1110 Fa15 (SJP)

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Office hrs: After class any day, **Help Room: Wed 3-4**, **Office** F3:30-4:30

(+ any time, by app't! Email me with "Phys 1110" in the subject)

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Reading for Wed (!) Look at `www.colorado.edu/physics/phys1110`

Background: Wolfson Ch. 1 (all) and/or Thinkwell Ch 1.2 ("Measuring the world...")

New stuff: Wolfson Ch. 2.1-2, and/or Thinkwell 2.1.1-4 ("investigating 1-D motion")

Online lecture notes: you're reading them! You can also look at Prof. Dubson's if you prefer, they will be super similar content, just his "style". See our website…

Read the syllabus (especially, exam dates!)

(Reading will generally be a couple of sections/lecture! Try not to get behind, it's important)

Please: register your clicker online ASAP. (Extra credit, it reduces exam weights)

Lecture #1: Intro, Syllabus

Every week: Wed Mastering Physics (MP), Thurs (or Wed) tutorial, occasional online stuff.

Lecture #2 will be: Position, displacement, velocity. (*Kinematics*)

Welcome! Phys 1110 is an introductory calc-based course in Physics (and science). It's about understanding and describing nature. Physics is about *things* - as versus biological systems, or even chemical systems. *How* do they move? *Why* do they move? How do they *work*? It's about describing and understanding the real world, and the physical objects in it.

The world studied by physics looks enormously complicated: CD's, microwave ovens, moonlight, sunsets, rainbows, flying birds, baseballs, airplanes, surface of Pluto.. You name it! But beneath this overwhelming chaos and diversity is a remarkable order and simplicity.
This is the main theme of Physics 1110 and 1120 (and all of physics) - seeking out the few underlying simple laws and patterns that let us relate and understand a huge variety of phenomena. It has taken humanity eons to start to sort it out, and the process is still ongoing!

E.g. the patterns you see in a fireworks display, or the shower of sparks from a grinder, the path of a fly ball or an Olympic long jumper... they're all basically the same simple physics (gravity, and projectile motion) We'll learn about this already next week.

Physics can be enormously practical and useful, especially for any kind of engineer or physicist. But, it's also very human to be curious about how the world works. We have physics in our genes! Cave people learned it's a good idea to move (and which way!) if rocks are falling towards you. Clans that spent the time and effort to observe the stars and moon (and correlate them with weather patterns) were surely better able to time and prepare crop plantings. Just watch young kids, they're enormously curious - Why is the sky blue? What's a rainbow? What happens if I throw this rock towards that window?...

You must try to find and feed that curiosity in yourself this semester. (Well, o.k., let's avoid throwing rocks at windows, but...) Ask *why*, how do we *know* this, what is going on, how does this work? I hope you will discover how fun and interesting physics is, as well as how useful for understanding (and designing) devices and technology. When we learn formal rules, or apply math - the game becomes "how can I make sense of this? How does this fit with what I know instinctively about the world"?

Surprisingly, the idea of watching and measuring carefully, of creating mental and mathematical models, of experimenting and calculating and comparing - the essential essence of what we call science - is relatively new in the world. 2000 years ago, Aristotle (a Greek philosopher) articulated brilliant, intuitive ideas about how the world works. He was a genius, but he did get a lot of things wrong. His failure to *experiment* may have been one of the prime factors separating him from modern scientists. (Modern here means maybe 400 years ago or so.)

E.g.: Aristotle observed that objects in motion tend to slow down. He decided that matter has a natural state, which is the state of rest. But it turns out this is not correct - he failed to distinguish between the fundamental, natural motion of objects from the extra *complications* of friction. Friction depends on speed, material, surfaces, etc. You can reduce it, even (almost) eliminate it if you try hard enough. Galileo (400 years ago, i.e. almost 2000 years after Aristotle) experimented with balls rolling on inclines. Those rolling downhill speed up. (The steeper the incline, the faster they speed up, but they *always* speed up) Those rolling uphill slow down. (Again, the steeper the incline, the faster they slow down, but they *always* slow down). Galileo asked himself - what about the case right in the middle, with an incline that's flat (neither uphill nor downhill)? Surely the object will neither speed up nor slow down, but continue along as it was. *An object in motion will continue with the same speed and direction, as long as there are no external forces (like friction) acting on it*. And his observations and experiments *verified* that this is indeed the case.

