X. FORMS OF ENERGY: Stored Energy and Useful Energy (Day 9)

A. INTRODUCTION:

1. Energy is the ability to do work.

   a. Food eaten.

   b. Plugged in electric shears

   c. Oil pumped from the ground

   d. Water stored behind the dam

   e. Windmills catch the wind

   f. Geothermal plants

B. KINDS OF FORCE:

1. Force is a push or a pull.

2. Force is needed to change the state of motion of an object.

3, There are four main kinds of force in nature.

   a. Gravitational Force
      i) Gravity is the force of attraction, or the pull, between all pieces of matter.
      ii) Action-at-a-distance.
      iii) Responsible for the round shape of the earth.
      iv) Keeps the atmosphere in place around the earth.
      v) Gravitational force on an object is called weight.
      vi) The amount of force exerted on you depends on your mass.
      vii) At the same time as the earth is pulling down on you, you are pulling the earth up with the same force.
   b. Strong Nuclear Force
      i) The force that holds the nucleus of an atom together.
      ii) It is strong enough to overcome the repelling forces of the positive protons packed together inside the nucleus.
      iii) It does not extend beyond the nucleus of the atom.
   c. Weak Nuclear Force
      i) Present among the particles in the nucleus.
      ii) Involved in such nuclear events as the beta decay type of radioactivity.

d. Electromagnetic Force
   i) Made up of the forces of attraction and repulsion caused by electrical charges and magnetism.
   ii) Holds molecules together and binds molecules to each other.
   iii) Makes the electric motors work.
   iv) Make your muscles work.

C. MEASURING WORK

1. Work is done when a force changes the motion of an object.

2. If an object doesn't change its state of motion, no work was done.

   a. An object has to move some distance in the direction of the force.

3. To find the amount of work done in a given situation, force is multiplied by the distance through which the force is applied.

   a. Distance is measured in meters.
   b. Force is measured in a unit called the NEWTON. (Abbreviated "N")
   c. To calculate the amount of work done, Newtons are multiplied by meters.

4. The work unit could be called the Newton-meter, but has its own name.

   a. The amount of work done by one newton acting over a distance of one meter is expressed in a unit called the JOULE. (Abbreviated "J")

5. Work = Force x distance

   Work = newtons x meters

   Work = N x m; Joule = N x m

D. POWER

1. The rate at which work is done is POWER.

2. If work is done in a short amount of time, the power is higher than if the work is done more slowly.

3. Suppose two loads of the same mass were lifted through the same distance. The Load is lifted more slowly than the second.

a. The rate at which energy is used to lift the first load is smaller. But the amount Work done, the energy, stays the same.
b. The only thing that changes is the time needed to do the work.

4. Mini-bike vs. Motor cycle. Motor cycle is more powerful because it can to the same amount of work in a shorter time.

5. Power is measured in joules per second. One joule per second is equal to one WATT

a. 1000 watts is equal to a kilowatt.

E. KINETIC AND POTENTIAL ENERGY

1. Energy in action is KINETIC ENERGY.

a. Energy of motion.

b. The faster the car moves, the more kinetic energy it has. The brakes turn kinetic energy to heat to slow the automobile down.

c. When the car's speed is doubled, it's kinetic energy is four times as great.

d. When the car's speed is tripled, it's kinetic energy is nine times as great.

2. Potential Energy is stored energy.

a. This is the energy of water stored behind a dam.

b. This is the energy in gasoline, oil, coal, dynamite and the nucleus of an atom.

c. The force needed to lift 10 kg is 98 newtons.

d. To lift 10 kg of mass a distance of 1.4 m, it takes 137.2 Joules of work.

i) The 10 kg can do 137.2 joules of work by itself if it falls off the shelf.

ii) Sitting on a shelf 1.4m high, the 10 kg mass has 137.2 joules of potential energy.

iii) When the 10 kg mass falls off the shelf, the kinetic energy just before it hits the floor is 137.2 joules.

3. Energy obeys the LAW OF CONSERVATION OF ENERGY.

a. This means that energy is neither created nor destroyed.
b. In the example above, the 137.2 joules of energy becomes heat once the 10 kg mass hits the floor.
c. Energy of motion, kinetic energy, usually turns into heat..
    i) The kinetic energy of an automobile turns into heat when the brakes are applied.

4. Energy can take many forms.

a. Chemical energy is the energy released when atoms exchange electrons during a reaction. Chemical energy is turned into heat and light during burning.

c. Chemical energy is turned into electrical energy by a battery.
d. Light, heat, electricity, and chemicals are all forms or sources of energy.

5. Most action takes place when energy changes form. Energy can keep changing Form, but it is never destroyed.

F. QUESTIONS:

1. What is energy?

2. What is force?

3. What are the four kinds of force in nature?

4. Name three things that involve electromagnetic force.

5. When is work done?

6. How do you calculate the amount of work done?

7. What is the unit that expresses the amount of work done?

8. Explain the difference between work and power?

9. Which does more work, a train traveling at 125 miles per hour or a bicycle traveling at 3 miles/hour? Which vehicle has more power?

10. What are the names of the units of force, work, and power?

11. What is kinetic energy?

12. What is potential energy?

13. What do heat, light, electricity, and chemical reactions have in common?

14. What does the Law of Conservation of Energy mean?

G. ACTIVITY: Heat Energy (Materials: Rubber band, paper clip)

1. Touch the end of a paper clip briefly to your lips.

2. Quickly straighten the paper clip and touch it to your lips again.

3. How does the temperature of the paper clip change when it is bent?

4. Hold a rubber band with you thumbs and index fingers. Touch the rubber band briefly to you lips.

5. Quickly stretch the rubber band and touch it to your lips again.

6. How does the temperature of the rubber band change when it is stretched?

7. You used energy to bend the paper clip. What happened to that energy?

8. You used energy to stretch the rubber band. What happened to that energy?

9. What seems to eventually happen to energy?

H. KEY FACTS AND CONCEPTS:

1. Energy is the ability to do work.

2. Force is a push or a pull.

3. The unit of force is the newton.

4. Four main force act in nature: gravity, strong nuclear force, weak nuclear force, and Electromagnetic force.

5. Work is done when force act over a distance.

6. The unit of work and energy is the joule.

7. Power is the rate at which work is done or energy is used.

8. A watt of power is equal to one joule or energy used per second.

9. Kinetic energy is the energy of motion.

10. Potential energy is stored energy.

11. Energy can neither be created nor destroyed.

12. Light, heat, and electricity are all forms or sources of energy.

13. Energy eventually takes the form of heat.