Term Information

Effective Term	Autumn 2025

General Information

Course Bulletin Listing/Subject Area	Physics
Fiscal Unit/Academic Org	Physics - D0684
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	1125
Course Title	Practicing Physics – Matter, Heat, and Motion
Transcript Abbreviation	Practicing Physics
Course Description	Students work in groups to perform hands-on investigations on density, motion, and thermodynamics and develop models to describe and explain their observations. Through discussions with instructors and peers, students consider the effects of science in society and apply their scientific skills to everyday situations. Intended for non-science majors, especially those contemplating a teaching career
Semester Credit Hours/Units	Fixed: 4

Offering Information

Length Of Course	14 Week, 12 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus, Lima, Mansfield, Marion, Newark, Wooster

Prerequisites and Exclusions

Prerequisites/Corequisites	None
Exclusions	Not open to students with credit for 1106
Electronically Enforced	Yes

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	40.0801
Subsidy Level	General Studies Course
Intended Rank	Freshman, Sophomore, Junior, Senior

Requirement/Elective Designation

Natural Sciences

Course Details

Course goals or learning objectives/outcomes

- Gather and analyze data and develop models related to the topics of density, buoyancy, calorimetry, and one-dimensional motion. Use those models to make quantitative predictions.
- Construct a relevant plot of the data, obtain a best fit line and equation, and interpret quantities such as slope and y-intercept.
- Construct operational definitions of physics quantities and explain and justify the need for measurement standards.
- Solve density, calorimetry, and linear motion problems using proportional reasoning.
- Use multiple representations to describe physical contexts and phenomena related to density, buoyancy, calorimetry, and one-dimensional motion and translate between these representations.
- Interpret and apply the meaning of compound physical quantities, such as gram per centimeter cubed.
- Describe and explain the relations between position, velocity, and acceleration graphs for an object moving in one dimension with a constant acceleration
- Determine and justify uncertainty in measurements and present results with appropriate uncertainty, including the use of error propagation to obtain calculated values with appropriate uncertainty.
- Use uncertainty to critically evaluate claims that two measured quantities are the same or different.
- Evaluate the social and ethical implications of scientific claims in the media by interpreting data presented in tables, figures, and graphs, and including the concept of measurement uncertainty.
- Recognize that, while many current scientific models and practices are productive, science is an ongoing, iterative process for building and refining methods and models of the world, and provide examples.

Content Topic List

- Properties of matter:
  - -Definition and measurement of mass and volume
  - -Definition and calculation of density
  - -Sinking and floating behavior in arbitrary liquids
  - -Law of conservation of mass
- Heat and Temperature:
  - -Definition of temperature and temperature scales
  - -Model for heat transfer
  - -Combining hot and cold fluids
  - -Heat capacity and specific heat
  - -Phase changes
- Motion and Forces:
  - -Uniform and non-uniform motion in one-dimension
  - -Definition of velocity and acceleration
  - -Relationship between position, velocity, and acceleration graphs
  - -Definition of force (as F(net) = ma)
- Scientific practices:
  - -Operational definitions
  - -Uncertainties in measurement and error propagation
  - -Plotting data and obtaining best fit equations; interpreting fit parameters.
  - -Using proportional reasoning to solve simple physics problems

Sought Concurrence

No

Attachments

- P1125-ge-foundations-submission.pdf: GE Foundations submission

  (Other Supporting Documentation. Owner: Heckler,Andrew Frank)
- Physics1125_Syllabus.docx: Revised Syllabus

  (Syllabus. Owner: Heckler,Andrew Frank)
- Cover letter 2nd Submission.docx: Cover letter 2nd submission

  (Cover Letter. Owner: Heckler,Andrew Frank)

Comments

- Please see Subcommittee feedback email sent 02/04/2025. *(by Hilty,Michael on 02/04/2025 01:11 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Heckler,Andrew Frank	11/18/2024 03:40 PM	Submitted for Approval
Approved	Heckler,Andrew Frank	12/04/2024 02:01 PM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	01/15/2025 04:33 AM	College Approval
Revision Requested	Hilty,Michael	02/04/2025 01:11 PM	ASCCAO Approval
Submitted	Heckler,Andrew Frank	04/07/2025 12:17 PM	Submitted for Approval
Approved	Heckler,Andrew Frank	04/07/2025 12:18 PM	Unit Approval
Approved	Vankeerbergen,Bernadette Chantal	04/16/2025 11:12 AM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Hilty,Michael Neff,Jennifer Vankeerbergen,Bernadette Chantal Steele,Rachel Lea	04/16/2025 11:12 AM	ASCCAO Approval

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To whom it may concern:

We are respectfully resubmitting a new course request for Physics 1125. This course is a 4 credit-hour combination and adaptation of two existing physics courses: 1106 and 1107, which are both legacy GE courses and 5 credit-hours each. Further the new 1125 is designed to meet the new requirements for a GE Foundations: Natural Science course.

We have addressed the concerns about the structure of the course, making it clear that there is an explicit lab component, and a lecture/recitation component. We also added suggested clarifications to the syllabus. Below we append our responses to the committee response.

We look forward to the opportunity to offer this course. Please let us know of any questions or concerns.

Sincerely,

Andrew Heckler
Professor
Vice Chair for Administration
Department of Physics
Ohio State University
heckler.6@osu.edu

Below are the Department of Physis responses to the Subcommittee. Our responses are in blue:

- The Subcommittee notes that the credit hour expectations for this course are not in-line with the expectations for a 4-credit hour course (as discussed on page 1 of the syllabus under "Credit hours and work expectations). In total, a student should be expected to have 12 total hours in order to earn a grade of "C" within the course. On page 1 of the syllabus, and in the cover letter provided, this course is mentioned to be a laboratory course with no formal lectures. However, in curriculum.osu.edu, this course is marked as being predominately a lecture course. If it is, indeed, the case that the course is asking to be a full laboratory experience, the course would be required to meet for 8 total hours *each week* and students should expect to have 4 hours of outside work *each week* in order to obtain a letter grade of "C". More commonly for courses within the GEN Foundation: Natural Sciences category, however, courses divide their time by having 3 credit hours of the course being a "lecture" portion and 1 credit hour being a "laboratory" experience. This would mean that the course would need to meet for 5 total hours *each week* and have 7 hours of outside work *each week* for students to earn a letter grade of "C". The Subcommittee ask that the course readjust the contact hours in the course to meet the requirement for a 4-credit hour course. Additionally, if there are particular concerns regarding how contact hours are determined, please do not hesitate to reach out to ASC Curriculum and Assessment Coordinator Michael Hilty.70.

Response:

Thank you for the clarification on this requirement, which we initially overlooked. To align with this new format, we are adapting the course to be:

1) Two 80-minute lecture/recitation sections per week. This is the equivalent of a 3 credit hour lecture course. 6 hours/week is expected to complete assignments outside of the classroom.
2) A 110 minute lab session. This will account for the 1 credit hour of lab.

We were able to make this adaptation fairly easily since the lectures will now involve a small amount of lecture mixed with interactive groupwork focused on completing in-class assignments and activities. Changes made in syllabus (page 1) to reflect the class meets each week for 2 80-minute lecture/recitation sessions and a 110 minute lab session. In addition there are 6 hours per week of outside work.

Board of Trustees bylaws and rules:

3335-8-24 Credit hours.

1. One credit hour shall be assigned for each three hours per week of the average student's time, including class hours, required to earn the average grade of "C" in this course.
2. One credit hour shall be assigned for each two consecutive hours of practical or experimental work per week in any department or school.

