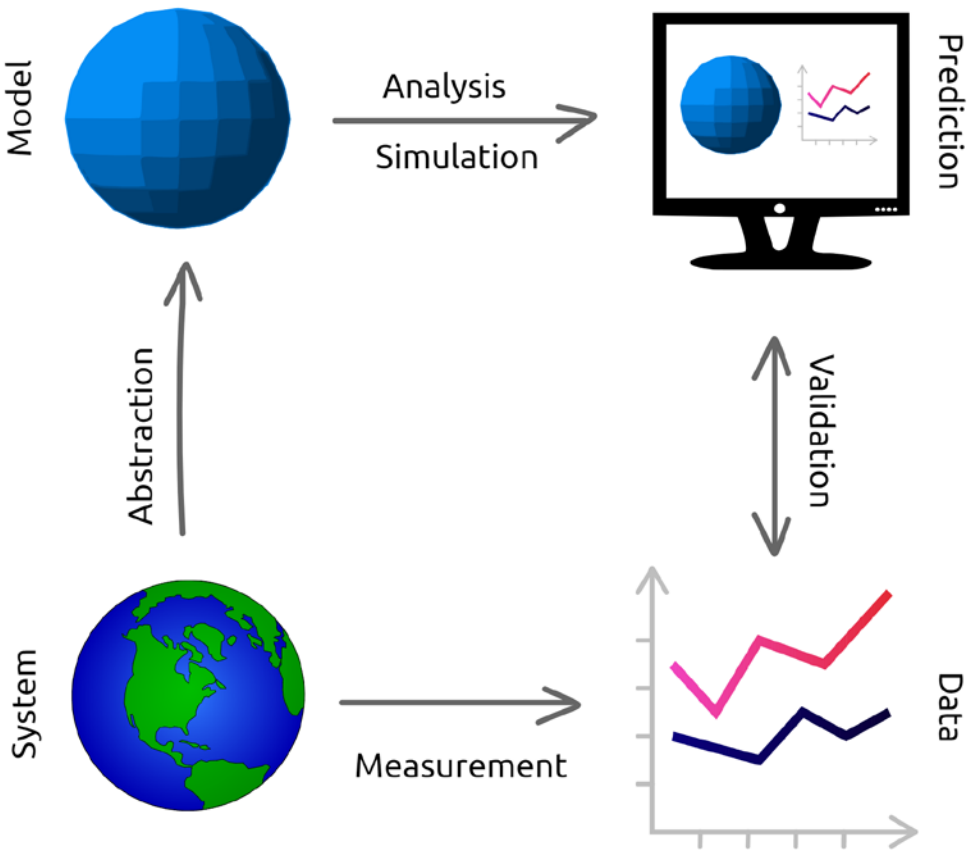
Introduction to Sensors, Instrumentation, and Measurement