This was in some ways the beginning of modern science. Galileo simplified, looked for basic behaviors, separated out complications, experimented, and tested his predictions. And, he turned out to be correct - nowadays we can easily produce ultra-low friction situations, and observe that *all objects* behave as Galileo predicted. His understanding was simple and *universal*. (Afterwards, you can always study friction, and add it back into the story to understand more complicated and realistic motion, but friction is not part of the fundamentally basic and simple story.) Some 50 years later, Sir Isaac Newton (the hero of Physics 1110!) extended and quantified Galileo's observations, including the motion of celestial objects as following exactly the same rules.

Believe it or not, 300 years later, most people in the world still function with a worldview that is fundamentally *Aristotelian*. Some of you may discover (to your chagrin) you have some intuitions about how things move and work that aren't quite correct, that are not *Newtonian*. We all have a *decent* sense of how the world works, of course - you can ride a bike, drive a car, throw a ball, use a microwave oven - but when pressed, you'll discover you have some deep-seated intuitions and conceptions that aren't always quite right! I'll try to *help you convince yourselve of this* with demos, logic, and discussion. One goal for this semester is to help you think about and understand the world in a Newtonian fashion. If you're serious about a sport (you pick it - running, soccer, climbing, skiing, driving, biking...) I guarantee you that while Aristotle may get you by, Newton will always do you better!! If you're designing structures, or apparatus, or electronics, or anything physical, you absolutely must understand how the world *really* works, or you may be in deep trouble!

Most real scientific and engineering work done today is done in collaborative efforts. There are a lot of reasons for this, but fundamentally, working in groups allows you to achieve more than the "sum of the individuals" - groups produce work that even the best in the group could not have done alone. We will work hard to create a cooperative learning environment in Phys 1110

- in lectures, in tutorials, and encourage you to extend this beyond the classroom. Take advantage of it! Listen to what your classmates tell you - think about their viewpoints, try to argue with them (in the scientific sense of the word - not getting angry, but defending your ideas, and making sense of theirs) If you "get it", try to teach it to someone who is struggling - there is *no better way* to deepen your understanding!

Physics 1110 will focus on *both* qualitative and quantitative understanding. Homework and exams will involve both, too. Lectures will especially focus on qualitative understanding. This leads to an extremely important rule in this course - you must read the material in the text in *advance* of the lectures. Derivations, problems, and examples are all done in the book, and I'm going to reduce or eliminate repetition of that in class. It's not because they're unimportant (they're essential!!) It's because they're in the book, and you can all read! If you prefer lectures, you have "Thinkwell", which breaks my old-fashioned lectures up into 10 minute chunks. You're welcome to watch those if you feel the need - but they're no substitute for coming to class!

Lectures are for *consolidating* reading you've just done - checking and correcting misunderstandings with the use of Concept Tests and demos. (So, be sure to bring your clickers to lecture every day.) Lectures are *not* going to be presentations and explanations of the fundamental concepts. You will learn those fundamentals *before* class The book/Thinkwell will introduce you to terminology and definitions, raise questions in your mind (and very possibly confuse you) The class will help you understand better what you've read about, deepen your understanding, and show you how everything fits together.

You'll do a lot of numerical problem solving in this class, but its not the main focus of lectures. Recitations will also focus on conceptual understanding, explanation, and sense-making. The lectures are about stimulating your thinking and furthering your basic understanding. I *guarantee* that understanding concepts of physics will improve your problem-solving abilities, but the reverse is generally not true (being able to solve plug and chug problems doesn't remotely demonstrate that you understand the physics!)

Please read the syllabus, and explore our website. It has lots of resources for you.

Final comment: I will assume you have basic algebra and trig skills. We'll also be using some calculus, but I'll explain and discuss what we use as it comes along. If you're taking Calc I in parallel (and learning it), you will be fine. If you feel uncomfortable with anything, don't worry - but do ask any TA or me for help! Also, you might want to look at the text's appendices for a quick review of most of the essentials. Prof. Dubson's lecture notes are also available on our website. They are very similar to mine, we will match pace and content almost exactly, but every physicist has their own style, so use whichever set works best for you!