3. One credit hour shall be assigned for each three hours of laboratory work per week, when no additional outside work is required. When outside work is required, then the standard in paragraph (A)(1) of this rule shall be applied.

- The Subcommittee would like additional information and guidelines/expectations regarding the "Project" assignment, as discussed on page 6 of the syllabus. Specifically, they would like to see further specificity on what students are expected to submit, as well as the nature of the assignment (is this assignment meant to be formal scientific writing or casual writing?). The Subcommittee notes that some of this information appears within the GEN Foundation: Natural Sciences submission form, but would like to see it reflected within the syllabus for both their own clarity and for the benefit of students.

Response:

We updated Project description in syllabus (page 6), which is reflected in the GE submission document. We also attached the document "Guidelines for Student Projects", which will be available to student on Carmen.

- The Subcommittee requests additional expectations and guidelines be provided for the "Video Homework group assignments", as found on page 6 of the syllabus. They would like to see what the minimum acceptable submission should include and what standards student will be beholden to. Additionally, they would like to recommend (but not require) that a rubric be developed and shared for this assignment and/or incorporating peer grading into the assignment.

Response:

We added a Video HW rubric to syllabus (page 9). Further, we added a HW and QOD rubric to syllabus (page 8). Finally the is a document "Homework rubric examples" which is attached to this submission and will be available to students.

- The Subcommittee notes that throughout the syllabus (such as on page 2 under "Course Description") there is mention of students working in groups. They were unsure how these groups would be formed and request that additional information be provided within the syllabus. Are these groups formed by the instructor or are students self-selecting themselves? And, do the groups change during the term?

Response:

We added comment on how groups are assigned in the syllabus under Description of Major Course Assignments (page 5).

- The Subcommittee asks that the GEN Foundation: Natural Science Goals be provided in the course syllabus, as this is a requirement of all General Education courses. While they note and appreciate the ELOs and explanatory paragraphs on pages 2-4, the goals do not appear present. The Goals and ELOs for all General Education categories can be found on the ASC Curriculum and Assessment Services website.

Response:

Added the goals to the syllabus (page 3)

Practicing Physics – Matter, Heat, and Motion Syllabus

Phys1125 Autumn 2025

Course Information

- **Course times:** Mondays 110 minutes, Tuesdays and Thursdays 80 minutes; times TBD
- **Credit hours:** 4
- **Mode of delivery:** In-person, Smith Lab room 2082
- **Textbook:** All readings, videos, etc. will be provided in the classroom and on Carmen
- **Mode of delivery:** This course is in-person. Attendance and participation during class activities are expected.
- **Pace of activities:** In-class activities are self-paced, and students are expected to keep pace with weekly and monthly deadlines.
- **Credit hours and work expectations:** This is a 4 credit-hour course that includes 3 credit hours of lecture/recitation and 1 credit hour of laboratory work. According to Ohio State bylaws on instruction (go.osu.edu/credithours), students should expect around 5 hours per week of time spent on direct instruction in addition to up to 6 hours of homework (reading and assignment preparation, projects) to receive a grade of C average.

Instructor

- **Name:** TBD
- **Email:** TBD
- **Office phone number:** TBD
- **Office location:** TBD
- **Student hours:** TBD
- **Preferred means of communication:**
    - My preferred method of communication for questions is **TBD.**

Course Description

Students work in groups to perform investigations on density, motion, and thermodynamics and develop simple models to make and test quantitative predictions. Through discussions with instructors and peers, students consider the effects of science in society and apply their scientific skills to everyday situations. Intended for non-science majors, especially those contemplating a teaching career.

Learning Outcomes

By the end of this course, students should successfully be able to:

- Gather and analyze data related to the topics of density, buoyancy, calorimetry, and one-dimensional motion
- Develop models on density, buoyancy, calorimetry, and one-dimensional motion and use these models to make quantitative predictions
- Make a relevant plot of the data, obtain a linear best fit line and equation, and interpret the slope and y-intercept
- Write operational definitions and explain and justify the need for standards
- Solve density, calorimetry, and linear motion problems using proportional reasoning
- Use multiple representations to describe situations related to density, buoyancy, calorimetry, and one-dimensional motion and translate between these representations
- Interpret the meaning of compound quantities, such as gram per centimeter cubed, and correctly use the information contained in them
- Relate position, velocity, and acceleration graphs for an object moving in one dimension with a constant acceleration
- Present measurements with appropriate uncertainty and use error propagation to obtain calculated values with appropriate uncertainty
- Use uncertainty to critically evaluate claims that two values are the same
- Evaluate the social and ethical implications of scientific claims in the media, using uncertainties, interpreting data presented in tables, figures, and graphs
- Recognize that, while current scientific models and practices are productive, science is an ongoing, iterative process for building and refining methods and models of the world and provide examples

General Education (GEN) Goals and Expected Learning Outcomes

As part of the Natural Sciences Foundations of the General Education curriculum, this course is designed to meet the goals and learning outcomes listed below. We include some details of the how the learning outcomes are applied to this course.

General Education (GEN) Goals:

- Successful students will engage in theoretical and empirical research study within the natural sciences while gaining an appreciation of the modern principles, theories, methods, and models of inquiry used generally across the natural sciences.
- Successful students will discern the relationship between the theoretical and applied sciences while appreciating the implications of scientific discoveries and the potential impacts of science and technology.

General Education (GEN) Expected Learning Outcomes:

- Explain basic facts, principles, theories and methods of modern natural sciences, and describe and analyze the process of scientific inquiry.

Through the activities presented in the course materials, students will design and perform simple experiments that allow them to observe and explain basic physical concepts and develop and test models related to mass, volume, density, buoyancy, calorimetry, and motion in one dimension.

- Identify how key events in the development of science contribute to the ongoing and changing nature of scientific knowledge and methods.

Students will identify how scientific reasoning has shaped the course of history and how physics, and science in general, is an ongoing process by discussing the need for standards and operational definitions throughout the course and working on a semester-long project on the impact of science and technology on a historical event and how the historical circumstances pushed the development of scientific models and technology in a particular direction.

- Employ the processes of science through exploration, discovery and collaboration to interact directly with the natural world when feasible, using appropriate tools, models and analysis of data.

Students will employ the process of science by performing explorations and measurements in the lab, while working collaboratively in small groups and reporting results to instructors and peers during class and in group presentations. Students will gather, analyze, and interpret data following activity prompts in the course materials, making relevant plots, obtaining a best fit equation, and interpreting the meaning of the fit parameters. Students will present data and calculated quantities with appropriate uncertainty and use multiple representations to form mathematical models. Students will then use these models and proportional reasoning to make quantitative predictions.

- Analyze the inter-dependence and potential impacts of scientific and technological developments.

Throughout the term, students will apply the scientific practices learned and practiced in class to real-world problems. In addition, students will complete a semester-long project where they will read a book or watch a movie where the topics of the course are used and write a reflection on how the events presented in the movie or book and the scientific concepts are related.

- Evaluate social and ethical implications of natural scientific discoveries.

Students will be able to use uncertainty to critically evaluate claims that two values are the same or different as presented in news reports and will discuss the ethical implications of news reports not using uncertainties in making claims. Students will be able to use the concepts explored in the motion unit to analyze and reason about quantities as a function of time in the real world, discuss how these quantities change with time, and discuss the implications to society of these changes.

- Critically evaluate and responsibly use information from the natural sciences

Through discussions with instructors and peer presentations and feedback, students will be presented with appropriate ways to use data and uncertainties to make scientific claims, such as whether two values are the same. Students will be able to explain whether a quantity can be used to determine an outcome of an action (causes) or simply influences a result (correlated). All assignments and assessments will have this component of critically evaluating and responsibly using information, from their own data collection and models or to evaluate others' claims about the natural world.