Measuring things

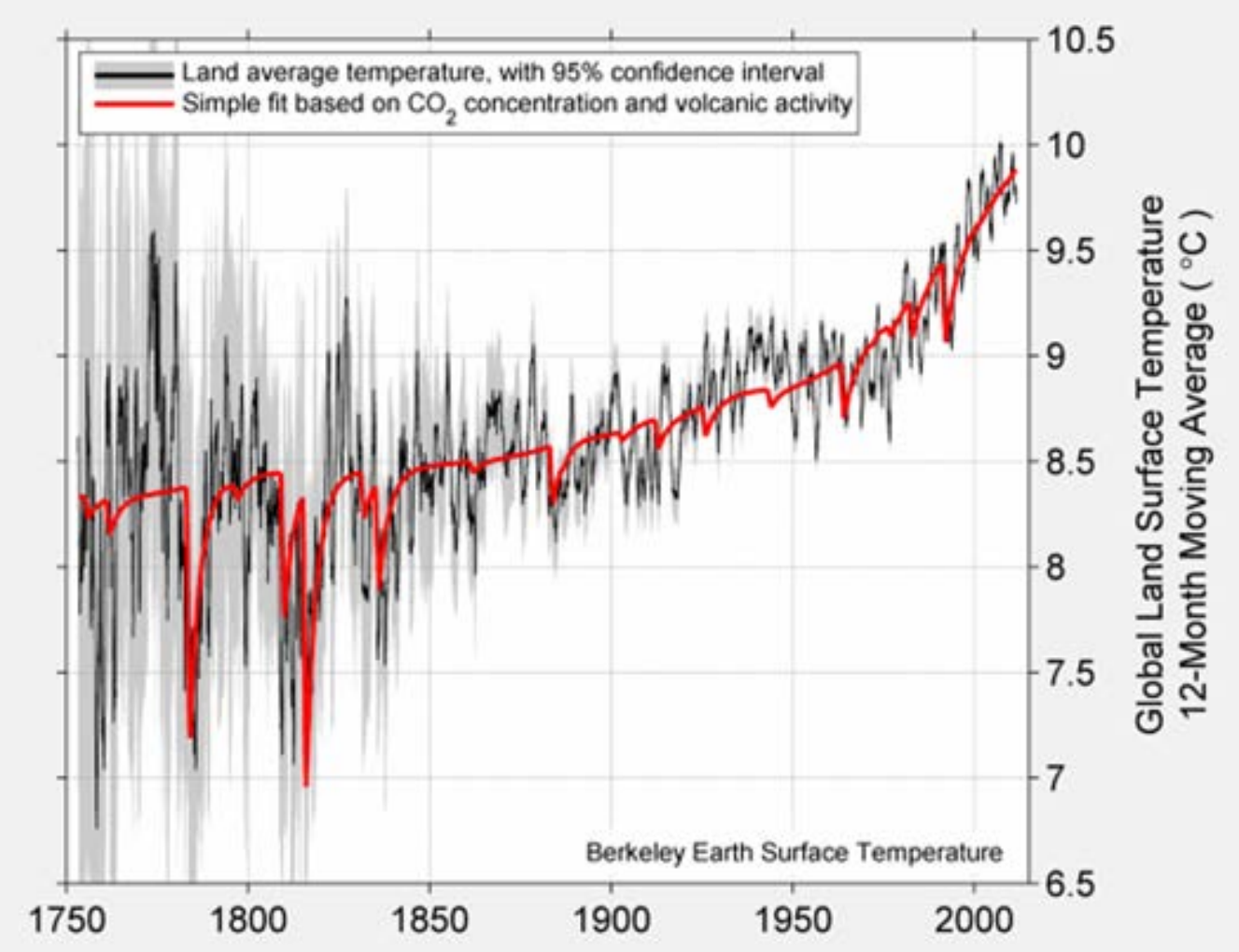
- Measurements are essential to all branches science and engineering.
- Understanding experimental data and looking at it critically is a very broad skill.
- Much of our understanding of the world was born from experimental measurements .

“Experiment is the sole judge of scientific truth” Feynman



- Models of systems are useless without validation (i.e. modsim).
- Quantitative experiments are key part of design (i.e. design nature)

