

PHYS 121—How Things Work
Dr. Tom Bing
Department of Physics, Emory University

Welcome to PHYS 121: How Things Work. We have two goals for this semester. The first (big surprise) is to learn a little something about how the world works. We'll spend a lot of time discussing the science behind everyday things like music, electricity, etc. A lot of complex phenomena can flow out of a surprisingly few simple, general ideas.

Our second goal is probably an even more important one: we want you to learn a little something about what it means to think like a physicist. That goal is central to Emory's existence as a liberal arts school. Why should (for example) an art major need to take a physics class? Well, I'm sure you've learned a certain way of thinking, a certain way of looking at the world, in your art classes. But the real power of such a worldview only comes through if you have stuff to compare and contrast it with. This semester you'll learn about a physicist's worldview. Even if you don't end up being all that fascinated with how a physicist approaches questions, at least that experience will help you define your own worldview that much better.

So what is a physicist's worldview? In a nutshell, it's a combination of mathematics (which most people would expect) and verbal-physical-common-sense reasoning (which surprises a lot of people). The real power comes from getting the mathematical and the verbal reasoning to work together...and that's what we'll be doing this semester.

And certainly that worldview leads to plenty of insights and consequences for real-world things. We'll learn about lots of technological innovations this semester. And we'll spend some serious time talking about the science (both physical and sociological) behind climate change.

And finally, a few words about me: I'm Dr. Tom Bing. My Ph.D is in Physics, with a specialty in Physics Education. Physics Education is a relatively new, rapidly growing field in the physics community. We take the same general physics classes and pass the same qualifying exams as the nuclear physicist down the hall, but our research is in how people think and learn about physics. A lot of the things we do this semester will be influenced by this research field.

PHYS 121 Homework Policy

Homework will be assigned weekly. The assignments will be posted on our Canvas site and will be due in class on Thursdays. Each homework assignment will have a mix of questions:

- some mathematical questions where the answer will be a number (you must show your work...papers that only have the answers won't get full credit)
- some verbal questions like multiple choice, short answer, and essays

You are welcome to work together on these assignments, but everyone must turn in their own handwritten (or typed) solutions. A quick word about the essays: **Passing someone else's writing (either another student or Wikipedia or whatever) off as your own is never acceptable. Like I said, feel free to consult all of these if you think it'll help you get your head around an idea...but I expect everyone's write-up to be different. For the record, "The car rolls down the hill" and "The car goes down the hill" are not different.**

I simply can't grade 60 homework assignments super carefully every week. Each assignment will have one randomly chosen mathematical question and one randomly chosen verbal question graded carefully out of 5 points each. All other questions on the assignment will be spot-checked and given 0, 1, or 2 points out of 2. Just because you're getting 2 out of 2 on these doesn't necessarily mean you're getting them right...solutions will be posted on Canvas and I encourage you to carefully check your work to make sure you're understanding things.

Like it says above, homework is to be handed in during our Thursday classes. Papers that are not in my hand by 11:30am on Thursdays are counted as late. 20% of the points are deducted for every 24-hour period afterwards. The weekend only counts as one 24-hour period. No after-the-fact (i.e. after 11:30am on Thursdays) excuses for lateness will be accepted.

PHYS 121 Grading Policy

Homework will make up 35% of your total course grade.

Tests will make up the remaining 65% of your total course grade. There are three tests...two during the actual semester and a third in our final exam timeslot during Finals Week...but that third test isn't a cumulative final exam (it's just a third test, same general length/difficulty as the first two). Your lowest of these three tests will count as 15% of your total grade and the remaining two tests will each be 25% of your total grade.

Tests are in class on the dates indicated in the Course Outline. In the case of a conflict, please contact me as soon as possible, at least a week ahead of time. After-the-fact excuses for test absence will require documentation and may not be acceptable. Tests will be based on lecture material (sometimes closely coupled to the demonstrations and computer simulations we use), homework assignments (including both the mathematical and the verbal types of questions), and questions and problems discussed in class. I ENCOURAGE YOU TO CAREFULLY REVIEW YOUR GRADED TESTS. IF YOU THINK THERE HAS BEEN A GRADING MISTAKE, WRITE UP A PARAGRAPH EXPLAINING YOUR CASE AND GIVE IT AND YOUR TEST TO ME.

It is, of course, a *serious* violation of Emory's Honor Code to submit an altered test for a re-grade. I randomly make copies of students' exams before returning them as a safeguard against this sort of thing.

Course Grades of 93.0 – 100 will be an A, 90.0 – 92.9 an A-, 87.0 – 89.9 a B+, 83.0 – 86.9 a B, 80.0 – 82.9 a B-, 77.0 – 79.9 a C+, 73.0 – 76.9 a C, 70.0 – 72.9 a C-, 67.0 – 69.9 a D+, 60.0 – 66.9 a D. A grade below 60.0 is failing.

It is the policy of Emory University to make reasonable accommodations for qualified students with **disabilities**. All students with special requests or need for accommodations should make this request in person as soon as possible, accompanied by confirmation in writing from the Office of Disability Services.

Physics 121

Course Outline

Instructor: Dr. Tom Bing, Room N236 MSC

Lecture: Tuesdays and Thursdays, 10:00am to 11:15am in E208 MSC

Office Hours: Tuesdays 11:30am to 1:30pm (or by appointment...or by walk-in if I'm not urgently busy)

Text: No official text...readings will be posted/distributed as we go along.

Your lecture notes are the most important thing. These readings are not meant to be complete (nor do I expect you to slavishly memorize every little detail in them)—they are merely a secondary voice for some of the main, basic points we care about.

Date		Topic
Jan	14 R	Course Introduction
		Unit 1: The Physics of Music: Introduction to Waves
	19 T	Different Kinds of Waves (Waves on a String, Sound Waves, etc.)
	21 R	How Instruments Produce Musical Notes
	26 T	Fourier Analysis: Simple Building Blocks Add Up To Complex Waves
	28 R	Beats and Loudness
Feb	2 T	Doppler Effect
	4 R	Review Day
	9 T	**** Test 1 (on Unit 1)
	11 R	Unit 2: The Physics of Electricity: Introduction to Charges
	16 T	Voltage, Current, and Resistance
	18 R	Complex Circuits
	23 T	Continue Complex Circuits
	25 R	Household Circuits and Devices
Mar	2 T	AC vs. DC, Electrical Power Generation and Distribution
	4 R	Digital Circuits
	8-12	No Class: Spring Break
	16 T	Review Day
	18 R	**** Test 2 (on Unit 2)
	23 T	Unit 3: The Greenhouse Effect: Light is a Wave
	25 R	Diffuse Emission/Absorption and Thermal Radiation
	30 T	Greenhouse Effect (in hot cars, on Earth, on Venus)
Apr	1 R	Personal Contributions/Carbon Footprint
	6 T	Economics/Social Inequities
	8 R	Share small projects
	13 T	Unit 4: Relativity: Special Relativity: Time Dilation
	15 R	Special Relativity: Length Contraction and Simultaneity
	20 T	General Relativity: Equivalence Principle and Gravitation
	22 R	Review Day
May	3 Monday	**** Test 3 9:30AM – 11:00AM (on Units 3 and 4)