Grading

How Your Grade is Calculated

Assignment Category	Percentage
Questions of the Day	~ 20%
Homework assignments	~10%
Video HW group assignments	~ 5%
Lab checkpoints	~ 15%
Class checkpoints	~ 10%
Project	~ 10%
Quizzes	~ 10%
Exams	~ 20%
Total	100%

See Course Schedule for due dates.

Descriptions of Major Course Assignments

For most of the course assignments, students will work in small groups. Student groups are assigned by the instructor; new groups will be assigned at the beginning of each of the three units.

Questions of the day

Description: A short assignment at the beginning of each class period, due during class. Each question in the Question of the day will be graded using the Homework and Question of the Day rubric.

Academic integrity and collaboration: You are expected to discuss the solution to the question of the day with your group. However, each student must submit their own answer, in their own words.

Homework

Description: Due weekly as an online submission. Two problems that extrapolate the concepts and problems explored during class, or an essay reflecting on the concepts learned in class. Each problem in the Homework will be graded using the Homework and Question of the Day rubric.

Academic integrity and collaboration: You are encouraged to discuss the solution to the homework problems with your classmates and instructor. However, each student must submit their own answer, in their own words. Any information from external sources must be properly cited; include the name of the work and pages, or a link if it is an online source. If you worked together with someone doing the homework, you are expected to mention this in the citations.

Video Homework group assignments

Description: A short (at most 2 minutes) video produced by each group where a real-world application of the topics covered in class is discussed. The Video Homework submission will be graded using the Video HW rubric.

Academic integrity and collaboration: Video submissions are group assignments. One video will be submitted per group, all students must be seen actively participating in the presentation of the problem and solution, and all members of the same group will get the same grade. They are open notes, books, and internet; proper citation of sources is expected. Collaboration with other groups is allowed and encouraged.

Lab Checkpoints

Description: Discussion with instructor during lab, where you present your completed work and sufficiently explain your reasoning and conclusions, as well as answer questions about your data collection process, data analysis, and model building, including determining uncertainties and error propagation, where appropriate. Lab checkpoints are graded on a mastery level, either no credit or full credit; you get to try again to complete each checkpoint.

Academic integrity and collaboration: Everyone in the group is expected to participate in the discussion with the instructor. Group members are expected to help each other out and all members must demonstrate understanding for the entire group to get credit for the checkpoint.

Class Checkpoints

Description: Discussion with instructor during class, where you present your completed work and sufficiently explain your reasoning and answers to the in-class exercises, as well as

answer questions about your work. Class checkpoints are graded on a mastery level, either no credit or full credit; you get to try again to complete the checkpoint.

Academic integrity and collaboration: Everyone in the group is expected to participate in the discussion with the instructor. Group members are expected to help each other out and all members must demonstrate understanding for the entire group to get credit for the checkpoint.

Project

Description: An informal essay on the social and ethical issues that arise from scientific and technological developments, as presented in a book or movie. Students will read or watch a piece of media of their choice that presents the scientific concepts taught in class and their influence on society. This connection could be either through the work of professional scientists during key historical events, like the construction of the atomic bomb or space exploration, or through the work of everyday scientists applying scientific and engineering principles to solve a local problem, like building a wind-powered water pump for their small town. Students will summarize the content of the book or movie in an essay presentation (written or video) and reflect and comment on the social and ethical issues presented therein. Students will work on their essay in class, following prompts from the instructor, and receive guidance and feedback from the instructor and peers. Students will submit a first draft, receive feedback from the instructor, submit a second final draft, and receive feedback from their peers. As part of the project, students will provide feedback to at least three of their peers' first and final submissions. More details on the project assignment are on Carmen in the document "Guidelines for Student Projects".

Academic integrity and collaboration: The project is an individual assignment. Discussion with others (students and instructors) of the topics and issues raised in the reading / watching is encouraged. However, each student must submit their own essay. For grading and instructions, consult the Guidelines for Student Projects document.

Quizzes

Description: A combination of multiple-choice, short answer, and long answer questions related to the topics in the current unit. Each quiz will be in person during class time, and it should take no more than 60 minutes to complete.

Academic integrity and collaboration: Quizzes are group assignments. All students are expected to collaborate and contribute to the answers. However, each student must submit their own answer, in their own words. Quizzes are closed book. However, each student is allowed one piece of printer paper with handwritten notes.

Exams

Description: A combination of multiple-choice, short answer, and long answer questions, as well as data collection and data analysis, related to the topics covered in the unit. There will be an exam at the end of each unit. Each exam will be in-person during class time and will take

no longer than 80 minutes to complete. There is no final exam for this course, instead the project takes the place of the final exam.

Academic integrity and collaboration: Exams consist of two parts: individual and group. The individual part of the exam is to be done individually. They are closed book. However, each student is allowed one piece of printer paper with handwritten notes and no collaboration is allowed. The group part of the exam will be done in groups. One submission per group is required and all members of the group will receive the same grade. Collaboration with your group is expected and all members of the group are expected to contribute to the answers. Collaboration with other groups is not allowed.

Rubrics

Homework and Question of the Day rubric
For examples on how the rubric is applied, see the Homework and Question of the Day Rubric Examples document.

Criteria	Ratings			Points
Main idea / Setup General statement of physical principle or definition relevant to the situation	2 pts Full Marks Present, correct, and complete	1 pts Partial credit Present, but incorrect or incomplete	0 pts No Marks Missing	2 pts
Explanation / application Logical step-by-step progression or application of main idea to specific situation	2 pts Full Marks Present, correct, and complete	1 pts Partial credit Present, but incorrect or incomplete	0 pts No Marks Missing	2 pts
Final Answer Statement of the final answer to the question posed	1 pts Full Marks Present, correct, and complete		0 pts No Marks Missing or incorrect	1 pts

Video HW rubric

Criteria	Ratings			Points
Problem quality Video analyses a real-life problem that is interesting and well-defined	1 point Full Marks Present and complete	0.5 points Partial credit Present, but incomplete	0 points No Marks missing	1 point
Participation All students in the groups are seen doing something or heard narrating something relevant to the presentation	1 point Full Marks All students	0.5 points Partial credit Some, but not all, students	0 points No Marks No or only 1 student	1 point
Timing Video is at most 2 minutes long	2 points Full Marks		0 points No Marks	2 points
Visual aids Visual aids are used, and they are appropriate for and helpful to understanding the problem and solution	2 points Full Marks Present, appropriate, and helpful	1 point Partial credit Present, but incomplete, inappropriate, or confusing; large blocks of text (as opposed to few bullet points and/or graphs, sketches)	0 points No Marks Missing	2 points
Solution Proposed solution solves the problem posed and is presented in a clear, easy-to-follow way	2 points Full Marks Solves the problem and is easy to follow	1 point Partial credit Solves the problem but presentation is confusing; OR does not solve the problem even though it is presented in a clear way	0 points No Marks Missing OR does not solve the problem and is confusing to follow	2 points
Presentation The content is presented in a conversational tone, with good flow and a logical path	2 points Full Marks Good flow, logical path, and conversational tone are all present	1 point Partial credit Presenter loses train of thought often, reads from text on slides, jumps around slides, among other things that interrupt flow	0 points No Marks Presentation is chaotic and statements do not follow each other logically or are unrelated to visual aids	2 points

Grading Scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70–72.9: C-
67–69.9: D+
60–66.9: D
Below 60: E

Other Course Policies

Academic Misconduct

See Descriptions of Major Course Assignments for specific guidelines about collaboration and academic integrity in the context of this online class.

