Lab Syllabus

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The majority of students who fail the lab do so for having failed to understand the contents of this syllabus. Read carefully, email with any questions

Goals:

To apply what you learn in the lecture, you will need some skills and concepts that are best learned in the laboratory. These skills include model building, data collection and analysis, laboratory record keeping, and formal reporting of results. You will also need enough statistics to perform elementary hypothesis testing. These skills apply to quantitative work in many fields, including the health- and life-sciences, math, and engineering. Although these activities should improve your understanding of the lecture material, our principle goal is to turn theory into practice.

Most students in introductory physics courses have had lab experience in chemistry and other disciplines. We build on that experience. Your teaching assistants will not be as specific about their requirements as your chemistry teaching assistants may have been. You will often be expected to figure things out on your own in consultation with your lab partner, but you will be graded by the rubrics – which can help to provide some guidance. Since you will be working more independently, you will be required to document your work more carefully, with less input from your teaching assistant.

To accomplish these goals, you will be expected to:

• Apply physics in a variety of physical settings.
• Build simple mathematical models.
• Design experiments.
• Document your experimental work, results, and data analysis in lab notes and notebooks.
• Evaluate and compare results using uncertainties.
• Employ representative software packages for data collection and analysis.
• Document your experimental methods, results, and data analysis in a lab notebook.
• Evaluate and compare results using uncertainties.
• Communicate your work in writing (short and long formal assignments).
Student responsibilities

- **Read the syllabus.** The regulations/guidelines in this syllabus take precedence over any oral commitments that may be made. The lab director is responsible for the final interpretation of these policies.
- **Arrive at your lab on time.** Many important instructions are given in the first 5 minutes of lab. It is vital to be on time to lab. In rare cases, room assignments may be adjusted to accommodate special requirements of a particular lab. Notice will be posted when this happens.
- **Perform all three graded labs at the end of the semester.** If you miss or expect to miss a graded lab due to sickness or another valid reason, a make-up laboratory is available at your normal time and location after completing the final graded lab.
- **Make sure that all submitted work is your own.** Academic dishonesty is not tolerated and is grounds for failing the course. Should a student have access to legacy lab notes, sufficient changes have occurred in recent semesters that this will be immediately apparent.
- Before each lab, read the lab manual and related course material, particularly if the material has not already been covered in lecture. Chapters in the freely available OpenStax textbook are referenced for further investigation, YouTube MOOC offerings can also help get you up to speed. You are expected to use the week prior to lab familiarizing yourself with all material required for the lab.
- Bring your calculator, pen and pencil, lab notebook, and scratch paper to lab each week.
- Come prepared to perform mathematical calculations based on the level of math appropriate for the course. This includes algebra, geometry, and trigonometry. For Physics 201 and 202, calculus is also required. All labs also conduct statistical work, which is not covered in any prerequisite courses for these labs. Students may wish to utilize Khan Academy or other resources for help with statistics.
- Do not bring food, tobacco, or beverages into a lab room.

**What is expected of you during each lab**

In lab, you are not required to get to the "end" of the experiments. The goal isn’t for you to perform some given action. The goal of the experiment is to get experience with and exposure to experimental techniques and data analysis.

Be deliberate with your approach to all parts of the lab. Doing parts 1-3 of 7 of a lab incredibly well is better than doing all 7 parts sloppily. And both will be graded on the merits of the work which was completed by the group. So long as you are making an effort to advance/improve during the full three hours in the lab, you will be capable of obtaining the same experience and advancement as others in the room.

We run our labs as Pass/Fail because it is impossible to evaluate two researchers and say conclusively that one is 3.87% superior to another. Fine-scale grading is simply not possible when there are so many valid approaches, so many potential complications. This is also why we are not interested in how well you perform a single action, but rather interested in your overall approach.

With an introductory experience in performing experimental science, you will not uncover great secrets which rock the foundations of science as we know it. You will not become a high quality
researcher. You may however develop habits and approaches which can serve you well on the path to accomplish such feats. Our goal is to have you learn how to observe carefully and record important details, how to design an experiment to test a hypothesis, what the difference is between a hypothesis and a prediction, to train you to be aware of assumptions, to pay attention to accuracy and precision, to quantify and account for error. And finally, our goal is also to help you learn how to communicate the results of your research to others.

**Final lab grades**

Lab and Lecture components of this four credit course are only loosely linked. Due to the open ended nature of scientific investigation, the Lab component is evaluated on a Pass/Fail basis. Final grade for the course will be determined completely by performance in Lecture activities. However, a failure of either the Lab or the Lecture will count as a failure of both, and each component will need to be re-taken if the student desires a passing grade (or just takes the course to obtain a better grade).

