of every single step you took.

Graphs & Analysis

This section should include graphs of the data that you mentioned in the introduction. The lab manual will guide you on the number of graphs that you should aim to include, but feel free to add more if you feel they are relevant. After each graph, include a few sentences explaining it: point out important features, comment on the fit of the data against any theoretical curves, etc.

Requirements

- All axes must be well labeled at a legible size and with appropriate units
- Use reasonable significant figures
- Calculate uncertainty whenever possible and use error bars.
- Don't skimp out on the explanations after each graph, as this is probably the most critical part of any report. Don't rely on the reader to make the connection between what is in the graph and the phenomena you are investigating, tell them explicitly.

Conclusion

In this section you want to demonstrate how all your results connect to elucidate the phenomena you set out to investigate. Discuss the strongest and weakest areas of your investigation, and describe changes that you would make to your experimental plan if you were to repeat your work. If possible, discuss how the things that you learned about in each experiment would be applicable to topics studied in other science classes.

Lab Report Rubric

Lab reports will be submitted on the last day of an experiment. It is recommended that students not actively engaged in recording or analyzing data should spend time working on other areas of the report. The lab report rubric is shown in Figure 1.

Introduction	**Max Points**	**Points**
Beginning of the lab report captures the reader's attention.	2	
Introduction contains background information about the physics being tested in the experiment and explains the physics behind what you are observing. Appropriate equations are discussed.	6	
Appropriate key terms are defined and explained. Demonstrates understanding of how the key terms are relevant to the lab.	3	
Lab report contains an obvious hypothesis. Explains why a certain outcome is expected.	3	
Methods		
Lab report contains a list of materials necessary to complete experiment.	2	
Experimental setup is described in detail. Images or drawings may be included and should be explained.	2	
Lab report contains description of the steps used to complete experiment and analyze data. **Not directly copied from lab manual**. This can just be an overview – you do not need to provide click-by-click directions for ImageJ, Amscope, or Virtual Dub	3	
Graphs & Analysis		
Lab report contains all graphs and tables necessary to support argument.	3	
All graphs and charts are labeled appropriately and contain proper units.	2	
Each graph or chart is explained. Explanation should include what the graph is showing and how it is relevant to the argument.	6	
Conclusion		
Lab report makes overall conclusions about the investigation and relates these conclusions back to the hypothesis.	6	
Conclusion explains how the trends observed relate to physics. Provides a summary of what was learned in the experiment.	6	
Potential sources of error are mentioned. If expected trend does not match the observed trend, what might be the reason?	3	
Conclusion proposes ways to extend the investigation and/or how the experiment relates to fields/concepts outside of physics.	3	
Total	50	

Figure 1: Lab Report Rubric

Final Presentations

The last session of the course is designated for final presentations. This is a group presentation that the students give covering one of the experiments that were conducted during the term. The presentation should last 10 minutes. See the rubric shown in Figure 2 for further details. Note that there is both a group and individual component to the grade. **If you fail to attend the final presentation will receive a zero for the "Final Presentation" portion (30%) of your grade. This cannot be made up.**

Topic:			
Group Members:			
Category:	**Scoring Criteria**	**Total Points**	**Score**
Organization (Group)	Information is presented in a logical sequence. Presentation contains an Introduction, Materials & Methods, Graphs & Analysis, and Conclusion section.	4	
Content (Group)	Introduction is attention-getting. Group members are introduced.	2	
	Introduction contains appropriate background information about the physics being tested in the experiment.	6	
	Introduction defines key terms associated with the lab and explains any relevant equations.	6	
	A clear hypothesis is present and the reasons behind the expected outcomes are explained.	2	
	Materials are listed and experimental setup is described. Experimental procedure is explained. Videos from the experiment may be included and should be explained.	5	
	Presentation contains all graphs and tables necessary to support argument.	2	
	Graphs and charts are labeled appropriately and with proper units.	2	
	Each graph or chart is explained. Explanations should include what the graph is showing and how it is relevant to the overall argument.	6	
	Conclusion summarizes the results and relates them back to the hypothesis.	4	
	Conclusion summarizes the physics learned in the experiment. Any questions from the lab manual are answered.	6	
	Potential sources of error are discussed. If expected trend does not match the observed trend, what might be the reason?	3	
	Conclusion proposes ways to extend the investigation and/or how the experiment relates to other fields/concepts outside of physics.	2	
Presentation (Group)	PowerPoint slides are well-prepared, informative, effective, and not distracting.	4	
	Images and videos enhance the presentation. Any video clips included in the presentation are narrated by the speaker.	4	
	Bullet points are clear and concise - no long paragraphs.	4	
	Slide text can be easily read by audience – font is an appropriate size for presentation.	4	
	Length of presentation is within 2 minutes of 10 minutes.	4	
Individual			
Presentation (Individual)	Speaker is well-rehearsed and uses limited filler words ("umm", "like", etc.)	5	
	Speaker uses a clear, audible voice.	5	
	Speaker has good eye contact with the audience and is not reading directly from slides.	5	
	Speaker presents an appropriate amount of the presentation.	5	
Question (Individual)	Speaker asks at least one question after another group's presentation.	5	
	Speaker answers at least one question during their group's presentation.	5	
Additional Comments:		**Total Points**	**Score**
		100	

Figure 2: Final Presentation Rubric

Students with Disabilities

If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TTD only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours or at another agreed upon time to discuss your needs. Student Disability Services' mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University.

Please be aware that a delay in getting SDS accommodation letters for the current semester may hinder the availability or facilitation of those accommodations in a timely manner. Therefore, it is in your best interest to get your accommodation letters as early in the semester as possible.

Religious Observance Policy

Because of the extraordinary variety of religious affiliations represented in the University student body and staff, the Wayne State University calendar makes no provision for religious holidays. It is University policy, however, to respect the faith and religious obligations of the individual. Students who find that their classes or examinations involve conflicts with their religious observances are expected to notify their instructors well in advance so that alternative arrangements as suitable as possible may be worked out.