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-38.7 (B) (https://trusteed.osu.edu/bylaws-and-rules/3335-5)). For additional information, see the Code of Student Conduct (http://studentlife.osu.edu/csc/).

Disability Services

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let us know immediately so that we can privately discuss options. To establish reasonable accommodations, we may request that you register with Student Life Disability Services (SLDS). After registration, make arrangements with us as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

If you are ill and need to miss class, including if you are staying home and away from others while experiencing symptoms of a viral infection or fever, please let us know immediately. In cases where illness interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations. You can connect with them at slds@osu.edu; 614-292-3307; or slds.osu.edu (https://slds.osu.edu/)

Religious Accommodations

Ohio State has had a longstanding practice of making reasonable academic accommodations for students’ religious beliefs and practices in accordance with applicable law. In 2023, Ohio State updated its practice to align with new state legislation. Under this new provision, students must be in early communication with their instructors regarding any known accommodation requests for religious beliefs and practices, providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course. Instructors in turn shall not question the sincerity of a student’s religious or spiritual belief system in reviewing such requests and shall keep requests for accommodations confidential.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities. If concern arise about a requested accommodation, instructors are to consult their tenure initiating unit head for assistance.

A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement and the student has notified their instructor, in writing during the first 14 days after the course begins, of the date of each absence. Although students are required to provide notice within the first 14 days after the course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the Office of Institutional Equity (equity@osu.edu). (Policy: Religious Holidays, Holy Days and Observances (https://oaa.osu.edu/religious-holidays-holy-days-and-obervances))

Course Schedule

Refer to Carmen for up-to-date due dates.

Unit 1: Properties of Matter

Week	Day	Assignment/Assessment	Classwork
1	1	Question of the day #1	Introduction to the class Lab 1: Balancing
1	2	Question of the day #2	Section 1 – Intro to balancing
1	3	Question of the day #3 HW 1 due Friday	Section 2 – Advanced balancing
2	4	Question of the day #4 Video 1 due Project media selection due	Lab 2: Advanced balancing
2	5	Question of the day #5	Section 3 – Measurement of mass Section 4 – Uncertainty
2	6	Question of the day #6 HW 2 due Friday	Section 5 – Operational definitions
3	7	Question of the day #7 Video 2 due	Lab 3: Volume
3	8	Question of the day #8	Section 6 – Volume Section 7 – Changes in mass, volume 1
3	9	Question of the day #9 HW 3 due Friday	Section 7 – Changes in mass, volume 2 Section 8 – Distinguishing mass and volume
4	10	Question of the day #10 Video 3 due	Lab 4: Measurement of density
4	11	Question of the day #11	Section 9 – Proportional reasoning Sections 10 & 11 – Density
4	12	**QUIZ 1** HW 4 due Friday	None

5	13	Question of the day #12	Lab 5: Sinking and floating 1
5	14	Question of the day #13 Project read / watch due	Project outline Section 12 – Sink/Float 1
5	15	Question of the day #14 HW 5 due Friday	Section 12 – Sink/Float 2
6	16	Question of the day #15 Video 4 due	Lab 6: Sinking and floating 2
6	17	Question of the day #16	Section 13 – Graphing mass and volume
6	18	**EXAM 1** HW 6 due Friday (extra)	None

Unit 2: Heat and Temperature

Week	**Day**	**Assignment/Assessment**	**Classwork**
7	19	Question of the day #17	Lab 7: Temperature and changes in temperature
7	20	Question of the day #18	Project: peer feedback on outline Section 1 – Temperature
7	21	Question of the day #19 HW 7 due Friday	Section 2 – Changes in temperature
8	22	Question of the day #20 Video HW 5 due	Lab 8: Heat transfer
8	23	Question of the day #21 Project first draft due	Section 3 – Heat transfer
8	24	No class – Autumn Break	No class – Autumn Break
9	25	Question of the day #22	Lab 9: Heat capacity and specific heat
9	26	Question of the day #23	Sections 4 & 5 – Heat capacity / specific heat
9	27	Question of the day #24 HW 8 due Friday	Section 6 – Proportional reasoning
10	28	Question of the day #25 Video HW 6 due Project Peer Feedback due	Lab 10: Phase changes

10	29	Question of the day #26	Section 7 – Phase changes
10	30	**EXAM 2** HW 9 due Friday (extra)	None

Unit 3: Motion and Forces

Week	**Day**	**Assignment/Assessment**	**Classwork**
11	31	Question of the day #27	Lab 11: Uniform Motion
11	32	Question of the day #28	Section 1 – Uniform Motion
11	33	Question of the day #29 HW 10 due Friday	Section 2 – Position and time
12	34	Question of the day #30 Video HW 7 due	Lab 12: Non-uniform motion 1
12	35	No class – Election Day	No class – Election Day
12	36	Question of the day #31 HW 11 due Friday	Section 3 – Non-uniform motion
13	37	Question of the day #32 Video HW 8 due	Lab 13: Non-uniform motion 2
13	38	Question of the day #33	Section 4 – Velocity
13	39	**QUIZ 2** HW 12 due Friday Project Final Draft due	None
14	40	Question of the day #34	Lab 14: Acceleration 1
14	41	Question of the day #35	Section 5 – Acceleration
14	42	Question of the day #36 HW 13 due Friday	Section 6 – Motion and graphs 1
15	43	Question of the day #37 Video HW 9 due	Lab 15: Acceleration 2
15	44	Question of the day #38	Section 6 – Motion and graphs 2
15	45	No class – Thanksgiving	No class – Thanksgiving

16	46	Question of the day #39	Lab 16: Forces Section 7 – Forces
16	47	**EXAM 3** HW 14 due (extra) Project Peer Feedback due	None

Brief Lab Descriptions

Lab 1: Balancing
Students will work with a simple balance to develop a model of how to tell whether a balance is balanced and what it means for different objects to balance each other.

Lab 2: Advanced balancing
Students will use the simple balance (without the pans) to explore how changing variables like mass, position, tilt, height, among others affect balancing. They will refine their model for how to tell whether a given configuration is balanced.

Lab 3: Volume
Students will explore some suggested definitions of volume and use them to measure the volume of several objects. Based on their results, students will develop an operational definition of volume, justifying their choices.

Lab 4: Measurement of density
Students will use their operational definitions of mass and volume to measure the mass and volume of several objects, with appropriate uncertainty, as well as pieces of those object. Students will explore the difference between homogeneous and inhomogeneous materials, calculate the mass-to-volume ratio of each material, including water and carbon dioxide, and conclude what that number means.

Lab 5: Sinking and floating 1
Students will explore whether several objects sink or float in water and develop an operational definition of sinking and floating. Combined with their results from Lab 4, students will write down a rule to determine whether a given object will sink or float in water.

Lab 6: Sinking and floating 2
Students will explore whether several objects sink or float in salt water and alcohol. Students will explore how the mass and volume of the liquid displaced depends on the mass of the object and whether the object sinks or floats in the liquid. Using these results, students will expand their rule to determine whether a given object will sink or float in an arbitrary liquid.

Lab 7: Temperature and changes in temperature
Students will examine an alcohol thermometer and use it to measure the temperature of water as it is heated then boiled for several minutes. Students will use the thermometer to measure

the temperature of several objects made of different materials and compare results. Develop an operational definition of temperature.

Lab 8: Heat transfer
Students will combine different amounts of hot and cold water with varying temperatures and measure the final temperature of the mixture. Develop a quantitative model for the relationship between mass, initial temperature, and final temperature of the hot and of the cold water.

