Welcome to Physics 102.001
Intro to Physics

Instructor: Prof. Bernd Bassalleck

Outline of today's class:

Overview of class content & philosophy & goals
Technicalities & ground rules
Review syllabus
Chapter 1 (mainly left to read):
Scientific Process What is Physics?
Start chapter 2, time permitting…

Class webpage with more detailed info (please read!) & syllabus via link at: http://panda.unm.edu

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My own background:
PhD, Universität Karlsruhe/Germany
Experimental Nuclear/Particle Physics
At UNM since 1982
Chair of Physics & Astronomy 2002 - 2012

Physics 102: *conceptual*, minimize math (but not eliminate completely either), no prior physics preparation assumed, for any non-science major (or science major, for that matter!)

Goals: explore (& have fun!) some important physics concepts, both classical & modern;
remove anxiety about physics (& elementary math);
increase science literacy

Technicalities (see webpage!): significant use of i>clickers; also UNM Learn (for grades & exams);

→Read book before class, please!!

Note: there is another Physics 102 section and a lab (only loosely coupled to the lecture course).

Brief look at class webpage & syllabus……
http://panda.unm.edu

So, what is physics? Try to answer yourself…..

Our textbook (p. 4): Physics is the study of phenomena that, like falling, are universal.

Wikipedia: Physics (from Greek *physis* – nature) is a *natural science* that involves the study of matter and its motion through spacetime, along with related concepts such as energy and force. More broadly, it is the general analysis of nature, conducted in order to *understand how the universe behaves.*

In my own words: Physics is about observing and understanding the phenomena of nature, incl. finding patterns among them or "*theories*".
It is the most *fundamental* of all sciences, an *experimental* science, with astronomy the oldest science, and the foundation of engineering and of technology and of the other sciences.

→ And therefore you should care because it is relevant to your life…..as this course will hopefully demonstrate. If you want to make a difference nowadays, you need to know some science. Why not physics?

www.bbc.co.uk/news/science-environment-14563766

4 recurring story lines/themes in our book:

- Scientific Process
- Modern (> ca. 1900) Physics (~1/2 semester)
- Energy, a central/crucial concept in physics
- Societal Context of Physics

www.nytimes.com/2011/08/21/science/earth/21laser.html?_r=1&ref=global-home&gwh=C6ACEA658C4AA319F8AF2008852AE0CB

Some demos….

http://www.youtube.com/watch?v=_dbnH-BBSNo

Chapter 1: The Way of Science (illustrated via the history of early astronomy)

The scientific process or "How do we know?"

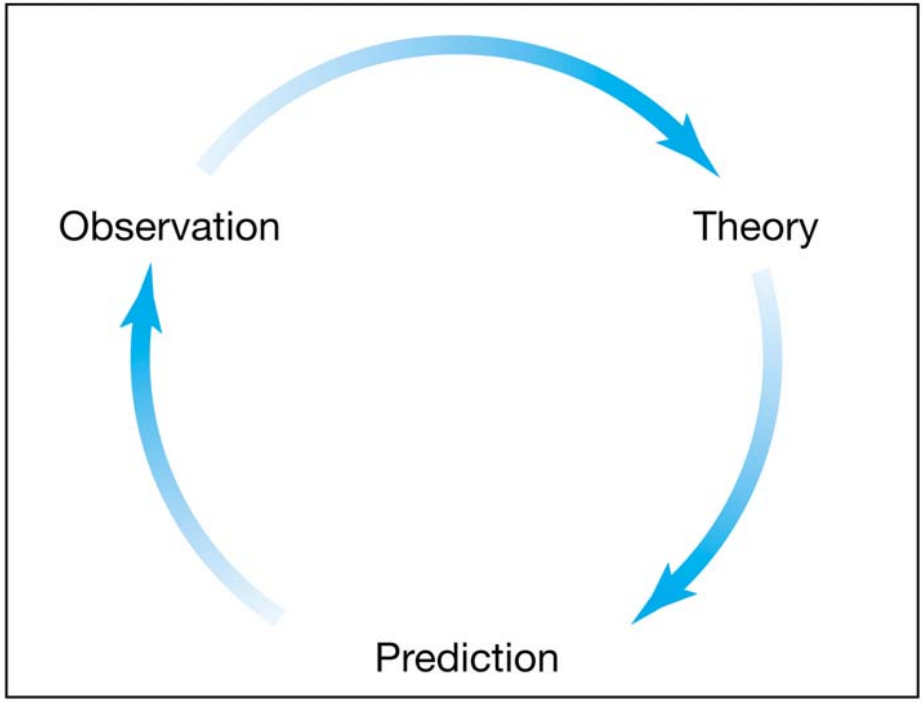
By observing/experimenting, by interpreting what we measure/observe, and by thinking!

