

SMU Honors Physics Section

SMU Department of Physics

FALL 2021

Professor Stephen Sekula

Syllabus for Honors Physics

General Information

The Honors Physics Section is intended to provide honors students with additional activities, information, and challenges to allow them to broaden and deepen their physics knowledge while concurrently taking the introductory physics course sequence. The framework of this syllabus is intended to allow honors students to go above and beyond the normal classroom environment without creating a huge additional burden on the students. Honors students should be looking to go a little further than non-honors students, and this syllabus reflects that.

Participants in the Honors Physics Section will engage in the following activities each semester:

- They will use class time to engage in learning exercises that synthesize information from the 130X introductory physics courses, allowing them to find more breadth and depth in the subject of physics.
 - They will have access to expertise from outside the classroom environment, including faculty, staff, and students from SMU and other institutions, as well as individuals with a physics background working in private industry. The goal here is to enrich their learning environment by giving them direct access to experts at various levels of the field.
 - They will engage in a coherent, semester-long project. Preparing for, and delivering, this project will be the focus of various activities throughout the semester. Honors students will be expected to learn to present their work to an audience, including (but not limited to) their peers in the Honors Physics Section.
 - Students will pass or fail the section based on an assessment of their work and participation, to be determined by the instructor.
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Honors Physics Section - FALL 2021

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(Learning Assistant: TBD)

Students will engage in a semester-long “Grand Challenge” problem-solving exercise. This will define the arc of the semester, setting the tone for planning out classroom activities and eventually defining the deliverable at the end of the course. In between class periods relevant to the development of solutions to the Grand Challenge Problem, the students will be engaged in demonstrations of physics principles and exercises to explore these demonstrations. These class periods will follow a pattern consistent with the scientific method: observation of a physical phenomenon, hypothesis building to explain the phenomenon, and calculation and testing to assess the hypothesis. The details of this program are given below. Taking into account Thanksgiving in the Fall and Spring Break in the Spring, each semester has 14 weeks in which a classroom period or activity of the Honors Physics Section is possible.

Plan of Activities

CLASS PERIOD	ACTIVITY
1	Introduction to the Honors Physics Section
2	Team and Scenario Assignment: Physics Game Night
3	<i>Interactive Activity #1</i>
4	First “Honors Collaboration Meeting” Presentation of the three ideas on outcomes of the premise in the Grand Challenge Problem
5	How to Present Your Findings
6	<i>Interactive Activity #2</i>
7	<i>Interactive Activity #3</i>

SMU Physics Honors Section – FALL 2021

8	Second “Honors Collaboration Meeting” Presentation of status of solutions to the Grand Challenge Problem, including first draft of your project media.
9	<i>Honors Physics Hack-a-Thon</i>
10	<i>Interactive Activity #4</i>
11	<i>Interactive Activity #5</i>
12	Third “Honors Collaboration Meeting” Final presentations of status of solutions to the Grand Challenge Problem, including project media drafts.
13	<i>PHYSICS DISCUSSION WEEK</i> (Each team meets with the instructors for 1 hour at a mutually determined time during the week. This substitutes for the regular class period)
14	Final Projects Due for Presentation and Evaluation

Assessment

Student performance for Honors Credit will be assessed as follows:

- Participation in weekly classroom meetings
- Quality of presentations at “Honors Collaboration Meetings”
- Quality of final project media
- Quality of engagement with the audience for your final project.

This course is pass/fail, but the determination of “passing” or “failing” is determined from the numerical grade you accumulate during the term. A final grade of C- (70%) or better is a “pass,” while anything less than that is a “fail”.

There is a 10% professionalism grade in this course which is tied to adherence to classroom etiquette, including the wearing of masks to protect oneself and others from SARS-CoV-2 during the ongoing pandemic.

Grade Components

Class Activities and Participation	55%
Honors Physics Collaboration Meetings	10%
Honors Physics Final Project	25%
Overall Professionalism	10%
Total	100%

The Grand Challenge Problem

The focal event of each semester is the solving of a “Grand Challenge” problem. This is a physics problem with no textbook solution. Rather, you will draw upon your own creativity, informed by the principles of physics you are learning in PHYS 130X, to address the question in as detailed a manner as possible. You will be assessed on:

- your incremental progress on developing answers to the question (see below);
- the creativity, originality, or novelty of the ideas that lead to your final answers;
- your ability to investigate the ideas through physics calculations and supporting material;
- and the reliability and accuracy of your calculations.

This is not purely a storytelling process; rather, you will engage in a mathematical and physical exercise where the math speaks, and you will describe what it says. The Grand Challenge process and solution will build gradually over the semester, woven into the fabric of the Honors Physics Section.