Lab 9: Heat capacity and specific heat
Students will develop and implement a procedure to determine the heat capacity of an aluminum block and iron washers, as well as calculating the specific heat of aluminum and iron.

Lab 10: Phase changes
Students will determine the latent heat of fusion and of vaporization of water. Students will expand their model of heat transfer to include phase changes.

Lab 11: Uniform motion
Students will determine the uncertainty of measuring distance (position) and time of a ball rolling on a near-frictionless track by measuring the time it takes the ball to travel equal distance segments. Students will write an operational definition of uniform motion. Students will use tables and graphs of positions and times of an object in motion to show whether a given motion is uniform or not.

Lab 12: Non-uniform motion 1
Students will expand their analysis of motion by measuring the position and time of a ball rolling on a track at equal time intervals. The track will be flat (uniform motion) then elevated (non-uniform motion). Students will use tables and graphs of positions and times of an object in uniform and non-uniform motion.

Lab 13: Non-uniform motion 2
Students will expand their explorations of uniform and non-uniform motion by measuring the time and position of a battery-powered cart that moves at a constant speed and a cart that rolls downhill (frictionless) using ticker-tape timers. This improves the precision of the measurements and allows for better discerning between uniform and non-uniform motion.

Lab 14: Acceleration 1
Students will use a motion detector and computer software (LoggerPro or Vernier Graphical Analysis) to collect data and make plots of a person moving in several (simple) configurations. Students will explore the relationship between the position-versus-time, velocity-versus-time, and acceleration-versus-time graphs and will use the software to perform appropriate fits and extract the value of the (constant) acceleration of the cart in the different segments of the track.

Lab 15: Acceleration 2
Students will use a motion detector and computer software (LoggerPro or Vernier Graphical Analysis) to collect data and make plots of a cart moving in several configurations. Students

will explore the relationship between the position-versus-time, velocity-versus-time, and acceleration-versus-time graphs and will use the software to perform appropriate fits and extract the value of the (constant) acceleration of the cart in the different segments of the track.

Lab 16: Forces
Students will measure and analyze the motion of a cart as it is being pulled. Students will explore how changing the pulling force and/or the mass of the cart affects the cart's acceleration. Students will use graphs to develop a model of the relation between pulling force, mass of cart, and cart's acceleration.

GE Foundation Courses

Overview

Courses that are accepted into the General Education (GE) Foundations provide introductory or foundational coverage of the subject of that category. Additionally, each course must meet a set of Expected Learning Outcomes (ELO). Courses may be accepted into more than one Foundation, but ELOs for each Foundation must be met. It may be helpful to consult your Director of Undergraduate Studies or appropriate support staff person as you develop and submit your course.

This form contains sections outlining the ELOs of each Foundation category. You can navigate between them using the Bookmarks function in Acrobat. Please enter text in the boxes to describe how your class meets the ELOs of the Foundation(s) to which it applies. Because this document will be used in the course review and approval process, you should use language that is clear and concise and that colleagues outside of your discipline will be able to follow. Please be as specific as possible, listing concrete activities, specific theories, names of scholars, titles of textbooks etc. Your answers will be evaluated in conjunction with the syllabus submitted for the course.

Accessibility

If you have a disability and have trouble accessing this document or need to receive the document in another format, please reach out to Meg Daly at daly.66@osu.edu or call 614-247-8412.

GE Rationale: Foundations: Race, Ethnicity, and Gender Diversity (3 credits)

Requesting a GE category for a course implies that the course fulfills **all** the expected learning outcomes (ELOs) of that GE category. To help the reviewing panel evaluate the appropriateness of your course for the Foundations: Race, Ethnicity, and Gender Diversity, please answer the following questions for each ELO.

A. Foundations

Please explain in 50-500 words why or how this course is introductory or foundational for the study of Race, Ethnicity and Gender Diversity.

Course Subject & Number: _____

B. Specific Goals of Race, Ethnicity, and Gender Diversity

GOAL 1: Successful students will engage in a systematic assessment of how historically and socially constructed categories of race, ethnicity, and gender, and possibly others, shape perceptions, individual outcomes, and broader societal, political, economic, and cultural systems.

Expected Learning Outcome 1.1: Successful students are able to describe and evaluate the social positions and representations of categories including race, gender, and ethnicity, and possibly others. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.2: Successful students are able to explain how categories including race, gender, and ethnicity continue to function within complex systems of power to impact individual lived experiences and broader societal issues. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Course Subject & Number: Physics 1125

Expected Learning Outcome 1.3: Successful students are able to analyze how the intersection of categories including race, gender, and ethnicity combine to shape lived experiences. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.4: Successful students are able to evaluate social and ethical implications of studying race, gender, and ethnicity. Please link this ELO to the course goals and topics and indicate *specific* activities/ assignments through which it will be met. *(50-700 words)*

Course Subject & Number: Physics 1125

GOAL 2: Successful students will recognize and compare a range of lived experiences of race, gender, and ethnicity.

Expected Learning Outcome 2.1: Successful students are able to demonstrate critical self- reflection and critique of their social positions and identities. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 2.2: Successful students are able to recognize how perceptions of difference shape one's own attitudes, beliefs, or behaviors. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 2.3: Successful students are able to describe how the categories of race, gender, and ethnicity influence the lived experiences of others. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met.

GE Rationale: Foundations: Social and Behavioral Sciences (3 credits)

Requesting a GE category for a course implies that the course **all** expected learning outcomes (ELOs) of that GE category. To help the reviewing panel evaluate the appropriateness of your course for the Foundations: Social and Behavioral Sciences, please answer the following questions for each ELO.

A. Foundations

Please explain in 50-500 words why or how this course is introductory or foundational in the study of Social and Behavioral Sciences.

Course Subject & Number: Physics 1125

B. Specific Goals of Social and Behavioral Sciences

GOAL 1: Successful students will critically analyze and apply theoretical and empirical approaches within the social and behavioral sciences, including modern principles, theories, methods, and modes of inquiry.

Expected Learning Outcome 1.1: Successful students are able to explain basic facts, principles, theories and methods of social and behavioral science. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.2: Successful students are able to explain and evaluate differences, similarities, and disparities among institutions, organizations, cultures, societies, and/or individuals using social and behavioral science. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Course Subject & Number: Physics 1125

GOAL 2: Successful students will recognize the implications of social and behavioral scientific findings and their potential impacts.

Expected Learning Outcome 2.1: Successful students are able to analyze how political, economic, individual, or social factors and values impact social structures, policies, and/or decisions. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 2.2: Successful students are able to evaluate social and ethical implications of social scientific and behavioral research. Please link this ELO to the course goals and topics and indicate *specific* activities/ assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 2.3: Successful students are able to critically evaluate and responsibly use information from the social and behavioral sciences. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

GE Rationale: Foundations: Historical or Cultural Studies (3 credits)

Requesting a GE category for a course implies that the course fulfills the expected learning outcomes (ELOs) of that GE category. To help the reviewing panel evaluate the appropriateness of your course for the Foundations: Historical and Cultural Studies, please answer the following questions for each ELO. Note that for this Foundation, a course need satisfy **either** the ELOs for Historical Studies **or** the ELOs for Cultural Studies.

A. Foundations

Please explain in 50-500 words why or how this course is introductory or foundational in the study of History **or** Cultures.

Course Subject & Number: Physics 1125

B. Specific Goals of Historical *or* Cultural Studies

Historical Studies (A) Goal: Successful students will critically investigate and analyze historical ideas, events, persons, material culture and artifacts to understand how they shape society and people.

