7th Grade Forces and Energy

Chapter 4: Energy

Lesson 1 (What is Energy?)

- <u>Work</u> force exerted on an object that causes it to move in the same direction of the applied force
 - If the object does not move, no work is done, no matter how much force is applied.
 - For work to be done, the object must move in the same direction as the force.
 - The amount of work done depends on the amount of force you exert and the distance the object moves.

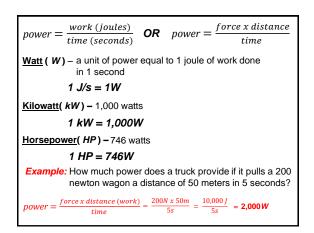
work = force x distance

Example: If you lift a 5-newton trumpet up 0.5 meters, you do <u>2.5J</u> of work.

 $w = f x d = 5N x 0.5m = 2.5N \cdot m$ (or 2.5 joules, or 2.5J)

Joule – unit of work
- the amount of work you do when you exert a
force of 1 newton to move an object a
distance of 1 meter
Power - the rate at which work is done

- the amount of work done on something in a certain amount of time
- An object that has more power than other objects does more work in the same amount of time, or does the same amount of work in less time.



Energy – the ability to do work or cause change		
 When you do work on an object, some of your energy is transferred to that object. 		
 You can think of work as "the transfer of energy". 		
 Both work and energy are measured in <i>joules</i>. 		
Kinetic energy – energy that an object has due to its motion		
 depends on the object's speed and mass 		
 The faster an object moves, the more kinetic energy it has. 		
 Kinetic energy also increases as mass increases. 		

Kine	etic Energy = $\frac{1}{2}$ x Mass x Speed ²	
Example:	A boy is pulling a 12 <i>kg</i> wagon at a speed of 1.5 <i>m</i> /s. What is the kinetic energy of the wagon?	
KE = ½ x 1	2 kg x (1.5 m/s) ² = 13.5 kg•m ² /s ² = 13.5 joules	
Potential energy – energy that results from the position or shape of an object		
	 also is the internal stored energy of an object, such as energy stored in chemical bonds 	
	 This stored energy is held in readiness and has the potential to do work. 	

Gravitational potential energy

- energy that depends on the height of an object
- is equal to the work done to lift the object to that height
- The force you use to lift an object is equal to its weight.

gravitational potential energy = work done

AND work = force x distance

SO

gravitational potential energy = force x distance

AND force = weight

AND

distance = height

SO

gravitational potential energy = weight x height Example: If a book that has a weight of 13N is lifted 2.6 meters off the ground, how much potential energy does it have? gravitational potential energy = 13N x 2.6m = 33.8 joules How much work was done on the book? work = force x distance = 13N x 2.6m = 33.8 joules elastic potential energy - the energy of stretched or compressed objects

Lesson 2 (Forms of Energy)

mechanical energy – the form of energy associated with the motion, position, or shape of an object

 is a combination of its potential and kinetic energy

mechanical energy = potential energy + kinetic energy

Example: A 5*N* ball is flying through the air at 20*m*/s at a height of 8 meters off the ground. What is the ball's mechanical energy?

potential energy = weight x height = $5N \times 8m = 40$ joules kinetic energy = $\frac{1}{2} \times mass \times speed^2 = \frac{1}{2} \times 5N \times (20m/s)^2 = 1,000$ joules

Mechanical energy = PE + KE = 1,040 joules

Types of Energy Associated With the Particles of Objects: 1. Nuclear Energy – the potential energy stored in the nucleus of an atom - This energy is released during a nuclear reaction. nuclear fission – a nuclear reaction in which the nucleus of an atom splits - Nuclear power plants use fission reactions to produce electricity. nuclear fusion – a nuclear reaction in which the nuclei of atoms join together

 This occurs in the sun, releasing huge amounts of energy in form of heat and light.

2. <u>Thermal Energy</u> –	the total kinetic and potential energy of all the particles of an object	
-	Adding heat causes particles to move faster (more kinetic energy), so the higher its temperature, the more thermal energy an object has.	
 <u>Electrical Energy</u> – the energy of charged particles in an object 		
-	 - <u>can be kinetic energy</u> if the particles are moving through a conductor (current electricity) or <u>can be potential energy</u> if they are not flowing, but could move at any time (static electricity) 	

4. Electromagnetic Energy

- the energy of light and other forms of radiation, which travels through space as waves
- caused by vibrating electric charges
- This energy does not require a <u>medium</u> (something to carry it), so it can travel through empty space.

Examples: visible light, microwaves, x-rays, ultraviolet (UV) rays, infrared (heat) waves, radio waves

5. Chemical Energy

- potential energy stored in bonds between atoms and molecules

 When chemical bonds are broken during chemical reactions, the stored (potential) energy is often released and can be used to do work.

Examples: energy in batteries, foods, matches,

fuels, and energy in your cells

Lesson 3 (Energy Transformations and Conservation)

All forms of energy can be transformed (changed) into other forms of energy.

Energy transformation:

- a change from one form of energy to another
- Sometimes one form of energy needs to be changed into another form to get work done.
- Some energy changes involve single transformations, while others involve many transformations.

Law of Conservation of Energy:

- Energy cannot be created or destroyed, only changed to other forms.
- When one form of energy is transformed to another, no energy is lost in the process.
- The total amount of energy is the same before and after any transformation.