A **student fails the lab if they score under “Expectation” in more than 5 Rubric categories across the final 3 labs.** Every evaluated rubric category used in the final 3 labs is used at least 3 times during the previous labs in the semester, with no new categories being added during the last 6 lab sessions (so you have at least 1 month of practice in every evaluation metric before being evaluated).

In addition to this failure condition, each week you must complete an “Exit Ticket” before leaving lab for the day. This primarily consists of “put everything how you found it” level of cleaning up your own lab station, but one important item to be aware of is that it includes "Required Level of Effort" as a check. This is a check at the TA’s discretion which can be refused if a student is failing to participate in a meaningful manner. A warning will have been issued during the lab session before a student is refused their Exit Ticket due to participation/effort. If you have **4 or more exit tickets incomplete**, that is a failure.

Attendance requirement in the lab is that **you will fail if you miss more than 2 labs** or more than 3 if at least one is excused). A make up session is available for the final 3 (evaluated) labs only, and that session is at your normal lab time the session following the third evaluated lab. Ensure that your schedule is set to avoid missing any of the final 3 labs. Save your one make up opportunity for unplanned emergency/medical use. No student may attend any lab section other than the one for which they are registered.

Although each lab partner in a group will report the same data, your data analysis, discussion of results, and conclusions must be your own. The Rubrics should be your guide for ensuring that your work is adequate prior to submitting it. In the last 30 minutes of class, before you leave your lab session and submit your work, review what you have recorded and evaluate yourself using the rubrics. There should be no mystery about what marks you will see when graded work is returned in the next week.

Questions regarding feedback on lab assignments need to be discussed with your teaching assistant within two weeks of receiving the evaluated material (earlier at the end of the semester). Final lab assessments (pass/fail) will be posted on Blackboard 1 week after makeup lab. Errors that affect
your physics course grade will be corrected after final grades are submitted to the Registrar, if necessary.

**Attendance Policy**

Except for the final three weeks of lab, all meetings serve as an opportunity to learn and practice the skills which will be evaluated at the end of the semester. **Failure to attend 3 or more labs results in failure of the course**, and since every evaluation metric is used 3 or more times, a student with 2 absences will still have an opportunity to practice each graded metric at least once in the semester.

Do not translate this to mean that the first 9 labs are meaningless. In previous semesters students who failed to pay attention to how the rubrics functioned and what expectations were found themselves failing the course on the very first of the three evaluated labs due to simple mistakes.

There are no make up opportunities offered for standard labs. The final three graded labs are provided with one opportunity for make up, which is during Closed Week at the normal time and location for your lab sessions.

**Do not attend lab if you are ill with something contagious.** Review your Lab Manual and discuss via email with your TA or peers to learn what you can of any new concepts from that missed week. If illness results in missing one of the graded lab sessions, notify your TA as soon as possible to ensure you have material available during the make up session at the end of the semester. **An illness only counts as an excused absence if accompanied by a signed statement which explicitly states you are ill and unable to attend class on the day of the missed lab.** Such a note must be delivered to your TA as soon as possible (no later than 1 week after the absence).

If you expect to miss your regularly scheduled lab to attend a university-approved activity, that absence counts as an excused absence. University-approved activities include music and athletic events in which you perform. Your TA must be provided with documentation for the absence to count as excused.

**Exam Conflicts** - If one of your other classes schedules an exam outside of normal hours and it conflicts with your lab session, **the instructor of that other class is required to arrange an alternative time for the exam with you.** This is set forth in WSU Academic Regulation 80 as of Spring 2016. Do not surrender any of your limited absences in lab just to take an exam, inform your professors of the regulation if they are unaware of it, and they will arrange an opportunity for you to take the exam without missing lab. But informing your professor of the conflict and arranging an alternate exam is your responsibility.

Students are not permitted to attend any lab section other than the one for which they are registered.

In summary, the methods by which a student can fail the lab portion of the class are as follows:

1. Score below Expectation in 5 rubric categories across all three of the final labs in the semester
2. Fail to obtain a completed Exit Ticket for 4 or more labs during the semester.
3. More than 2 absences during the semester.

Student conduct

“Washington State University, a community dedicated to the advancement of knowledge, expects all students to behave in a manner consistent with its high standards of scholarship and conduct. Students are expected to uphold these standards both on and off campus and acknowledge the University’s authority to take disciplinary action. The purpose of these standards and processes is to educate students and protect the welfare of the community.”—Quoted from the Preamble to the Washington State University Standards of Conduct for Students (https://www.deanofstudents.wsu.edu/student-resources/university-policies/).