Models are debated



Berkeleyearth.org

Measurements are debated

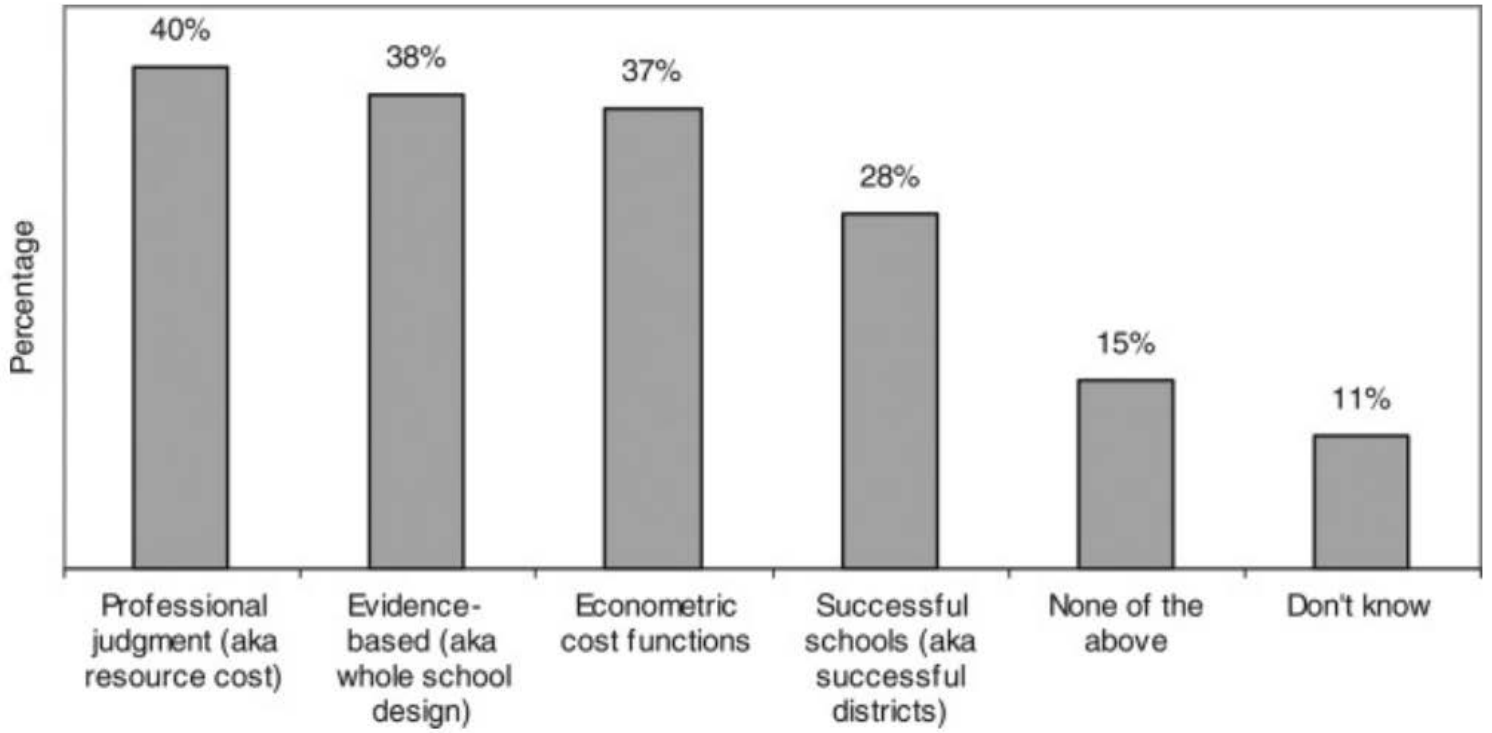
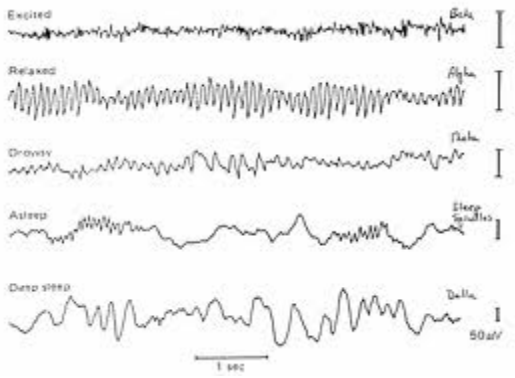
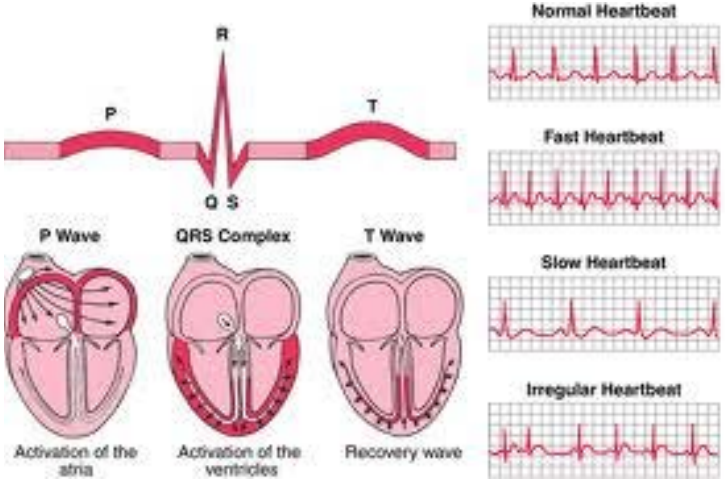


