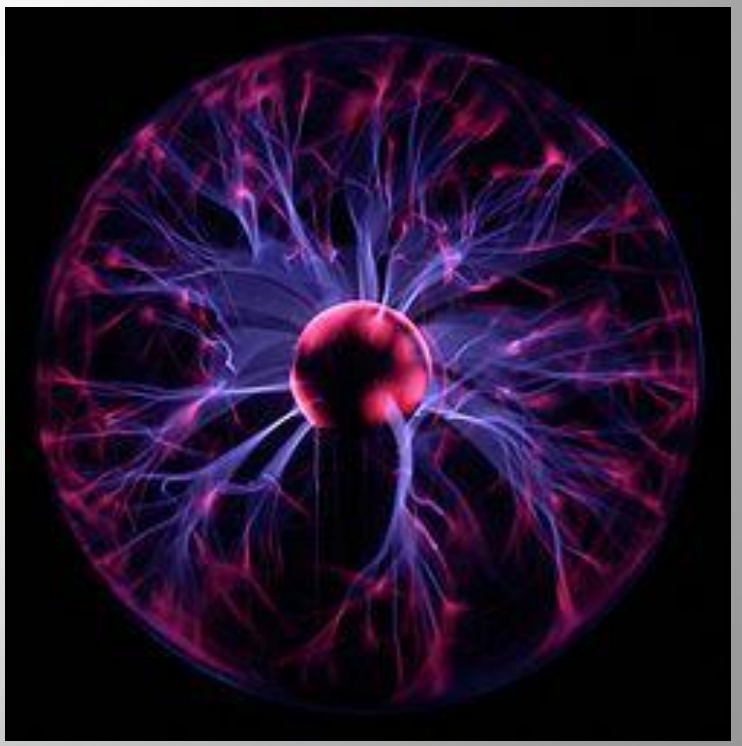
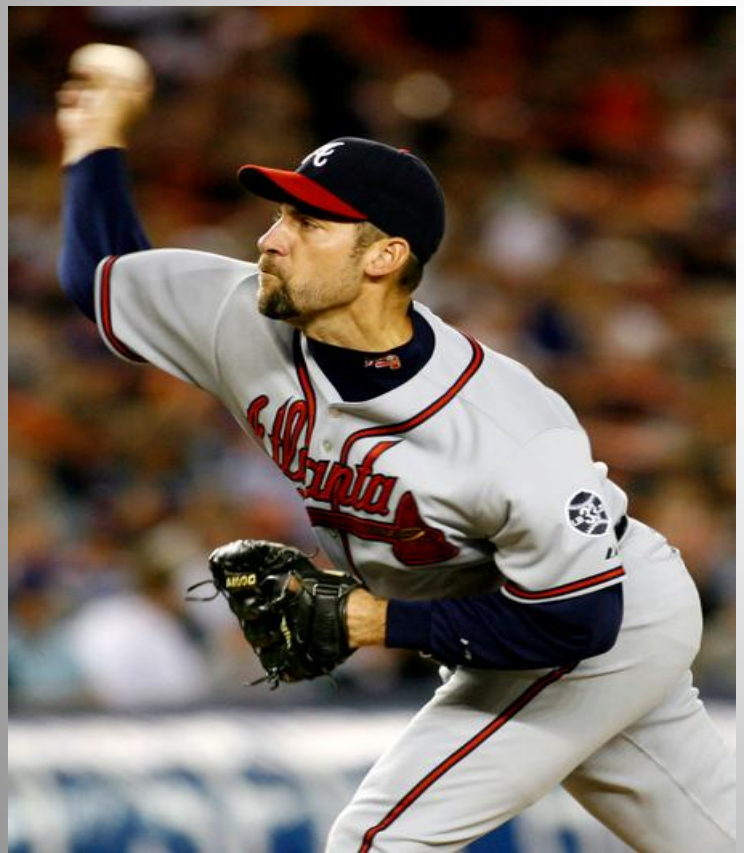
Notes: Energy

Energy: The ability to do work and the ability to cause change



Work: occurs when a force causes an object to move in the direction of the force

-Work and Energy are expressed in joules (J)