A partial list of prohibited conduct appears in Washington Administrative Code (WAC) Section 504-26 (http://apps.leg.wa.gov/wac/default.aspx?cite=504-26). Of special importance to the laboratories is the false reporting of data, experiment results, information, or procedures. Reporting data acquired by others (including your lab partner if you did not contribute) or in previous semesters is academically dishonest. Fabrication of results, information, or procedures, and sabotaging other students’ work is also prohibited. Violations of this policy will be reported to the Student Conduct Committee as instances of academic dishonesty and result in a failure of the course.

Students are expected to avoid behavior that unnecessarily interferes with the learning of other students. We expect students to be on time to labs and to mute their cell phones for the duration. The concepts of physics are subtle, and even the most intelligent students make mistakes. In this environment, it is important that students be willing to ask questions if they don’t understand what their lab partners say or do. To this end, we require that students and teaching assistants alike avoid behavior that discourages communication. This includes threats and insults. Students who repeatedly disrupt lab may be directed to leave the room and may be counted absent for that week’s lab.

Disability accommodations

Reasonable accommodations are available for students with documented disabilities. If you have a disability and need accommodations to fully participate in the lecture or lab, call or visit the Access Center in the Washington Building, Room 217 (Phone: (509) 335-3417, e-mail: Access.Center@wsu.edu, URL: http://accesscenter.wsu.edu). All accommodations must be approved through the Access Center. Notify both your lecture instructor and the lab director during the first week of lecture concerning any approved accommodations. Late notification may cause the requested accommodations to be unavailable.

As laboratory work is quite different from standard classwork, and we have no examinations, few accommodations apply to labs. Be sure to mention to your TA if you feel one of your accommodations should apply and is not being met.
Safety resources

General information on campus safety is posted at http://safetyplan.wsu.edu/—the Campus Safety Plan. Information on how to prepare for potential emergencies is posted on the Office of Emergency Management website (http://oem.wsu.edu/). Safety alerts and weather warnings are posted promptly at the WSU Alerts site (http://alert.wsu.edu/). Urgent warnings that apply to the entire University community will also be broadcast using the Campus Outdoor Warning System (speakers mounted on Holland Library and other buildings) and the Crisis Communication System (email, phone, cell phone). For this purpose, it is important to keep your emergency contact information up to date on the MyWSU system. To enter or update this information, click the “Update Now!” link in the “Pullman Emergency Information” box on your MyWSU home page (http://my.wsu.edu/).

Safety information that applies to the laboratories appears in the Lab Manual. Your teaching assistant will also present any safety information that applies to the current laboratory at the beginning of the laboratory. Students are expected to conduct themselves responsibly and take no unnecessary risks in the course of their work. Students who disobey the safety instructions of the teaching assistant will be directed to leave the room. All accidents and injuries must be reported promptly to your teaching assistant.

An Emergency Guide is posted by one door of each lab room. If faced with an emergency, follow the “Alert, Assess, Act,” protocol: Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and ACT to ensure your own safety and the safety of those around you. In case the fire alarm sounds, leave the building promptly in an orderly fashion. If you are not on a ground floor, use the stairs. Do not use the elevators. After exiting the building, gather across from the basketball court behind Waller Hall (down the hill, south of Webster Hall, see Figure 1) with the other members of your lab. A representative of the Department of Physics and Astronomy will tell you when it is safe to re-enter the building. If this does not happen before the end of the lab period, you are free to leave for your next class. If the emergency involves an active shooter, your options are to RUN, HIDE, or FIGHT (https://www.youtube.com/watch?v=5VcSwejU2D0). Each lab room door can be locked from inside in case of a lock down.

Why are we Pass/Fail?

In these labs, we want you to learn how to perform effective research. We know precisely what effective research looks like. But we have no idea how to design a test which can be applied to a large set of students which will conclusively show who is capable of doing effective research and who is incapable of it.

When we did assign a numeric grade in these labs, we were evaluating students on the ability to perform specific tasks, and acquire specific results. This allowed us to say if you were right or wrong.

The problem is, that research is not about right or wrong, it is about plausible and incoherent. You do not engage in research already knowing that there will be a satisfactory answer, you often
engage in research wondering if there is any answer at all. Other times you engage in research
fully expecting to see absolutely nothing of interest, but wanting to be sure that this is what will
happen anyway.

When we evaluated for numeric grades, students focused on doing the specific tasks we asked of
them. Students came away from the course understanding how to jump through those few hoops
which we set before them, and which would never again come up in their lives.