The Grand Challenge will be a team exercise¹. You will be randomly assembled into teams at the beginning of the semester. Your team will be expected to meet at least once a week outside of class to discuss the Grand Challenge and, in particular, how what you have learned that week might be used to explore a consequence of the theme of the Grand Challenge. Your team will report the status of your work (each individual presenting a brief, 5-minute overview of their status) at the “Honors Collaboration Meetings” - periods of in-class time (see schedule) devoted entirely to a

¹ Depending on the number of students in the Honors Physics Section, we will revisit this aspect of the Grand Challenge Problem.

SMU Physics Honors Section – FALL 2021

public airing of progress. Members of other teams are free to ask questions and offer suggestions or criticism of presented work. In addition, one of our week's will be devoted to in-depth discussions on the physics principles and details; these discussions will happen outside of class time (instead of class period) between each team and the instructors. This entire exercise is to model how real, collaborative, scientific work, as well as peer review, operates in the real world.

A separate and detailed explanation of the entire Grand Challenge exercise will be made available by the instructor.

Classroom Mask Policy

Masks are required in this course. This masking requirement is subject to change during the semester, and any changes will be announced in class, posted clearly in Canvas, and updated in the syllabus.

Mask wearing in this class is included in the expectations of professionalism within a culture of respect, such that failure to follow this classroom requirement would negatively impact the overall professionalism/participation grade for up to 10% of the final course grade.

University Honor Code

The student Honor Code² can be found in the SMU Student Handbook³. All students will be expected to adhere to it. Any student found cheating or plagiarizing any other person's work will be given a zero for that work and an academic violation will be filed through the Vice President for Student Affairs Office. If you are uncertain of the definition of plagiarism as it regards independent works of mathematical and physical computation, documentation, and demonstration, it is your responsibility to speak with the instructor and understand these rules.

Title IX and Disability Accommodations

² <http://www.smu.edu/StudentAffairs/StudentLife/StudentHandbook/HonorCode>

³ <http://www.smu.edu/StudentAffairs/StudentLife/StudentHandbook>

SMU Physics Honors Section – FALL 2021

Disability Accommodations	Students who need academic accommodations for a disability must first register with Disability Accommodations & Success Strategies (DASS). Students can call 214-768-1470 or visit http://www.smu.edu/Provost/SASP/DASS to begin the process. Once they are registered and approved, students then submit a DASS Accommodation Letter through the electronic portal, <i>DASS Link</i> , and then communicate directly with each of their instructors to make appropriate arrangements. Please note that accommodations are not retroactive, but rather require advance notice in order to implement.
Sexual Harassment	All forms of sexual harassment, including sexual assault, dating violence, domestic violence and stalking, are violations of SMU's Title IX Sexual Harassment Policy and may also violate Texas law. Students who wish to file a complaint or to receive more information about the grievance process may contact Samantha Thomas, SMU's Title IX Coordinator, at accessequity@smu.edu or 214-768-3601. Please note that faculty are mandatory reporters. If students notify faculty of sexual harassment, faculty must report it to the Title IX Coordinator. For more information about sexual harassment, including resources available to assist students, please visit www.smu.edu/sexualmisconduct .
Pregnant and Parenting Students	Under Title IX, students who are pregnant or parenting may request academic adjustments by contacting Elsie Johnson (elsiej@smu.edu) in the Office of the Dean of Students, or by calling 214-768-4564. Students seeking assistance must schedule an appointment with their professors as early as possible, present a letter from the Office of the Dean of Students, and make appropriate arrangements. Please note that academic adjustments are not retroactive and, when feasible, require advance notice to implement.

SMU Requirements

Religious Observance	Religiously observant students wishing to be absent on holidays that require missing class should notify their professors in writing at the beginning of the semester and should discuss with them, in advance, acceptable ways of making up any work missed because of the absence. Click here for a list of holidays.
COVID-19 and Other Medical-Related Absences	Students who test positive for COVID-19 and need to isolate, or who are notified of potential exposure, must follow SMU's Contact Tracing Protocol . To ensure academic continuity and avoid any course penalties, students should follow the same procedures described by their instructors as they would for any other medical-related absence in order to be provided with appropriate modifications to assignments, deadlines, and exams.
Excused Absences for University	Students participating in an officially sanctioned, scheduled university extracurricular activity should be given the opportunity to make up class

SMU Physics Honors Section – FALL 2021

Extracurricular Activities	assignments or other graded assignments that were missed as a result of their participation. It is the responsibility of the student to make arrangements for make-up work with the instructor prior to any missed scheduled examinations or other missed assignments. (See 2020-2021 SMU Undergraduate Catalog under “Enrollment and Academic Records/Excused Absences.”)
Final Exams	Final course examinations shall be given in all courses where appropriate, and some form of final assessment is essential. Final exams and assessments must be administered as specified in the official examination schedule. Exams cannot be administered or due during the last week of classes or during the Reading Period. Syllabi must state clearly the form of the final exam or assessment, and the due date and time must match the official SMU exam schedule. Final exams are not required to be provided online.