Expected Learning Outcome 1.1A: Successful students are able to identify, differentiate, and analyze primary and secondary sources related to historical events, periods, or ideas. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.2A: Successful students are able to use methods and theories of historical inquiry to describe and analyze the origin of at least one selected contemporary issue. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Course Subject & Number: Physics 1125

Expected Learning Outcome 1.3A: Successful students are able to use historical sources and methods to construct an integrated perspective on at least one historical period, event or idea that influences human perceptions, beliefs, and behaviors. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.4A: Successful students are able to evaluate social and ethical implications in historical studies. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Course Subject & Number: Physics 1125

Cultural Studies (B) Goal: Successful students will evaluate significant cultural phenomena and ideas to develop capacities for aesthetic and cultural response, judgment, interpretation, and evaluation.

Expected Learning Outcome 1.1B: Successful students are able to analyze and interpret selected major forms of human thought, culture, ideas or expression. Please link this ELO to the course goals and topics and identify the *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.2B: Successful students are able to describe and analyze selected cultural phenomena and ideas across time using a diverse range of primary and secondary sources and an explicit focus on different theories and methodologies. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.3B: Successful students are able to use appropriate sources and methods to construct an integrated and comparative perspective of cultural periods, events or ideas that influence human perceptions, beliefs, and behaviors. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.4B: Successful students are able to evaluate social and ethical implications in cultural studies. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met.

GE Rationale: Foundations: Writing and Information Literacy (3 credits)

Requesting a GE category for a course implies that the course fulfills **all** expected learning outcomes (ELOs) of that GE category. To help the reviewing panel evaluate the appropriateness of your course for the Foundations: Writing and Information Literacy, please answer the following questions for each ELO.

Course Subject & Number: Physics 1125

A. Foundations

Please explain in 50-500 words why or how this course is introductory or foundational in the study of Writing and Information Literacy.

B. Specific Goals of Writing and Information Literacy

GOAL 1: Successful students will demonstrate skills in effective reading, and writing, as well as oral, digital, and/or visual communication for a range of purposes, audiences, and context.

Expected Learning Outcome 1.1: Successful students are able to compose and interpret across a wide range of purposes and audiences using writing, as well as oral, visual, digital and/or other methods appropriate to the context. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. Explain how the course includes opportunities for feedback on writing and revision. Furthermore, please describe how you plan to insure sufficiently low instructor-student ratio to provide efficient instruction and feedback. *(50-700 words)*

Course Subject & Number: Physics 1125

Expected Learning Outcome 1.2: Successful students are able to use textual conventions, including proper attribution of ideas and/or source, as appropriate to the communication situation. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. Is an appropriate text, writing manual, or other resource about the pedagogy of effective communication being used in the course? *(50-700 words)*

Expected Learning Outcome 1.3: Successful students are able to generate ideas and informed responses incorporating diverse perspectives and information from a range of sources, as appropriate to the communication situation. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Course Subject & Number: _____

Expected Learning Outcome 1.4: Successful students are able to evaluate social and ethical implications in writing and information literacy practices. Please link this ELO to the course goals and topics and indicate *specific* activities/ assignments through which it will be met. *(50-700 words)*

GOAL 2: Successful students will develop the knowledge, skills, and habits of mind needed for information literacy.

Expected Learning Outcome 2.1: Successful students are able to demonstrate responsible, civil, and ethical practices when accessing, using, sharing, or creating information. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Course Subject & Number: Physics 1125

Expected Learning Outcome 2.2: Successful students are able to locate, identify and use information through context appropriate search strategies. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 2.3: Successful students are able to employ reflective and critical strategies to evaluate and select credible and relevant information sources. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Course Subject & Number: Physics 1125

GE Rationale: Foundations: Literary, Visual, or Performing Arts (3 credits)

Requesting a GE category for a course implies that the course fulfills **all** expected learning outcomes (ELOs) of that GE category. To help the reviewing panel evaluate the appropriateness of your course for the Foundations: Literary, Visual, and Performing Arts, please answer the following questions for each ELO.

A. Foundations

Please explain in 50-500 words why or how this course is introductory or foundational in the study of Literary, Visual, or Performing Arts.

B. Specific Goals

Goal 1: Successful students will analyze, interpret, and evaluate major forms of human thought, cultures, and expression; and demonstrate capacities for aesthetic and culturally informed understanding.

Expected Learning Outcome 1.1: Successful students are able to analyze and interpret significant works of design or visual, spatial, literary or performing arts. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Course Subject & Number: Physics 1125

Expected Learning Outcome 1.2: Successful students are able to describe and explain how cultures identify, evaluate, shape, and value works of literature, visual and performing art, and design. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.3: Successful students are able to evaluate how artistic ideas influence and shape human beliefs and the interactions between the arts and human perceptions and behavior. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Course Subject & Number: Physics 1125

Expected Learning Outcome 1.4: Successful students are able to evaluate social and ethical implications in literature, visual and performing arts, and design. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Goal 2: Successful students will experience the arts and reflect on that experience critically and creatively.

Expected Learning Outcome 2.1: Successful students are able to engage in informed observation and/or active participation within the visual, spatial, literary, or performing arts and design. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Course Subject & Number: Physics 1125

Expected Learning Outcome 2.2: Successful students are able to critically reflect on and share their own experience of observing or engaging in the visual, spatial, literary, or performing arts and design.
Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

GE Rationale: Foundations: Natural Science (4 credits)

Requesting a GE category for a course implies that the course fulfills **all** expected learning outcomes (ELOs) of that GE category. To help the reviewing panel evaluate the appropriateness of your course for the Foundations: Natural Sciences, please answer the following questions for each ELO.

A. Foundations

Please explain in 50-500 words why or how this course is introductory or foundational in the study of Natural Science.

In Physics 1125, students will apply the scientific practices aligned with the Next Generation Science Standards, which have as goals to develop students ' scientific habits of mind, have students participate in the process of scientific inquiry, and teach them how to reason scientifically. These practices include: developing and using models, planning and carrying out investigations, analyzing and interpreting data, constructing explanations, and engaging in argument from evidence. In Physics 1125, students will engage in hands-on activities and apply these practices to the topics of density, sinking and floating behavior, heat exchange, and motion in one dimension. Starting from their own observations, students will develop basic physical concepts, use and interpret a variety of scientific representations such as graphs and simple equations, and construct explanatory models with predictive capability. Physics 1125 has as primary emphasis discovery rather than memorization, and teaching is primarily through questioning rather than telling, focusing on both quantitative and conceptual reasoning. This approach allows for open-ended investigations, working in groups, and discussions between instructors and individual students. Additionally, students will apply these scientific practices to analyze everyday situations, as well as historical developments, and will reflect on how the practices of science have influenced, and continue to influence, society. Students will leave Physics 1125 with the understanding that physics is not a body of facts to be memorized, but rather a collaborative and ongoing process, in which they can participate.

Course Subject & Number: Physics 1125

B. Specific Goals for Natural Sciences

GOAL 1: Successful students will engage in theoretical and empirical study within the natural sciences, gaining an appreciation of the modern principles, theories, methods, and modes of inquiry used generally across the natural sciences.

Expected Learning Outcome 1.1: Successful students are able to explain basic facts, principles, theories and methods of modern natural sciences; describe and analyze the process of scientific inquiry. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Through the activities presented in the course materials, students will design and perform simple experiments that allow them to develop basic physical concepts related to mass, volume, density, buoyancy, calorimetry, and motion in one dimension. These explorations lead students to develop and test models on, for example, law of conservation of mass, sinking and floating behavior of objects in an arbitrary liquid, heat transfer, phase changes, motion in one dimension, and relationship between force and acceleration. Alongside these experiments, students engage in and discuss the process of scientific inquiry and the limitations of experimental design in, for example, discussions about practical constraints on control of variables and inferences that can be made from various control of variables designs.