By shifting to Pass/Fail, we make this course demand more of the students. No longer do we tell
you precisely what to do at any given moment. No longer do we assure you that you will walk
out of your 3 hour lab feeling like you did accomplish a specific tasks at a level consistent with
expectations. This can be an uncomfortable feeling for many students.

However, by putting students in this more difficult space in terms of understanding expectations,
we remove the overly specific hoops which are needed in order to reliably assign numeric grades
to a large population. It is the hope that without focusing on those meaningless goals, students will
focus on the broader objective of learning how to form a convincing argument which is supported
by conclusive data, or how to build predictive models to prepare for potential outcomes in sensitive
situations. Those two tasks will absolutely come up again and again through your life, and are
precisely the goals of experimental research.
And so, while saying we have lofty ambitions for what you shall learn, and that we are knowingly placing you in an uncomfortable position academically, it is valuable to discuss a little bit about how people learn. Learning originates within the learner. While it is useful to have an instructor present who is a subject matter expert, it is absolutely possible to sit in a room with a genius who tells you all sorts of wonderful things and walk out knowing nothing new at all. It is also frequently the case that a person can spend a week in total isolation, and come out from it considerably more informed and capable than they were at the start.

Think through your academic life thus far. How often have you learned something while resenting your time in the class? What did you take away from any class in which you were absolutely bored? In the class where you learned the most, how did you feel? Our emotions inform our approach to learning a great deal. And how we see the value of a course’s material informs much of our emotional perspective. If you feel that this course offers you nothing valuable, then you are not going to enjoy your time in the course and you are not going to learn anything while here.

And so, we put it to you…. What can you possibly gain in this course which is of value to you, personally?

We are in the physics department, and we will often work with physics scenarios. But the wonderful thing about physics is that it is a study of all of reality. It should be absolutely possible to find something you are interested in which also happens to be connected to physics. In addition, our focus is on how to conduct experimental research, how to support an argument or build a predictive model. And so while you may have a week where you crash plastic carts into one another, the actual focus that week will be on finding a way to use a few points of data which you can easily gather to reliably predict what would happen in a similar scenario which you cannot actually test.

Previously in these labs, we would tell students how the instrumentation works, and require them to simply believe what we say about the capabilities and limitations of the instruments. We would tell students what tests to make measurements on, and how to analyze those measurements. Then we would tell the students that, because of the analysis, they can now predict some specific thing which was meaningless to them. All of these actions are still the basic actions which you will perform each week. But now we want to avoid telling you to do them outright. We want you to decide to do them on your own.

The problem is, that in the case where we told you precisely what to do, we were helping you to form a convincing data driven argument which may convince someone else of a pointless truth, but we were skipping the step of convincing YOU of the truth. Students were being asked to use instruments they do not understand to do things they do not care about and come up with predictions they have no use for. I am hopeful you can see why this may not have been particularly interesting and engaging, which would lead to a poor emotional state and prohibit any chance of meaningful learning.

And so, we enter into a Pass/Fail grading scenario, and gain the freedom to start each lab allowing you to interact with the instrumentation we will be using for the week. Convince yourself that it does work, figure out the limitations of the measures which can be obtained. In order to figure out that something works, first you have to use it to do something which can easily be done in another way. This allows you to verify that it does indeed work. Then you want to try and use the tool to
do something which you cannot easily do another way, but which you can at least verify intuitively to be reasonably accurate. Only after this is verified can you use the instrument to measure things which you cannot possibly figure out in any other way.

Now, once you have convinced yourself that the equipment we are providing you does work, you are still expected to make measurements and predictions with things that you likely do not care about. That is because what you are measuring and predicting is not the focus of our instruction. Our focus is on how and why you are measuring and predicting. Those predictions are formed through analysis of the data collected in the measurements, and such analysis can be performed in many different contexts. We limit ourselves to rather uninteresting scenarios to accomplish two things: 1) Finish the lab within the 3 hours we have available with materials available to all students, and 2) reduce how much students focus on the content of the experiment, and increase how much students focus on the design and process of the experiment.

Again . .  . crashing carts together is not likely to come up any time in the future for your life. But taking information about how something behaves in a safe settings and figuring out from that how it will behave in a dangerous settings will come up time and again for all of you.

**Possible changes**

The lab director reserves the right to correct errors in the syllabus and to modify lab schedules and room assignments. The lab director has delegated some authority to modify assignments and due dates to your teaching assistant. This helps ensure that your are graded according the criteria stated during your lab meeting.