→ Important interplay experiment←→theory

No absolute "truth", no dogmas, open-mindedness, willingness to revise, change one's mind after new facts emerge.

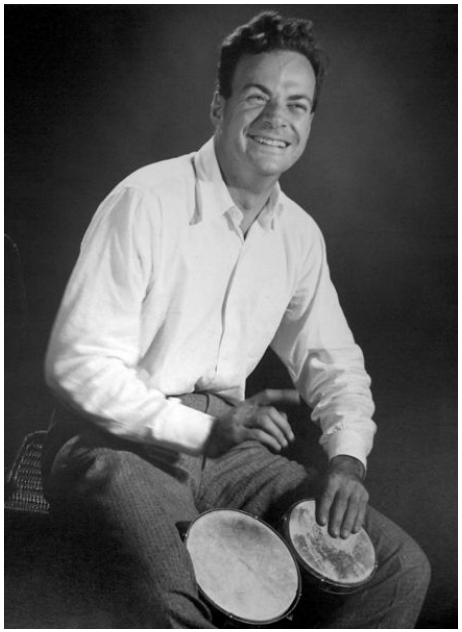
The Scientific Method

- Combines thinking (theory) and testing (experiment)
- If a prediction does not agree with experiment what must be done?



Experiments are crucial to science

"But also needed is *imagination*...to guess at the wonderful, simple, but very strange patterns beneath [the experiments], and then to experiment to check again whether we have made the right guess."



"The principle of science, the definition, almost, is the following: *The test of all knowledge is experiment.*"

"Science is the belief in the ignorance of experts"

Richard Feynman

From p. 20:

Observation refers to the data-gathering process. A **measurement** is a quantitative observation, and an **experiment** is an observation that is designed and controlled by humans, perhaps in a laboratory.

A scientific **theory** is a well-confirmed framework of ideas that explains what we observe. A **model** is a theory that can be visualized, and a **principle** or **law** is one idea within a more general theory. The word *law* can be misleading because it sounds so certain. As you will see, scientific ideas are never absolutely certain.

Note that a theory is a *well-confirmed* framework of ideas. It's a misconception to think that a scientific theory is mere guesswork, as nonscientists occasionally do when they refer to some scientific idea as "only a theory." Theories—well-confirmed explanations for what we observe—are what science is all about and are as certain as any idea can be in science.

The correct word for a reasonable but unconfirmed scientific suggestion (or guess) is **hypothesis.** For example, Kepler's first unconfirmed suggestion that the

From p. 22:

The Scientific Process

Science is a process, a way of learning, rather than a set of conclusions. It is the process of using evidence (experiments and observations) and reason (hypotheses and theories that correlate the evidence) to develop testable knowledge about the natural world. This basis in evidence and reason distinguishes science from other forms of knowledge based on belief, intuition, personal authority, or authoritative books.

(Most?) Important single word above: ??

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(Most?) Important single word above: testable

Also, often not a straight-line process (as illustrated in Ch. 1)

Theories can be very powerful, with significant predictive power.

Remember: *theory = framework of scientific ideas, well confirmed by experimental/observational evidence*

CONCEPT CHECK 9 William is absolutely certain of a particular scientific principle. You can conclude from this that (a) this principle is correct; (b) this principle is wrong; (c) this principle is irrelevant; (d) William is being scientific; (e) William is being unscientific; (f) William is a blithering idiot.

CONCEPT CHECK 11 The most characteristic feature of science is (a) the use of precise mathematical relations; (b) precise quantitative observations; (c) the absolute truth of the scientific laws; (d) the mutually supporting relationship between theory and observation.

Please also read 1.8 on pseudoscience.
("Everybody is entitled to his/her own opinion, but not to his/her own facts!")