Examples from course:

Students work in groups to perform investigations for using a balance to develop their own definition of mass and measure the mass of multiple objects. During these in-class activities, students have multiple “checkpoint” discussions with the instructor, describing their experimental design, presenting their results, and justifying their conclusions. As a result of these discussions, students iteratively improve their experiments, observations, and models.

During an in-class assessment, students work with their group to predict the final temperature that a mixture of hot and cold water will have, using the model of heat exchange they developed in class based on their observations. Additionally, students will discuss and list reasons why the measured final temperature differs from the predicted value, noting the limits of their model and its applicability. After receiving their graded submissions, students may discuss their answers and grades with instructors to further clarify their ideas, as part of a formative assessment component.

During a summative assessment, students work with their groups to use the analytical methods and the model for one dimensional motion developed in class. This model is developed from their observations of a ball rolling down a straight incline. Students apply the methods developed to obtain the acceleration of an object experiencing constant acceleration in a situation they have not seen before (for example, a freely falling basketball or balloon).

Expected Learning Outcome 1.2: Successful students are able to identify how key events in the development of science contribute to the ongoing and changing nature of scientific knowledge and methods. Please link this ELO to the course goals and topics and indicate specific activities/assignments through which it will be met. *(50-700 words)*

Students will identify how scientific reasoning has shaped the course of history and how physics, and science in general, is an ongoing process. Activities for this include experiments and exercises about the need for standards and operational definitions. These precise, unambiguous definitions and standard measurement units allow us to check others’ findings and build upon the work of others. In addition, students will complete a semester-long project where they will read a book or watch a movie where the topics of the course are used and write a reflection on how the events presented in the movie and the scientific concepts are related. Examples of books and movies that can be used for this project are The Boy Who Harnessed the Wind, Hidden Figures, Oppenheimer, as well as biographies of influential scientists.

Examples from course:

During an in-class activity, students work in groups to determine how much information they know about two pets, whose masses are given in units of wooden blocks. Through “checkpoint” discussions with the instructor, students conclude that we cannot tell whether the pets in question are large dogs or small rodents without knowing more about the wooden blocks used to measure their mass. In contrast, if the mass were given in units of hex nuts, the units we use in our class, students could tell whether the pets were large or small, because they have been using hex nuts and have an intuitive understanding of how many hex nuts make up a large or a small mass. This leads to the introduction of the concept of standards, that we need to use the same units to be able to communicate our results with people outside of our class, and unit conversion, that knowing how to two different scales relate allows us to compare measurements of the same property that are made using different scales.

For several in-class exercises and assignments, students will work in groups and discuss with the instructor their operational definitions of several quantities like mass, area, and volume. New quantities will be defined as they are introduced during the term. Every time a new term is defined operationally, students will discuss with the instructor during “checkpoints” the importance of such definitions to the development of scientific models, both their own simple models constructed in class and the more sophisticated ones professional scientists use.

For the project, students will read or watch a piece of media that presents the scientific concepts taught in class and their influence on society. This connection could be either through the work of professional scientists during key historical events, like the construction of the atomic bomb or space exploration, or through the work of everyday scientists applying scientific and engineering principles to solve a local problem, like building a wind-powered water pump. Students will summarize the content of the book or movie in an essay presentation (written or video). Students will submit a first draft, receive feedback from the instructor, submit a second final draft, and receive feedback from their peers. As part of the project, students will provide feedback to at least three of their peers’ submissions.

Course Subject & Number: Physics 1125

Expected Learning Outcome 1.3: Successful students are able to employ the processes of science through exploration, discovery, and collaboration to interact directly with the natural world when feasible, using appropriate tools, models, and analysis of data. Please explain the 1-credit hour equivalent experiential component included in the course: e.g., traditional lab, course-based research experiences, directed observations, or simulations. Please note that students are expected to analyze data and report on outcomes as part of this experiential component. *(50-1000 words)*

Students will employ the process of science by performing explorations and measurements in the lab, while working collaboratively in small groups and reporting results to instructors and peers during class and in group presentations. During in-class activities, students will gather, analyze, and interpret data following the activity prompts in the course materials. Students will make relevant plots of the data, obtain the best fit equation, and interpret the meaning of the fit parameters, such as slope and y-intercept. Students will present measurements with appropriate uncertainty and use error propagation to obtain calculated values with appropriate uncertainty. For motion in one dimension, students will use motion diagrams, in addition to time-dependence graphs of position, velocity, and acceleration, to describe motion. Through the use of these various representations, students will learn to interpret compound, multi-unit, quantities, such as gram per cubic centimeter and meter per second squared. Summarizing their discoveries, students will create models and use proportional reasoning to make quantitative predictions. These skills will be used throughout the course, in in-class activities, in-class assessments (question of the day, quizzes, and exams), weekly homework assignments, video presentations, and discussions with instructors during checkpoints.

Examples from course

Following prompts from a handout, and through “checkpoint” discussions with the instructor, students use clay, which sinks in water, and wood, which floats in water, to construct an inhomogeneous object that sinks in water. They also use wax, which floats in water, and aluminum, which sinks in water, to construct an inhomogeneous object that floats in water. They measure the mass and volume of each piece, and of the entire object, to propose a definition of average density that can be used to predict whether a given inhomogeneous object will sink or float in water.

In a summative assessment on density, students are asked to determine whether a given solid metal object that has been painted gold is made of solid gold. Working with their group students design and perform an experiment to measure the mass and the volume of the object with appropriate uncertainties and calculate its density, using error propagation to determine the uncertainty of this calculation. They then compare their calculated value of density with the reported values of density of various materials and use their knowledge of uncertainty to determine whether the object is (definitely, maybe, or definitely not) made of a given material.

In a homework assignment on motion, students are given a motion diagram of two objects moving in a straight line and make a position versus time graph for their motions, with appropriate units. Students then draw a best fit line through the data points, and manually find the equation for this best line, including the slope with appropriate units. Students decide whether the best fit line should be forced to go through the origin of the graph and justify their decision. They then interpret the information contained in the slope and y-intercept and use this information to answer questions about the objects’ motion, like whether the two objects ever have the same speed, or which one will arrive at a common destination first.

In a group video presentation, students use proportional reasoning and their model for heat transfer and how different materials require different amounts of calories to change their temperature by one degree to explain everyday phenomena related to heat transfer, for example, why on a hot, sunny day the concrete surrounding an outdoor swimming pool feels hot, while the water inside the pool feels cooler.

In an in-class assessment, students work with their groups to qualitatively sketch the position versus time graph and acceleration versus time graph for an object moving in a straight line, given the velocity versus time graph. The sketches should reflect that the velocity is the first derivative of position with respect to time, and the acceleration is the first derivative of velocity with respect to time.

Course Subject & Number: Physics 1125

GOAL 2: Successful students will discern the relationship between the theoretical and applied sciences, while appreciating the implications of scientific discoveries and the potential impacts of science and technology.

Expected Learning Outcome 2.1: Successful students are able to analyze the inter-dependence and potential impacts of scientific and technological developments. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Throughout the term, students will apply the scientific practices learned and practiced in class to real-world problems. These applications can be in in-class exercises, weekly homework assignments, or group video presentations. In addition, students will complete a semester-long project where they will read a book or watch a movie where the topics of the course are used and write a reflection on how the events presented in the movie or book and the scientific concepts are related. Examples of books and movies that can be used for this project are The Boy Who Harnessed the Wind, Hidden Figures, Oppenheimer, as well as biographies of influential scientists.

