

## PHYS170L-003: General Physics I Lab

Fall 2019: August 26–December 20  
R 12:30 PM–3:20 PM, Room: STB 209

**Version 1:** August 8, 2019 (subject to change)

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**Instructor:** Kathy Cooksey, Ph.D., STB 220; [kcooksey@hawaii.edu](mailto:kcooksey@hawaii.edu); 808-932-7195  
**Office Hours:** M 2–3P, W 11A–12P, R 10–11A, F 1–2P, and by appointment  
**Websites:** Laulima PHYS-170L-003 (HIL.11610.FA19)

### Course Description:

A required laboratory supplement for and PHYS 170; covers basic principles of experimentation and physical measurement. Presents illustrative experiments in mechanics, heat and waves.

**Pre-requisites:** PHYS 170 which may be taken concurrently.

### Email, Textbook, and Websites:

- UHH considers email and Laulima an official form of communication; students are responsible for receiving and returning information in a timely manner.
- The professor will email students at their [hawaii.edu](http://hawaii.edu) accounts only.
- The instructor of the lecture (PHYS272) determines the textbook. The lab will largely be using materials provided via Laulima.
- The Laulima course website is listed under PHYS-170L-003 (HIL.11610.SP19). This site will be the hub for all course information.

### Good-to-Know about the Professor:

- She enjoys teaching and wants to be better at it, and she really cares about helping students be better. These aspects combined mean she is on the students' side; trust in that and knowledge that she is receptive to feedback will smooth over rough patches.
- She chooses teaching techniques based on physics-education research to support student learning as best as possible. This means she has one or more reasons for nearly every component of and action in a course. She'll gladly motivate these choices whenever necessary or asked.
- Her primary goal is to help students improve *how* they learn with the logic that if students learn how to learn, they can master any content. The related goal is to focus on transferrable skills so that time and effort spent for the class yield benefits beyond the course and semester.
- Generally, she does not answer questions directly. A student making connections and constructing a solution her- or himself will ingrain the answer more effectively, and the professor facilitates the process by asking leading questions. Since the motivation is to help the students, they should embrace and engage with this process. (It is also a transferrable skill to discuss ideas and answer questions on the fly.)
- She thinks no single resource is comprehensive, so the expectation is that the student will have to work with the professor, the lab manuals and videos, the PHYS272 textbook, and the wealth of material available on the internet.
- The expectation is that a course requires 2–3 hr outside-of-class time per credit per week.. Hence a 15-cr semester equals 30–45 hr per week (i.e., a full-time job).
- She generally responds to email 24-to-48 hours after receipt. If the matter is urgent, the student should call (office voicemail is automatically emailed) or stop by her office (her general weekly schedule is on her homepage: <http://www2.hawaii.edu/~kcooksey>).

- When a lab leads the lecture, the professor takes the time to work through the fundamental physics with the lab groups that need or request it.
- She expects students to make a good faith effort to conduct the experiment from the materials provided but knows they will need help. She will help upon request but may also intercede.
- She has a strong focus on natural-science majors learning basic statistics and spreadsheet functionality.
- She also focuses on the lab reports as a learning tool<sup>1</sup> and an assessment.

### Lab Rules:

- Students are responsible for their own learning, which includes preparing for class, submitting work, asking questions, and seeking additional help.
  - The majority of college students use instructors' office hours and/or tutoring services (e.g., Kilohana; info below).
  - Office hours are good times to get individualized help from the expert (i.e., the instructor), and office hours are part of the instructor's job.
- Students must respect and support of their peers' learning, which means helping each other with difficult concepts but not just giving the answer.
- Group work is encouraged in lab and for reports. However, all submitted work must be the original work of the student with reference to any partner(s).
- Students need to convey (either in person, by email, through an intermediary, or somehow) to the professor questions, comments, and concerns about the course.
- The professor will be receptive to and respectful of the students' needs and interests and should generally follow the section rules as detailed for the students (also see next section).
- Students are required to read the lab manuals and view videos before the lab period and bring any pre-lab assignments to class (usually a table for data or a pre-formatted spreadsheet).
- Students more than 15 minutes late to class will not be permitted to participate in that day's lab. Students with understandable issues with this (e.g., another class very far away, mobility problems, etc.) must discuss the situation with the instructor.
- There will be a limited number of make-up lab opportunities. A student may only make up a lab for which s/he is excused.
  - If a student must miss a class for a reasonable reason, s/he must email the professor before the start of class time.
  - If a student were unable to email in advance due to extreme circumstances, s/he should contact the professor as soon as possible. Such instances will be judged on a case-by-case basis.
    - \* In such (and similar) situations, the student is strongly encouraged to contact Student Services (info below). Student Services are liaisons between students and instructors, when Life adversely impacts Academics. If Student Services intervenes on a student's behalf, the instructor will work to accommodate any missed content and points.
- It is required for the students to conduct the lab experiment to submit a lab report. Students need to sign the attendance sheet each class.
- The lab reports are due in a week, whether there is a lab or not. More details below.
- Late lab reports are only accepted within 24 hr of the due date and time, for 75% of the credit.

