Tues Aug 23: Lecture #1.

www.colorado.edu/physics/phys1240
(**Homework** for Thurs- look over the site, read the syllabus, read preface, and Ch 1.1-4!)
HW for next Tuesday: first of the "online participation" surveys. See web.
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Key logistical/administrative points for today:
Textbook (Hall)
bring clickers (every class, particip + extra credit!)
exam schedule (no makeups)
homework schedule. (CAPA on Thurs, online questions/survey on Tues)
Next class we'll talk about hw details, but first set is printed and available in basement)

Class is participatory and collaborative. Attendance is expected, join the conversations! (Please: cell phones off, no newspapers. Class runs till 1:45!)
Prereqs: no physics or science. Basic algebra, and graph reading. (Don't worry - you'll get better as we go, but if this is a serious worry for you, talk to me ASAP. All you'll need is a willingness to try. Like learning to swim, if you had put it off until now...) Math is the language of physics - I can de-emphasize it (and will), but we shouldn't eliminate it!

Musical acoustics is a field which involves (at least!) music (art), physics (science), psychology (perception), and physiology (human ear/throat).

Remarkable synthesis! Our focus here is on the science (as vs, say, music appreciation) but we'll bring in all the elements as we move along. Why should you be interested in a course like this?

We're all interested in music - some to play, some to synthesize, everyone to listen... This course will tap into your curiosity about what's going on, how it works. There will be practical aspects (wiring your speakers, using the equalizer buttons properly, setting up your stereo, mucking with "garage band" software, how loud is too loud...) and for the musicians, some helpful ideas about playing of instruments, and choices in composition...

But it's really a deeper issue - how does sound and music *work*? What are the physical principles involved (there are only a few!) and how do they help us predict, understand, and manipulate sound? It's important and useful to learn how to think this way (like a scientist!) You don't have to *become* a scientist, you just need to be able to think like one when you want to :-)

See syllabus/web for very specific goals: all comes down to explain, predict, understand - test with exp't! The *content* all surrounds musical acoustics, but if you learn to think like a scientist, you can tackle questions that won't even occur to you for another 10 years...

Interlude: some "meta-comments" (about the *course*, rather than the content...)

Guiding principles for this course:
1) People understand concepts best by seeing them in action, and thinking about them, rather than by passively listening
2) Understanding physics (and solving problems) is a learned skill, like cooking, or baseball, or playing the guitar
It takes time, effort, and practice
3) People learn best by thinking and discussing
4) Students learn the most when they take responsibility for what is learned.

I cannot teach you physics! Because, it's not a collection of facts. It's a way of thinking. It involves analyzing, applying concepts, solving problems. You have to make sense of this yourself. My job is to provide you with RESOURCES to help you learn - including

Clickers/discussions in class - good guiding questions!
Content, problems...
Nice web page
Online simulations (physics games)
Online homeworks
Learning Assistants and problem solving sessions (homeworks are meant to be hard, maybe too hard to do alone! They're o.k. if you work and learn together. We help your interactions and coach, but won't give the answers!)
In-class experiments and demos

We use concept tests in class because they are a proven teaching technique with demonstrable advantages. You need to focus on them, *think* right here in class, talk with your neighbors... Listen to them, make sense of their arguments. Try to rephrase what they're saying - if you disagree, explain why. If you can't articulate your own ideas, they're not well enough developed yet. This is how science is done! "Arguing" science is not like, say, your parents arguing about money - it's a good thing! It's not personal, or aggressive: "arguing with your neighbor" means connecting ideas, relating back to experiments and theories and models. If you don't know the answer, you can always guess (that's fine!) You'll see how your classmates are doing, I get instant feedback, and can adjust the tempo and contents on the fly, very empowering for YOU in a large class like this! It's all about the reasoning (not the "right answer"), about learning how to think and "argue" science rationally. (Plus, it's a lot more fun than listening to a droning lecture for 75 minutes in a row!)

__________________ Back to content:

What is "sound"? How do you define "music"? How do "acoustics" fit in? **(Demo: bell)**
This is partly definitions (that is, human conventions) which I'm not so concerned about, it's the *ideas* that matter!

Sound can refer to a physical disturbance (a "pressure wave") that travels from a source... or it can refer to your *sensation* when that wave wiggles your ear-drum. (That's the essence of the old puzzle about "if a tree falls in a forest"...)

So we'll need to study three things to get a handle on sounds:
1) The source, or creation of sound waves
2) The nature of these wave, and how they are transmitted
3) The detection mechanism (usually, your ear)
That's what this course is all about, and we'll talk about all three first at an "overview" level for the first month or so of the term, and then circle back with more details and specifics, maybe even several "passes" at deeper levels, as we go through the course.

Acoustics is the SCIENCE OF SOUND. It's a branch of physics - like studying light, or electricity,... There are people who study acoustics for a living (about 7000 members of the Acoustics Society of America). Sometimes it might be related to psychology (what sounds good, e.g.) and sometimes it's engineering (designing better sonograms for medicine, e.g) and sometimes it's pure physics (understanding the wave phenomena from a source) Topics of study might involve health (speech, hearing) , perception (neural processing), architectural issues (sound mitigation), sound reproduction, digital synthesis... and lots more.

Music is intentional, ordered, and (in SOME respect) "aesthetic".
Speech can be musical or not, but its purpose is (usually) communication.
Noise is random, usually unwanted (not always)...
These boundaries are subjective and variable! We'll talk about all of them more this term.

Fitting with our list above, *our study* (in this course) of musical acoustics is about
1) Production 2) Propagation 3) Perception of sound.
As I said, we'll "spiral" around these three ingredients all term.

A super-quick first-pass overview, then:

1) Production of sound comes from rapidly vibrating things. Feel your throat as you talk, your vocal cords vibrate (buzz). ALL sound comes from some kind of vibrations. Watch a guitar string vibrate when you strum it...can you see the vibration that causes the sound?
2) Propagation of sound depends on the "medium", the material. Mostly, we'll think of sound in air. We'll talk about HOW sound can travel through air - we speak of the "sound wave", which travels. (In air, at about 344 meters/sec) What's waving? How does it move, why at that speed? We'll get there soon! It's all very real, and well understood, but it's a little subtle... (It's one of the first topics we'll cover.)
3) Perception happens at our ears. There are physical interactions with features inside your ear, which result in electrical signals to your brain, which are interpreted, as "sound". Some aspects of this are very well understood, but the "higher level" (neural/cognitive) aspects are still very much "under study".

We might add "electronic processing" as a fourth ingredient - different from the three main topics above. We'll talk about this as we go along, and USE electronics to help us image, and understand, all three of the key features above.