Examples from course

After writing an operational definition of temperature and discussing in class how feeling of hotness or coldness is not an appropriate measure of temperature students will work with their groups on a video presentation where they discuss how the development of the thermometer and temperature scales allowed for the development of models for heat and heat transfer, using the industrial revolution as the historical background. Their presentations should focus on the societal impact of the simultaneous (iterative?) development of the scientific models and the technological improvements that allowed people to make better, more precise measurements.

For the project, students will read or watch a piece of media that presents the scientific concepts taught in class and their influence on society. This connection could be either through the work of professional scientists during key historical events, like the construction of the atomic bomb or space exploration, or through the work of everyday scientists applying scientific and engineering principles to solve a local problem, like building a wind-powered pump. Students will summarize the content of the book or movie in an essay presentation (written or video) and discuss the impacts that such application of scientific practices and development of technology had on society. An example of such an impact can be how the improvement of timekeeping devices advanced commerce. Students will submit a first draft, receive feedback from the instructor, submit a second final draft, and receive feedback from their peers. As part of the project, students will provide feedback to at least three of their peers ' submissions.

Expected Learning Outcome 2.2: Successful students are able to evaluate social and ethical implications of natural scientific discoveries. Please link this ELO to the course goals and topics and indicate *specific* activities/ assignments through which it will be met. *(50-700 words)*

Students will be able to use uncertainty to critically evaluate claims that two values are the same or different, for example, when a news report claims that the amount of a given substance in food exceeds safety thresholds. Students will be able to describe the difference between operational definitions and dictionary definitions, write their own operational definitions of the quantities they work with in the lab, as well as describe the need for standards in measurement. Students will be able to use the concepts explored in the motion unit to analyze and reason about quantities as a function of time in the real world, for example, number of cases of an infectious disease or number of births, how these quantities change with time, and how to interpret their rate of change.

Examples from the course

In a group video homework students will discuss whether the claims made in a news article about oat products are reasonable. Students will present evidence as to why such claims cannot be made given the data presented in the article, since the reported measurements have no uncertainty reported. They will estimate an " average uncertainty " using the data in the article and evaluate whether a given family of products had RoundUp quantities that exceed the safety threshold. They will also discuss the ethical implications and the effect on the public of publishing such studies with measurements without uncertainties.

In a group video homework on rates of change, students will plot a quantity as a function of time, such as number of COVID cases or number of births per month or year. They will calculate the slope at regular intervals, plot the slope (rate of change) as a function of time and interpret and explain what it means. They will discuss the implications of their calculations for the public if recent trends continue.

During in-class exercises, students will write an operational definition of temperature (the process needed to measure temperature) and compare with the feeling of hotness or coldness when holding wood or aluminum. During the " checkpoints ", students will discuss with the instructor why feeling of hotness or coldness is not an appropriate measurement of temperature and discuss the ethical implications of situations when feeling of hotness or coldness is used in everyday life (large and small).

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Expected Learning Outcome 2.3: Successful students are able to critically evaluate and responsibly use information from the natural sciences. Please link this ELO to the course goals and topics and indicate *specific* activities/ assignments through which it will be met. *(50-700 words)*

Students will design and perform experiments as well as analyze data to construct predictive models. Through discussions with instructors and peer presentations and feedback, students will be presented with appropriate ways to use data and uncertainties to make scientific claims, such as whether two measured values are the same. Students will be able to explain whether a quantity can be used to determine an outcome of an action (causes) or simply influences a result (correlated). In-class assignments, in-class assessments (question of the day, quizzes, exams), homework assignments, and video presentations will all have this component of critically evaluating and responsibly using information, from their own data collection and models or to evaluate others ' claims about the natural world.

Examples from course

During a homework assignment about density, students will determine from measurements of mass and volume (with uncertainties) given what material an object is likely made of. They will do so by calculating the density, using error propagation to calculate the appropriate uncertainty, and comparing their calculated values to the known densities of several materials. They will then compare their answer to that of two hypothetical students, where one student did not consider uncertainties in their calculations and conclusion, while the other did consider uncertainties, but still drew the incorrect conclusion. Students will then provide explanation / justification as to why each of the hypothetical students is wrong.

In an in-class assessment about volume and uncertainty, students will determine whether a given volume of water will fit inside a tank with known dimensions. Students will calculate the volume that can be contained inside the tank by multiplying the tank ' s length times width times height, each with uncertainty, to obtain the largest and smallest possible values the tank ' s volume could have. They will use their knowledge of uncertainties to compare the volume of the tank with the volume of water to determine whether the water will (definitely, maybe, definitely not) fit inside the tank.

In a group video homework students will discuss whether the claims made in a news article about oat products are reasonable. Students will present evidence as to why such claims cannot be made given the data presented in the article, since there are no uncertainties. They will estimate an " average uncertainty " using the data in the article and evaluate whether a given family of products had RoundUp quantities that exceed the safety threshold. They will also discuss the ethical implications and the effect on the public of publishing such studies with measurements without uncertainties.

During in-class " checkpoint " discussions with the instructor about experiments discussing mass and volume, students will expand their view of control of variables in experiments. Previously, students discussed the need to keep everything the same and change only one thing at a time to be able to determine which variable affected the result of the experiment. In this experiment, three cylinders with the same volume but made of different materials are placed inside a container with water. It is found that one of them floats while the others sink. Students will discuss with their group and with the instructor the difference between being able to determine an outcome of an action (like the cylinder sinking or floating) and a variable simply influencing a result (like saying the mass of the cylinder is important to sinking and floating). These discussions include the limitations of experimental design, different types of control of variables in experiments, and the extent to which one can draw conclusions from observations.

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GE Rationale: Foundations: Mathematical and Quantitative Reasoning (or Data Analysis) (3 credits)

Requesting a GE category for a course implies that the course fulfills **all** expected learning outcomes (ELOs) of that GE category. To help the reviewing panel evaluate the appropriateness of your course for the Foundations: Mathematical and Quantitative Reasoning (or Data Analysis), please answer the following questions for each ELO.

A. Foundations

Please explain in 50-500 words why or how this course is introductory or foundational in the study of Mathematical & Quantitative Reasoning (or Data Analysis).

B. Specific Goals for Mathematical & Quantitative Reasoning/Data Analysis

Goal: Successful students will be able to apply quantitative or logical reasoning and/or mathematical/statistical analysis methodologies to understand and solve problems and to communicate results.

Expected Learning Outcome 1.1: Successful students are able to use logical, mathematical and/or statistical concepts and methods to represent real-world situations. Please link this ELO to the course goals and topics and indicate *specific* activities/ assignments through which it will be met. *(50-700 words)*

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Expected Learning Outcome 1.2: Successful students are able to use diverse logical, mathematical and/or statistical approaches, technologies, and tools to communicate about data symbolically, visually, numerically, and verbally. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.3: Successful students are able to draw appropriate inferences from data based on quantitative analysis and/or logical reasoning. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

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Expected Learning Outcome 1.4: Successful students are able to make and evaluate important assumptions in estimation, modeling, logical argumentation, and/or data analysis. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*

Expected Learning Outcome 1.5: Successful students are able to evaluate social and ethical implications in mathematical and quantitative reasoning. Please link this ELO to the course goals and topics and indicate *specific* activities/assignments through which it will be met. *(50-700 words)*