# "Energy Conversion"

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I. DCPS Standards:

8.5.1 Explain how energy is the ability to do work and is measured in Joules (J).

8.5.2 Describe kinetic energy as the energy of motion (*e.g.* a rolling ball).

8.5.5 Explain that energy may be stored as potential energy in many ways, including chemical bonds.

8.5.10 Explain that at in processes at the scale of atomic size or greater, energy cannot be created or destroyed but only changed from one form into another.

II. Goals:

Students will understand that energy can be and often is converted from one form to another.

III. Objectives:

Students will describe the process of energy conversion in simple demonstrations.

Prerequisite Knowledge: Energy can roughly be described as the ability to do work. ("Work" actually has a precise definition in physics.) It is in measured in units of Joules (J), named for the English scientist James Prescott Joule. All moving objects have kinetic energy. The kinetic energy of a moving object of mass m moving with speed v is $(1/2)mv^2$. (Here we refer to just the translational kinetic energy, not the rotational kinetic energy.) Mechanical energy (macroscopic energy of material objects not including heat) also involves stored energy called potential energy. The forms most important for this curriculum are gravitational potential energy and elastic potential energy.

Moreover, energy has forms other than the mechanical energy described above. One of the most significant is electromagnetic radiation, which involves all the light we see as well as radio waves, microwaves, X-rays and gamma rays. Energy can also be stored in the electronic configurations of chemical bonds. This acts as a type of potential energy called chemical energy. Other specific forms of kinetic energy are sound and heat. Sound waves are large scale, somewhat ordered longitudinal vibrations of a medium such as air. Heat, on the other hand is the completely random kinetic energy of molecules all moving independently in different directions. It has no order to it and therefore specific circumstances (namely a path from higher temperature to lower temperature) must be put into place to convert heat into any useful work. This is an entire subject called thermodynamics.

Finally it must be noted that one of the most fundamental laws in all of physical science is that of conservation of energy. This states that although energy changes form, the <u>total</u> amount of energy (in Joules) of an isolated system remains the same.

IV. <u>Essential Questions</u>:
What forms of energy are exhibited in the demonstrations? Which form has been converted into which?

V. <u>Materials</u>: Wind-up toy, flashlight, match or lighter.

VI. <u>Differentiating Instruction</u>: This activity should pose no problem to speakers of English.

VII. <u>Rationale</u>: This activity illustrates the conversion of energy in simple demonstrations.

VIII. Activity Procedure: The instructor discusses energy conversion and conservation (even though this particular lab is qualitative) with the students, mentioning specific forms of energy. The relevant forms of energy for this lab are kinetic energy, elastic potential energy, chemical energy, heat (or thermal energy), and electromagnetic radiation (electromagnetic energy). The instructor then performs a demonstration: holding up the object, executing the appropriate action (winding up the toy and letting it go, turning on the flashlight, or striking the match), and then asking the students what forms of energy were involved in the process. This is repeated for the other two demonstrations.

IX. Evaluation and Assessment: What is the example of energy conversion in each case? [For the toy, elastic potential energy into kinetic energy; for the flashlight, chemical energy of the batteries into electromagnetic energy; for the match, chemical energy (and a bit of kinetic energy from striking it) into electromagnetic energy and heat.] Students record their answers. Can they think of other examples? Students write their own statement in their lab notebooks saying what they have learned about energy. Optional: Mention that in each case, some of the energy gets converted to heat (this is obvious with the match). This leads to the concept of efficiency; the more efficient a process is, the less waste heat is produced.