Kinds of Energy (4.2 in Text)

Energy is the ability to do work. It has these characteristics:

- Energy is transferred from one object to another when work is done
- Energy comes in many forms and is interchangeable
- Energy can be stored and used later to do work
- Energy is always conserved in a closed system

**** Law of Conservation of Energy** = Energy cannot be created nor destroyed, but it change forms.

So, yes…the total amount of energy remains the same, but unfortunately, all forms of energy are not *useful* to us. For example, we put gasoline (chemical) energy is our car, but not ALL these energy makes the car go. Heat energy is often considered 'wasted' energy. Many energy conversions do have some conversion to heat and so we say some energy is 'wasted'. Truly, it is not lost – it just didn't go where we wanted it to go. (Sound is often a form of 'wasted' energy.)

Types of Energy *** Eg and Ek will be a big focus for this unit.**

1. *** Gravitational Potential Energy (Eg)** – is the energy an object has simply because it is raised. When a hammer 'falls', it can exert a force and cause a nail to move. It does 'work'!
2. Elastic Energy – is the energy stored in something that is pulled or compressed out of it's normal (rest) state. When released, it returns to this rest state and has the ability to exert a force and do work.
3. *** Kinetic Energy (Ek)** – Is the energy of motion. Moving objects can exert a force and cause something to move…doing work!
4. Chemical Energy – is the energy stored in molecules ie: food you eat and fossil fuels (coal, oil and natural gas). So when we digest food and burn fuel we release energy to do our work.
5. Sound Energy – energy carried by sound. Sound, we'll learn, has the ability to move/vibrate molecules and your eardrum, thus doing work.
6. Thermal Energy – is the energy inherent in moving molecules.
7. Radiant Energy – is electromagnetic radiation waves that 'radiate' from the source like the sun or a campfire.
8. Electrical Energy – is the energy associated with moving electrons.
9. Nuclear Energy – is the energy stored in an atom's nucleus. Sometimes this energy is released spontaneously (radiation). When you split an atom (nuclear fission) this energy is also released. When you join 2 small nuclei , energy can be released too (nuclear fusion). This last example is how the Sun releases energy.
10. Rest Mass Energy – is the total energy an object has because of its mass. See more below

Einstein and Rest Mass Energy – Einstein theorized with 'thought experiments' that mass has energy simply because it exists. The total energy of a mass at rest is calculated by (you guessed it)

$\mathbf{E = mc^2}$ Where E = energy (J), m = mass (kg) and c = 3.00×10^8 m/s (speed of light)

Now, nuclear power plants split uranium atoms (nuclear fission). It is found that the mass of the products is slightly less than the mass of the original uranium. This missing mass is called 'mass defect'. You should remember from an earlier grade, that mass is conserved – it can't just disappear. So, where does this mass go? It goes into energy as the formula predicts: $\mathbf{E = mc^2}$

Remember: c = 3.00×10^8 and it is squared! So a little mass results in a LOT of energy – nuclear energy!

Units for Energy

Energy is measured in Joules (J) named after James Joule a British scientist who made contributions in the field of energy. The Joule is a derived unit, not a base (SI) unit.

1 Joule = 1 Newton· metre

Sometimes when we discuss energy, especially the amounts we need in our society, we use very large amounts. You need to be familiar with metric prefixes once again.

1 kJ = 10^3 J (1000)

1 MJ = 10^6 (1 000 000)

1 GJ = 10^9 (1 000 000 000)

You may have heard of a kilowatt hour (kW·h). 1 kW·h = 3.6 MJ

How much is 1 Joule of energy??

2 golf balls raised to chest height have 1 Joule of Grav. Pot. Energy.

3 Olympic athletes racing as fast as they can have a combined energy of 1000 Joule (1 KJ)