PowerPoint Notes on Energy and Energy Conservation

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Slide 4

When water falls, gravity does positive work while air resistance does negative work. While hiking up a mountain, Marlene and Bob do positive work on their backpacks, while gravity does negative work on them. A waiter carrying a level tray does no work, and gravity does no work, either.

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Students who are familiar with calculus might notice that this area is the same as the integral of the force function over distance.

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Grendel is the cat shown at the higher height, on the left.

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The derivation of this equation is beyond the scope of many introductory physics and astronomy courses, but it is useful for students to see the form that it takes. The minus sign is worth spending some discussing with students, as it indicates that gravitational systems have negative potential energy associated with them and are thus "bound." This should make sense, since planets do not spontaneously fly away from the Sun, nor does the Moon spontaneously leave Earth's orbit.

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Note the lack of minus sign here, which is due to the fact that opposite charges have attractive forces (the q's have opposite signs, resulting in a negative potential energy and the same kind of "bound" system as in gravitation) and like charges have repulsive forces (the q's have the same sign, resulting in positive PE).

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Good background reading on nuclear energy:
http://www-istp.gsfc.nasa.gov/stargaze/SnucEnerA-2.htm

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It is useful to use some examples here to illustrate the difference between temperature and total thermal energy. Both the bread and cheese in a pizza, for example, are at the same temperature, but one is much more likely to get burned by the cheese. While the average kinetic energy of the particles is the same, the total energy contained in the denser medium of the cheese is greater. Another example is outer space (or the sunlit surface of the moon), where the temperature is often quite high. However, because the medium is very rarefied (almost a vacuum), there is very little total energy, and thus, it is "hot" in the sense we usually think of.

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For more details, see the PowerPoint slides entitled *Energy Levels and Atomic Spectra*

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