Physics Integration Lesson 13 – Epistemology and Instrumentation

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During the first semester of physics we measured mass, distance, time, velocity, acceleration, force, momentum, torque, frequency and energy. I trust that what was presented in class and tested in the lab reinforced what you already knew about the physical world through sports, music and visiting amusement parks. In addition I hope you have confidence that the theoretical relationships between these concepts capture 'reality,' how the world really works. If there is any question whether these things are true, all you have to do is test them out. This is why we have confidence in knowledge gathered through a scientific methodology.

How we know what is true and the process by which we determine it is true falls under a major field of philosophy called epistemology. I mentioned this in lesson 2 last semester and epistemology applies to all subjects from science to theology. What changes this semester is that the concepts and measurements do not correspond to quantities directly measured by your body. When listening to music, we understand what it means to change the frequency of the sound emitted by an instrument or a singer. Force, inertia and acceleration of Newton's Laws are seen everywhere from hitting a ball with a bat to driving a car around a sharp curve. However, electric fields, voltage, current and resistance are far removed from common experience. In fact the theory developed this semester will deal with things that are unseen and only measured by their effect on an instrument. How do we know they are real?

Before the eighteenth century, humanity's experience with electricity was by watching lightning bolts and being shocked by objects during the winter. During the past three centuries a rapid development occurred taking us from the electricity storage experiments of Benjamin Franklin to the scanning of cancer using magnetic resonance imaging (MRI). During this same time our conceptual view of created substance[1] of which all physical things are composed went from being infinitely divisible to being composed of atoms, protons, electrons, quarks and strings. Are each of these things 'real' or are they only models that are consistent with measurements made by sophisticated tools to enhance our observation of the universe?

1. In physics you make observations with your five senses (mostly three, I don't expect you to taste or smell things in physics) as well as with instruments, like the multimeter. Between your senses and instrument readings, which do you feel gives you the most accurate measurement of reality? Why?
2. The discovery of the electron and the nucleus of the atom are just over a century old. The standard model of elementary particles, which includes quarks and leptons, was established about 50 years ago. Membrane theory, an outgrowth of string theory was proposed 20 years ago and states there are 11 dimensions. Whenever a new theory is introduced, there is a period of time when it is treated as speculative science, not necessarily real. Is it only a matter of time before a theory is accepted as real or are there other criteria? Explain.

[1] Robinson, T. 17th Century Theories of Substance. Internet Encyclopedia of Philosophy. Accessed Aug. 28, 2019. https://www.iep.utm.edu/substanc/