Homework Assignment #5, Explaining Physics Concepts to a General Audience

N.B. *This assignment will be peer-reviewed* (HW #6).

The purpose of this assignment is to practice explaining scientific concepts in a way that is clear, concise, and meaningful for non-experts. For this assignment, your audience is non-scientists who have a general interest in physics but no specific knowledge of the physics concept you choose.

First, select a physics topic to write about. (See the list of example topics on the next page.) You should choose a topic where you have a solid grasp of the physics; the point of this assignment is to communicate that understanding to a general audience, not necessarily to learn some new physics.

We've provided a list of topics to get you started; you may choose one of these topics or pick a topic from your coursework or research. If you opt for the latter, you must submit your proposed topic to phys496@physics.illinois.edu for approval ***before*** you start writing.

Your paper, which should be no more than two pages, including text and figures, must contain the following elements:

1. An engaging title.
2. A "byline"—your name, the date of the article, and the place where the article was written, e.g., Urbana, Ill. (See https://news.illinois.edu/view/6367/801710 for how to do the byline and place).
3. A strong opening to capture the audience's interest.
4. A single main idea, conveyed in laypersons' language (no jargon, no arcane technical terms, no equations beyond high-school algebra).
5. At least two illustrative images, with appropriate credit given to the sources. The figures should be understandable and meaningful to a general audience (i.e., no complicated plots). You do not have to create these figures yourself, but you must credit the original authors and identify where they came from. You must also provide your own, original captions to explain the figures.
6. At least four embedded hyperlinks[*] to related, supplementary material that the audience can use to learn more about your topic. Links should be to content appropriate for the intended audience—no links to technical papers.

Suggested topics are ***listed on the next page***.

Due: **Friday, October 11, 9:00 p.m.** Email your assignment to phys496@physics.illinois.edu. Be courteous to your reviewers and get your assignment submitted by the deadline, so they have adequate time to complete their reviews. Assignments submitted after the deadline will have at least 20 points deducted and will be ineligible for rewrite points.

Total—100 points; 70 points on the accuracy of the physics and 30 points on clear, concise writing

[*] See http://www.gcflearnfree.org/word2010/13.2 for instructions on how to insert a hyperlink in a Word document.

Basic Topics:

- How levers work.
- The distinction between centripetal and centrifugal forces.
- Gauss' law: How do you figure out how much charge is in a box without looking inside?
- Faraday effect: How do you apply an electric field without using a battery?
- Show that calculating the charge of a point charge through the divergence of its electric field yields a different result from the surface integral from Gauss' law. Explain this discrepancy.
- Temperature dependence of the entropy of a single spin-1/2 degree of freedom in a magnetic field.
- Does the same amount of water, subjected to the same amount of heat inflow, boil faster at constant pressure or constant volume? Why?
- Explain the parameter dependence of the ground state energy of a particle in an infinite square well.
- Show that a conserved quantity in a quantum mechanical system implies that a related operator commutes with the Hamiltonian.

Advanced Topics:

- Why should the energy levels of the hydrogen atom depend on the orbital angular momentum quantum number? Why don't they?
- Why does the wave function of a spin-1/2 particle change by a minus sign when you rotate it by 360 degrees?
- Why does hydrogen want to form a diatomic molecule, but helium does not?
- Explain why a discrete quantum system with only a single state in the Hilbert space contains no useful information.
- Explain the "no cloning" theorem from quantum information science.