Student Support

Student Academic Success Programs	Students needing assistance with writing assignments for SMU courses may schedule an appointment with the Writing Center through Canvas. Students who would like support for subject-specific tutoring or success strategies should contact SASP, Loyd All Sports Center, Suite 202; 214-768-3648; https://www.smu.edu/sasp .
Caring Community Connections Program	CCC is a resource for anyone in the SMU community to refer students of concern to the Office of the Dean of Students. The online referral form can be found at smu.edu/deanofstudentsccc . After a referral form is submitted, students will be contacted to discuss the concern, strategize options, and be connected to appropriate resources. Anyone who is unclear about what steps to take if they have concerns about students should either consult the CCC Reference Guide or contact the Office of the Dean of Students at 214-768-4564.

Additional Policies

Campus Carry Law	In accordance with Texas Senate Bill 11, also known as the ‘campus carry’ law, and following consultation with entire University community, SMU chooses to remain a weapons-free campus. Specifically, SMU prohibits possession of weapons (either openly or in a concealed manner) on campus. For more information, please see: http://www.smu.edu/BusinessFinance/Police/Weapons_Policy .
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I-M-A Physicist

An Approach to Active Peer Learning

In this course, you are dropped into situations involving one or more physical phenomena and expected to explore, play, hypothesize, test, and share your results. These are the core traits of a good scientist. To help guide this process, which otherwise might lead you nowhere, please try to implement in some form the “I-M-A Physicist” approach in your group. Your groups typically contain 3 people. In the case that there are exactly three people, you should designate one person to fulfill each of the following roles in the group:

- **(I)nquirer:** this person asks questions about the phenomena, intended to inspire the other members of the team to take a step in inquiry. When another member of a team has drawn a conclusion, the inquirer might ask a challenge question. For instance, if the phenomenon demonstrated in the class is that two objects of different mass, dropped at the same time from the same height, are observed to reach the ground at the same time, an opening inquiry might be:
 - “I wonder whether the material that makes the objects has any effect on the outcome?”
- **(M) easurer:** this person’s job is to perform a measurement (or if more than one person is needed for measurement, coordinate the measurement between people) intended to gather data that addresses an inquiry. In the example above, the measurer’s job is to respond to the inquirer by proposing that different materials be dropped, whether of the same mass as one another or of different masses. The measurer’s job is to make sure the materials really do start at the same height, and to record (e.g. using a camera phone) the moment when they reach the ground. Measurement can take many forms: a meter stick and marked paper, a video, an audio recording, etc. Be creative! Use the tools you have in your pocket, or ask for tools you do not have.
- **(A) nalyst:** this person’s job is to take the data from the measurer and draw conclusions from it. Conclusions should be rooted in the data; no conclusion not supported by the data should be drawn. Perhaps this is by watching a video or listening to an audio recording, and stating a conclusion (or more than one) from what is recorded. Perhaps this is by reading marks made using a pencil and meter stick, or time measurements recorded in a chart. Data takes many forms, and the Analyst’s job is to determine what the data are

saying.

Inquiry, Measurement, and Analysis (IMA) are core to the progress of knowledge using the scientific method. This way of thinking about roles in a team-based exercise can help guide you in learning how to conduct each step. In a real-world situation, each scientist is expected to conduct inquiry, measurement, and analysis, either by themselves or as part of a team.

If there are *MORE* than 3 team members, the others in the group can help with measurement and other activities, but at least one of them should be designated as a dedicated “opponent”:

- **(O)pponent:** this person’s job is to challenge, in a constructive manner, any assumptions that are implicit in inquiry, measurement, or analysis, and to offer alternative explanations of the data that might be consistent with the data but not considered by the other members of the team. To be constructive, the opponent should not merely stand in the way of assumptions or conclusions, but offer a selection of next steps to eliminate or verify their opposition.

If there are only three members, all three team members should take the role of the Opponent after a round of Inquiry-Measurement-Analysis has concluded. Challenging assumptions and conclusions are essential to the progress of science; what differentiates science from other human endeavors is that a scientific opponent offers in return the test that verifies or refutes their challenge, and *accepts* the result of their proposed test (even if it dis-confirms their challenge), regardless of its outcome.

GRAND CHALLENGE PROBLEM (FALL 2021)



Photo by Alison Wang on Unsplash

That can't be right. Or can it? And what if it *were* right?

Use what you have learned/are learning in introductory physics courses to assess three possible aspects of a cartoon, including the implications of the depiction of physics being correct or incorrect and what would be expected in the real world.