Figure 1. Which of the Following Is the Best Way to Estimate the Cost of Adequate School Funding?
Note: Bars do not total 100 percent because more than one response per respondent is possible.

http://steinhardt.nyu.edu/scmsAdmin/media/users/lah431/EDFP_a_00034.pdf

Measurements are important in healthcare



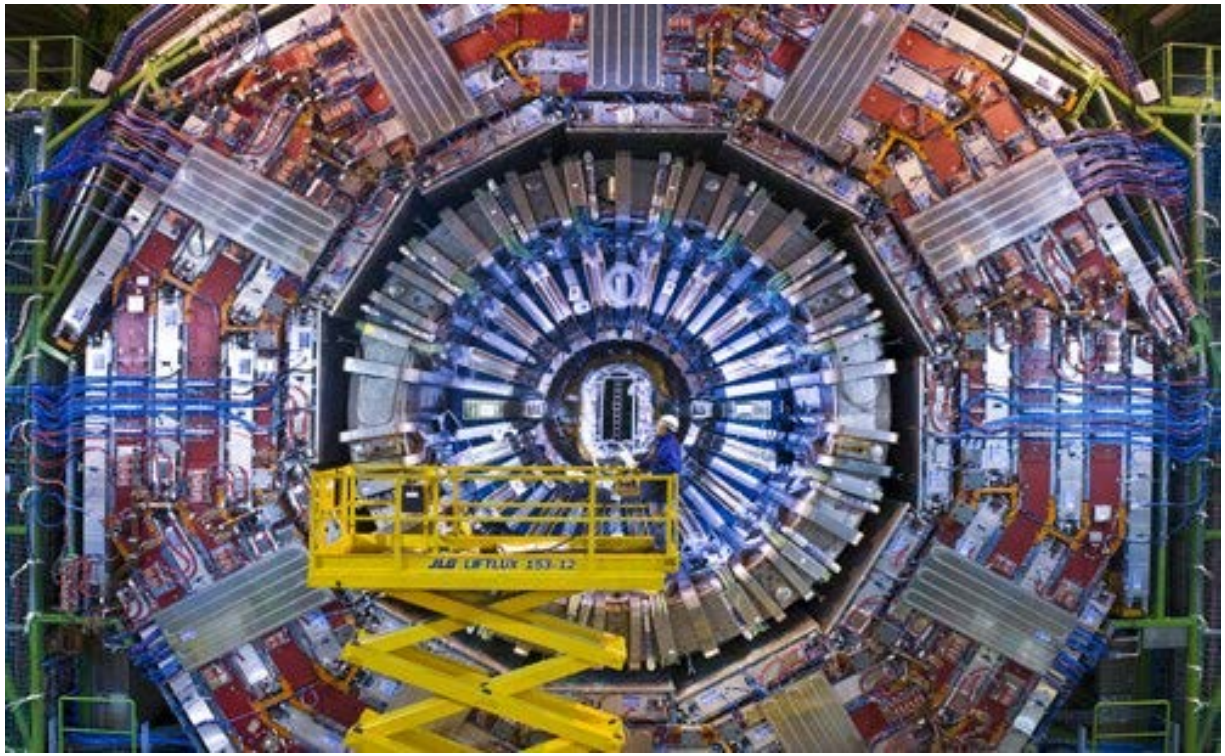


Would you fly without sensors?

Robots need to touch and see

Next generation transportation

Measurements can tell us how the universe is built



Large hadron collider

But this is only a first course.

What you will learn (hopefully)

- Make a set of physical measurements.
- Analyze and present experiment data.
- Use measurements to test physical models.
- Build circuits to interface sensors with a computer.
- Analyze and design simple circuits.