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<sup>1</sup>See "The Writing Revolution" in *The Atlantic* (Oct 2012): <http://www.theatlantic.com/magazine/archive/2012/10/the-writing-revolution/309090/>.

- The lowest lab grade will be dropped.
- Students must calculate the desired quantity—as soon as they have sufficient data—as a test of the experimental setup and process and discuss with the instructor.

### Section-Specific Details:

- *Lab “Reports”*
  - Each lab “report” will have five prompts to be addressed in lieu of a formal report. Each is worth two points; one point will be given for a good faith effort to address the prompt. The other point will be given in full or in part, as appropriate for the quality of the answer.
  - The answers should be in complete sentences, typed, and uploaded as a single PDF document to Drop Box.
  - The “report” is due one week after the experiment, at class time, even if there is no lab.
  - Plagiarism is unacceptable. Everything should be in your own words.
  - *Equations, Tables, and Figures*
    - \* All should be numbered with a clear explanation of terms (e.g., variables, symbols) in the appropriate place in the report text.
    - \* A “clear table of results (not raw data with comparison to expectation” will include: (i) section and column headers that enable the reader to reproduce the calculation of the (ii) theoretical/expected result, which is also provided; (iii) the experimental result. If the experimental result is a mean, (iv) there will also be a standard deviation. (v) The experimental result is compared to theory/expectation as detailed in the *Statistics Basics* section below.
    - \* Tables (and calculations) should show a reasonable number of digits; strict adherence to significant figures is not required. The rule of thumb is three non-zero digits.
    - \* Tables and figures should have clear units.
    - \* Tables and figures should also have a “clear, informative caption.” The expectation is that a caption explains what is shown—columns for tables or axes, colors, symbols, curves, etc for figures—and the importance of the information—what does it show.
  - *Grammar and Syntax*
    - \* Physical quantities nearly always have units, and the units should always be provided.
    - \* It should be written in the past tense, unless stating a fact that is true beyond the scope of the report (e.g., “The electric force is  $F = qE$ , where  $q$  is the charged particle and  $E$  is the electric field.”)
    - \* The subject should be “we” when it applies to all partners and “I” when it is important to highlight what the author of the report did. Science papers are always first person plural (e.g., “we did”), third person (e.g., “the authors did”), or passive voice (e.g., “it was done”). The lab reports should only use first person plural (e.g., “we did”) or passive voice (e.g., “it was done”).
    - \* This is formal writing, so there are no contractions (e.g., use “do not” instead of “don’t”).
    - \* The report should be reasonably well-written, meaning it is spell-checked and read through aloud to polish the most awkward sentences.
    - \* The word “data” is plural (e.g., “data were recorded”) and “datum” is singular (e.g., “datum was recorded”).

- *Statistics Basics:*

- The mean (AKA average) is calculated as  $\bar{x} = \frac{1}{\mathcal{N}} \sum_{i=1}^{\mathcal{N}} x_i$ , where  $\mathcal{N}$  is the total number of measurements,  $x_i$ , that are summed (that is the  $\sum_{i=1}^{\mathcal{N}}$  notation). It has the same units as  $x_i$ .
  - \* Note: it does not have to be  $x_i$  and  $\bar{x}$ . The notation should be sensible and informative. For example, if one were measuring velocity, it would be more informative to use  $v_i$  for the individual measurements and  $\bar{v}$  for the mean.
- The *sample* standard deviation is calculated as  $s = \sqrt{\frac{1}{\mathcal{N}-1} \sum_{i=1}^{\mathcal{N}} (x_i - \bar{x})^2}$ . It has the same units as  $x_i$  and  $\bar{x}$ .
- The *sample* standard deviation is different from the *population* standard deviation (which is divided by just  $\mathcal{N}$  and not  $\mathcal{N} - 1$ ). It is the responsibility of the student to verify whatever software formula s/he uses to compute the “standard deviation” returns the *sample* standard deviation.
  - \* Note: By convention, *population* mean is denoted  $\mu$  (“mu”), and the population standard deviation is  $\sigma$  (“sigma”). “Population” refers to the absolute truth, which we try to measure but usually we cannot make the measurements of everything nor conduct infinite trials. Scientific literature is sometimes sloppy and will use  $\mu$  and  $\sigma$  for *sample* mean and standard deviation.
- The mean,  $\bar{x}$ , and sample standard deviation,  $s$ , are measured from the experimental data. Thus, assuming Gaussian statistics, roughly 68.3% of the experimental measurements should fall within  $\bar{x} - s$  and  $\bar{x} + s$  (AKA  $\bar{x} \pm s$ ); roughly 95.4% should fall within  $\bar{x} \pm 2s$ ; and roughly 99.7% within  $\bar{x} \pm 3s$ . Therefore it is *not* useful to compare the dispersion (i.e., spread) of the experimental measurements (e.g., quoting the minimum and maximum values) with the experimental mean,  $\bar{x}$ , and its sample standard deviation,  $s$ .
- It *is* useful to compare the experimental mean with the expected or theoretical value,  $x_{\text{theor}}$ . It is also appropriate to use the experimental sample standard deviation to quantify accuracy and precision, detailed below.
- Accuracy and precision:
  - \* “Accurate” is typically defined as  $\mathcal{N}_s = \left| \frac{x_{\text{theor}} - \bar{x}}{s} \right| \leq 3$ , which means in 99.7% of the experiments, the experimental mean is within  $\pm 3s$  of the expected/theoretical value,  $x_{\text{theor}}$ .
  - \* “Precise” generally means  $\frac{s}{|\bar{x}|} \times 100\% \lesssim 10\%$ .
  - \* If there were no standard deviation, the results are assessed to be accurate if the percent error is  $\left| \frac{x_{\text{theor}} - \bar{x}}{x_{\text{theor}}} \right| \times 100\% \lesssim 10\%$ . And if there is no sample mean,  $\bar{x}$ , compare  $x_{\text{theor}}$  with individual measurements  $x_i$ .

