Intro to Science

Today

- Reading Quiz

- Lecture/Discussion
  Physics: The fundamental science

- Debrief activity from yesterday

Reading Quiz

Full name and date on upper right corner of paper; name of assignment at the top. Then write *full sentence* answers to these questions, using your book if necessary.

1. Explain, in a sentence or two, why physics is considered the most basic science.

2. Is the **scientific method** considered to be a "cookbook" method that **IS** the universal key to the discoveries and advances in science?

3. Define, in a complete sentence, a scientific **fact**.

4. Scientific theories undergo change. Is this a *strength* or a *weakness* of science? Explain with a complete sentence or two.

Physics – The Basic Science

Science–the study of "questions about nature"–is split up into two main branches:

- *Life Sciences:*
  include biology, zoology, botany…

- *Physical Sciences:*
  include chemistry, physics, geology, astronomy…

Physics = the study of matter and energy
Chemistry = the study of how matter is put together: atoms, molecules, and larger structures
Biology = the study of matter that is living

A note about notes:

Don't copy *everything* down. Copy only ***important*** words, phrases, definitions, formulae, diagrams, examples…

You'll quickly learn how to identify what's most important. What's important on this page?

Math – The Tool of Science
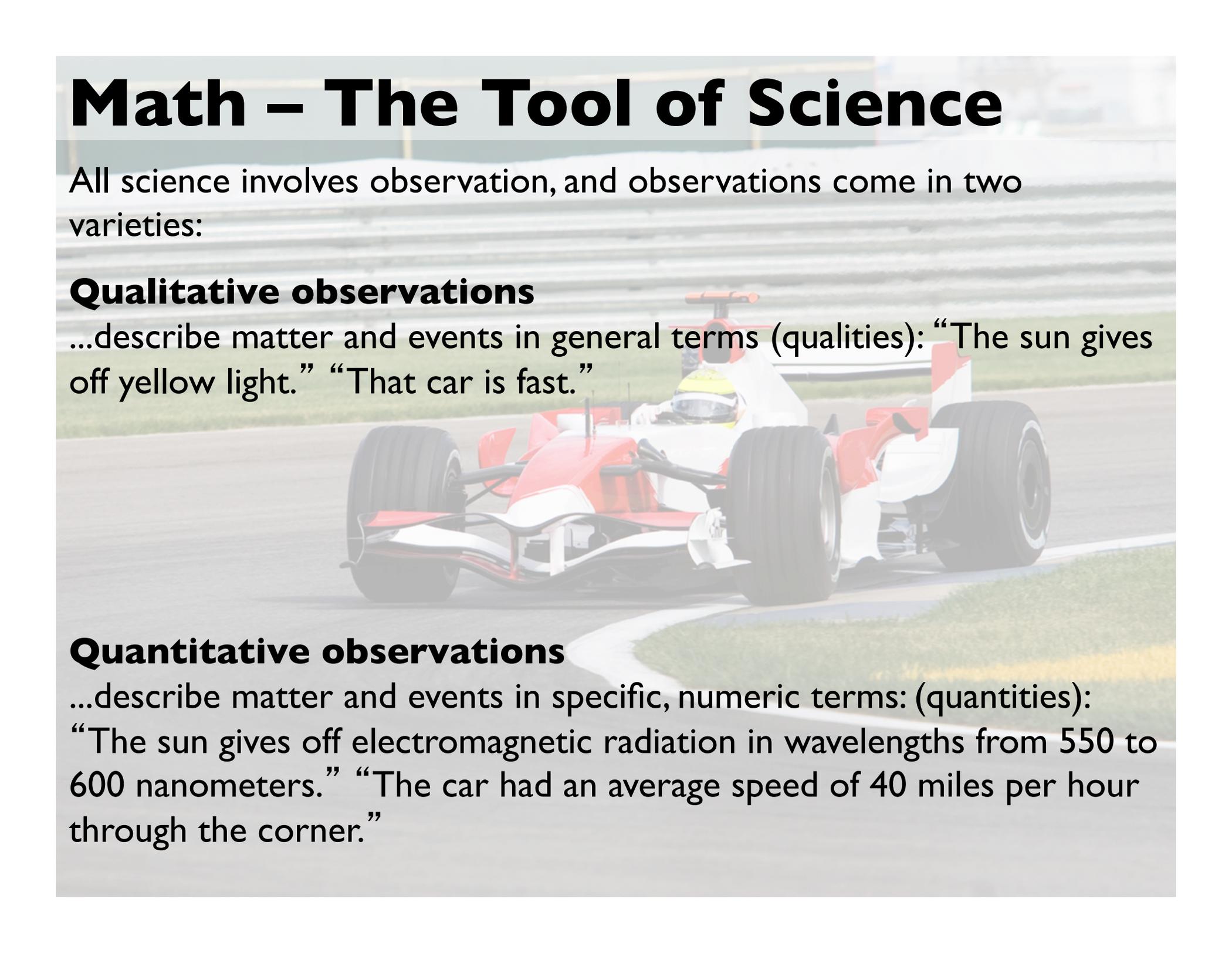
All science involves observation, and observations come in two varieties:

Qualitative observations

...describe matter and events in general terms (qualities): "The sun gives off yellow light." "That car is fast."

Quantitative observations

...describe matter and events in specific, numeric terms: (quantities): "The sun gives off electromagnetic radiation in wavelengths from 550 to 600 nanometers." "The car had an average speed of 40 miles per hour through the corner."

Math vs. Conceptual Physics?

The idea behind "conceptual physics" is that it's not absolutely necessary to learn physics using math. In fact, it's possible to talk about most of what happens in the physics world without any numbers at all.

And yet... many of the relationships that we'll talk about in this class *are* quantitative relationships, and most people find it *much* easier to understand what's going on if we use a few simple calculations from time to time. So we will!

Aristotle vs. Galileo

The Greek philosopher & metaphysicist **Aristotle** (384-322 B.C.) based his analysis of falling bodies on pure logic: "An object that weighs twice as much will fall twice as quickly." This belief was so logical that it persisted for almost 2000 years.

Galileo Galilei was born at the end of the Middle Ages, in 1564, in Pisa, Italy. Although he was taught the Aristotelian view, Galileo didn't agree with it: he felt that any knowledge or theory about the natural world is only valid if it agrees with *experimental results*. A theory that doesn't agree with experimental results is invalid and must be modified.
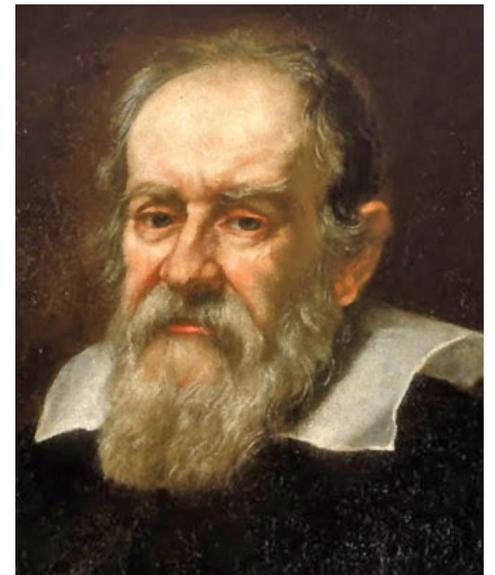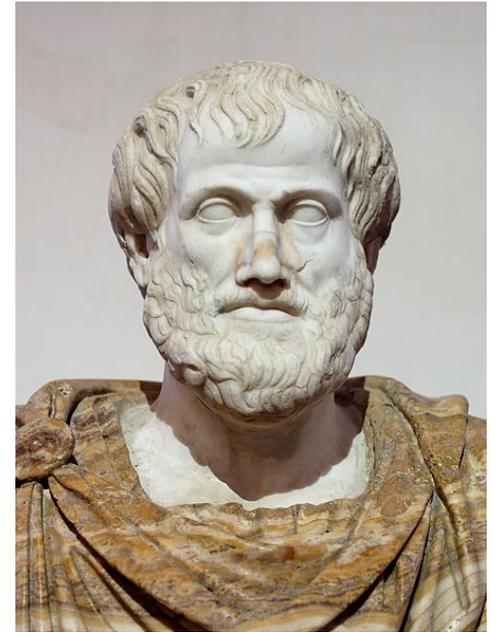
The "Scientific Method?"

This idea, that our knowledge of the world must be verified with experimentation, was one of Galileo's greatest contributions to science, and the reason he is sometimes called "the father of modern science."