Course structure

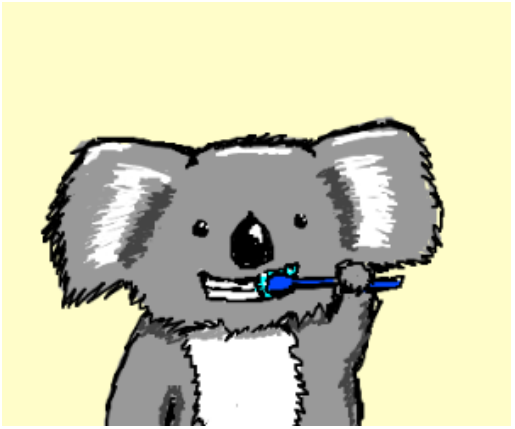
- Weekly labs
  - These include temperature, mechanical strain, EKG, pulse oximeter, blood pressure, ultrasound, and ballistocardiograph.
- Weekly readings/videos, quizzes, and class time
  - These topics connect to the labs, even if you don't always see it immediately.
- Even pace through the year

Lab etiquette

- Don’t take equipment/tools that aren’t yours – in the real world we call that stealing.
- Put things back when done.
- Don’t leave your junk lying around – the classroom is shared.
- Throw away old (cheap) parts, your old paper, etc
- Keep chips on your breadboard week to week.
- Obey the golden rule, not the tragedy of the commons.

A few things.

- This is not just a circuits course – but many measurements are electronic (all in this course).
- For most of you, a lot (maybe all) of the material will be new.
- Strive to learn good skills and habits for future semesters.



Grades – pass/no-record

- **Conjecture:** If you turn everything in, come to class, spend a reasonable amount of time on homework, and put forth a reasonable effort, the probability of passing (and actually learning a lot) is 100%.
- **Corollary:** You can no-record by not doing the above mentioned tasks.

Use pass/no-record to focus on learning,
but turn your s%$# in on time!

http://isim.olin.edu/Policy.shtml

What you need to do to pass iSIM:

- Submit lab reports on time with a score of Marginal or better.
- You can keep 1 Unacceptable rating on lab report without needing to resubmit.
  - For any lab report submitted on time that receives an Unacceptable rating, you can talk to the NINJA/professor about how to improve, and then you can resubmit that lab report within 3 weeks of the due date, or before the end of the semester, whichever is first.
- You can choose not to submit 1 report at all.
- Complete 70% of quizzes on time (assume there will be 10 quizzes).

Life throws us all curveballs sometimes. If issues outside class are impacting your ability to keep with the work - see one of the faculty. They will help you come up with a plan to get on track. Do not ask Ninjas for extensions or special accommodations.

Lab Reports

Description

- Very short description of what you did (a few sentences). Usually you will include a photo of your circuit (not for Lab 1)

Evidence

- Include evidence in the forms of tables or figures that capture your results. Each table or figure should have a brief caption that summarizes its content. Tables and figures should be legible, with appropriate axes, units etc (see Plots document).

Interpretation

- You should interpret the evidence that you have included. What do the results indicate? What can you infer? What are some of the issues with the results.

Lab reports usually include a few plots, captions, and a few paragraphs.
Weekly labs are individual.

Feedback on Lab Reports

All labs will be submitted via Canvas one week later before your next lab session starts.

Ninjas will grade and comment on your labs during the class period when you submit it. They will provide comments such that your future labs will get better and better as the year goes on.

We are providing grades on lab reports to help you get a sense of expectations. The grade options are:

- Excellent
- Good
- Marginal
- Unacceptable
- Nonexistent

Some tips

- Don’t sweat it if you don’t get something perfect the first time, we are jumping in feet first.
- A lab missing a few small things or with imperfect data is better than none at all. “The perfect is the enemy of the good”

- Use faculty and Ninjas if you are confused. Some confusion is natural and good. Too much is frustrating.
- Seek us out if you are having trouble with the class or if outside issues are causing you to fall behind – we have all gotten sick, had a family emergency, etc.

Website

isim.olin.edu

- Readings/Videos posted before each Monday class.
- Read through the lab once before your session.

https://canvas.instructure.com

- Complete weekly diagnostic quiz
- Turn in your lab reports and read feedback