### Campus-wide Information

**Disability Support:** Any student with a documented disability who would like to request accommodation should contact the Disability Services Office—Student Services Center, E230; 932-7623 (V), 932-7002 (TTY), [uds@hawaii.edu](mailto:uds@hawaii.edu)—as early in the semester as possible.

**Advising:** Advising is a very important resource designed to help students complete the requirements of the University and their individual majors. Students should consult with their advisor at least once a semester to decide on courses, check progress towards graduation, and discuss career options and other educational opportunities provided by UH Hilo. Advising is a shared responsibility, but students have final responsibility for meeting degree requirements.

**Kilohana Academic Success Center:** The KASC provides academic support opportunities for all UH Hilo students that foster their development into independent, self-motivated learners. Students who visit Kilohana have access to subject-specific and academic skills tutoring from UHH students selected for their academic achievement and dedication to helping others succeed. Kilohana is located on the lower level of the Mookini Library and on the web at <http://hilo.hawaii.edu/kilohana/>.

**Human Rights:** The University of Hawai'i at Hilo prohibits discrimination in its education programs based on race, national origin, color, creed, religion, sex, age, disability, veteran status, sexual orientation, gender identity or associational preference. If at any time during class you feel uncomfortable about what is being talked about, or feel that your human rights have been violated, please feel free to leave the room. However, the professor asks that you confer with her as soon as possible about what happened so that appropriate action can be taken if necessary to avoid future problems. If you are uncomfortable speaking with the professor about your concern, please contact Kalei Rapoza ([kaleihii@hawaii.edu](mailto:kaleihii@hawaii.edu)), Interim EEO/AA Director, at 932-7626.

**UH Hilo Title IX Policy:** The University of Hawaii is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources on your campus to support and assist you. Staff can also direct you to resources that are in the community. Here are some of your options:

If you wish to remain anonymous, speak with someone confidentially, or would like to receive information and support in a confidential setting, contact: • UH Hilo Counseling Services: SSC, room E-203, 932-7465; • UH Hilo Medical Services: Campus Center, room 212, 932-7369; and/or • Hawai'i Island YWCA, 935-0677.

If you wish to report an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, or stalking as well as receive information and support,<sup>†</sup> contact: • Libby Bailey, Title IX Coordinator, 932-7818, [libby.bailey@hawaii.edu](mailto:libby.bailey@hawaii.edu); • Jennifer Stotter, Director of the Office of Equal Opportunity & Deputy Title IX Coordinator, 932-7641, [jstotter@hawaii.edu](mailto:jstotter@hawaii.edu); and/or • Kalei Rapoza, Interim Director of Human Resources, 932-7626, [kaleihii@hawaii.edu](mailto:kaleihii@hawaii.edu).

<sup>†</sup>Please note that you do not have to file a report with the University to receive institutional support or assistance.

As a member of the University faculty, the professor is required to immediately report any incidence of sex discrimination or gender-based violence to the campus Title IX Coordinator. Although the Title IX Coordinator and professor cannot guarantee confidentiality, the student will still have options about how the case will be handled. The goal is to make sure the student is aware of the range of options available and has access to the necessary resources and support. For more information regarding sex discrimination and gender-based violence, the University's Title IX resources and the University's Policy, Interim EP 1.204, go to: <http://www.hawaii.edu/titleix>.

**Student Conduct:** Students are expected to follow the University of Hawai'i at Hilo Student Code of Conduct available at the following URL: <http://www.uhh.hawaii.edu/catalog/student-conduct-code.html>.