The process of verifying an idea with careful experimentation is called "the Scientific Method."

1.OBSERVATION
You notice something interesting, perhaps a pattern of events that is peculiar or doesn't make sense.

2. HYPOTHESIS
You make an "educated guess" that might explain why the thing that you observed happened.

3. PREDICT
You predict what some of the consequences of the hypothesis would be.

4. EXPERIMENT
You design some type of test that will allow you to confirm or disprove your hypothesis.

5. THEORY
After repeatedly testing your hypothesis, you may believe it enough to call it a theory.

The Scientific Method!

The reality, however, is that

Science is Messy.

Mistakes are made,
scientists cooperate with each other,
scientists steal from each other,
scientists have brilliant insights,
scientists cheat and lie...

...but scientific results are always
subjected to scrutiny, and gradually, we
improve our understanding of the world.
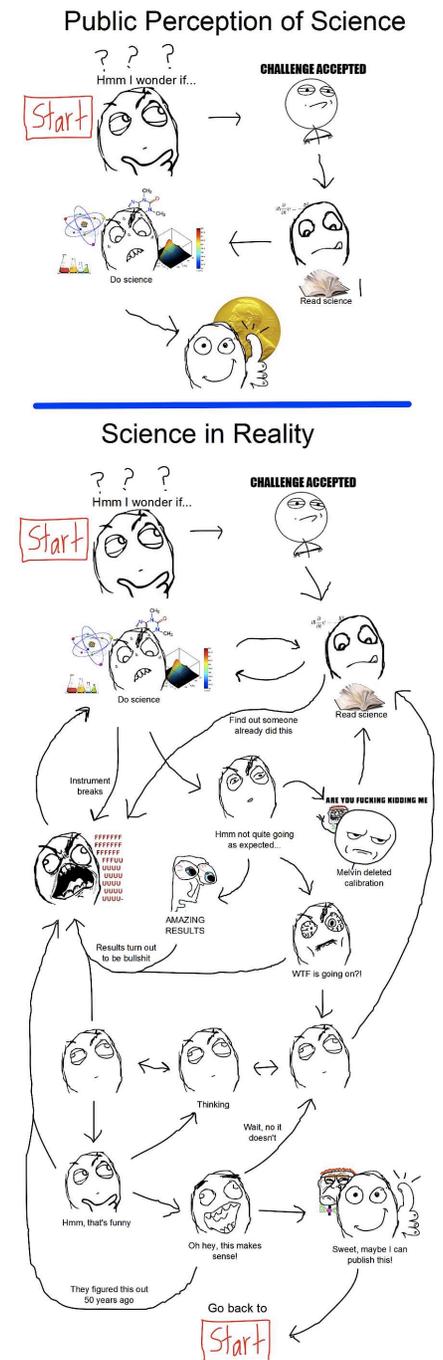
Facts, and Theories

A *scientific fact* is not necessarily something that is absolutely true. (?)

A *fact* is something that has been observed and agreed upon by a large number of competent observers.

A *theory* is a well-accepted model explains the mechanisms behind these factual observations.

Which of the following are *"just theories?"*

- Plate Tectonics

- Evolution

- The Kinetic Molecular Model

- The Big Bang

- Global Warming

- Relativity

Homework

- Homework: Name, date, assignment at top.

- Complete sentence answers, or
  Complete solutions (formula, numbers, answer)

- Ask questions! (Don't leave answers blank on homework.)

Reading Quiz - Answers

1. Explain, in a sentence or two, why physics is considered the most basic science.
   It's about the nature of basic things: motion, forces, energy, matter, heat, sound, light, atoms. It supports other sciences, and is fundamental to them.

2. Is the **scientific method** considered to be a "cookbook" method that **IS** the universal key to the discoveries and advances in science?
   No. (Trial & error, experimentation without guessing, and accidental discovery account for much of the progress in science. Success of science has more to do with an attitude common to scientists, rather than any particular method.)

3. Define, in a complete sentence, a scientific **fact**.
   A fact is a close agreement by competent observers who make a series of observations of the same phenomenon.

4. Scientific theories undergo change. Is this a *strength* or a *weakness* of science? Explain with a complete sentence or two.
   Refinement of theories is a *strength* of science: competent scientists must be experts at changing their minds when confronted with solid experimental evidence to the contrary.