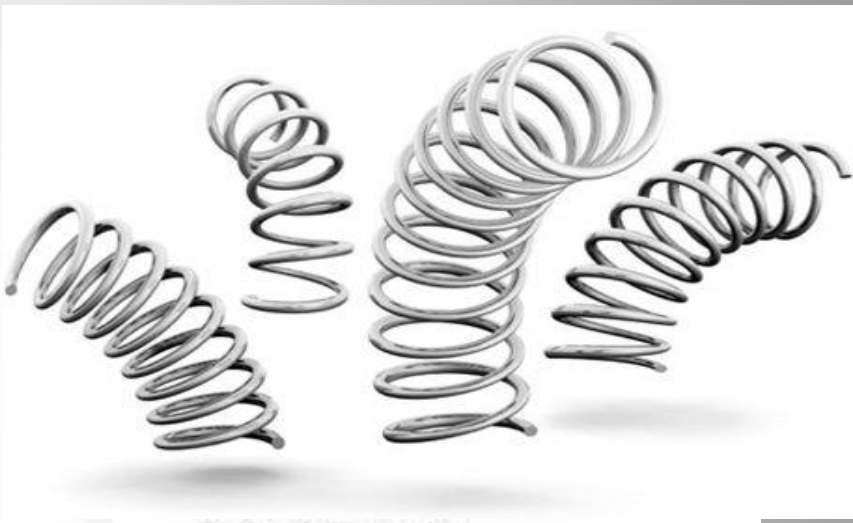


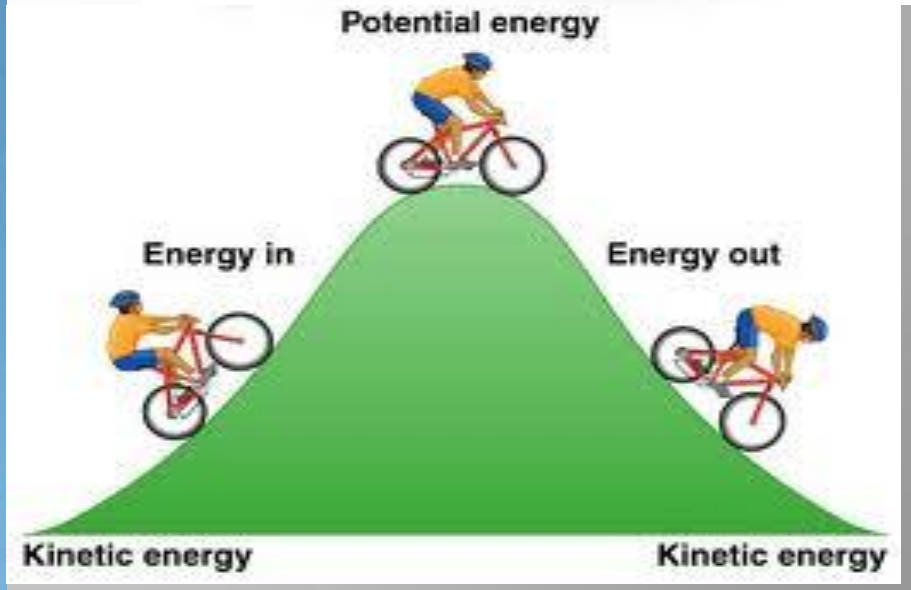
Kinetic Energy: energy of motion

- Objects with kinetic energy can do work
- The faster it moves the more kinetic energy
- The more massive it is the more kinetic energy
- Speed has a greater effect on kinetic energy than mass does
- **$KE=\frac{mv^2}{2}$**

Potential Energy: energy an object has because of its position or shape

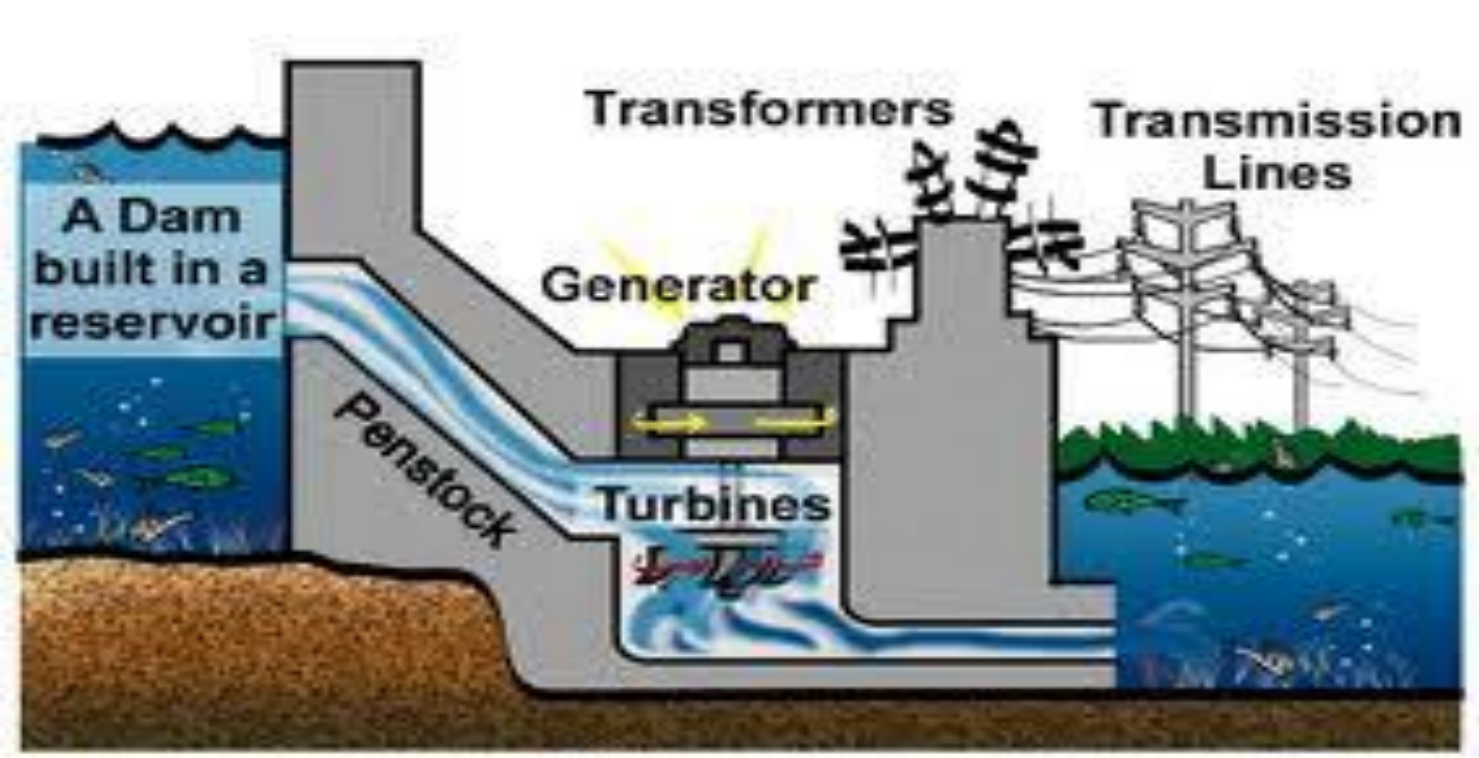
PE=M x g (gravity) x H



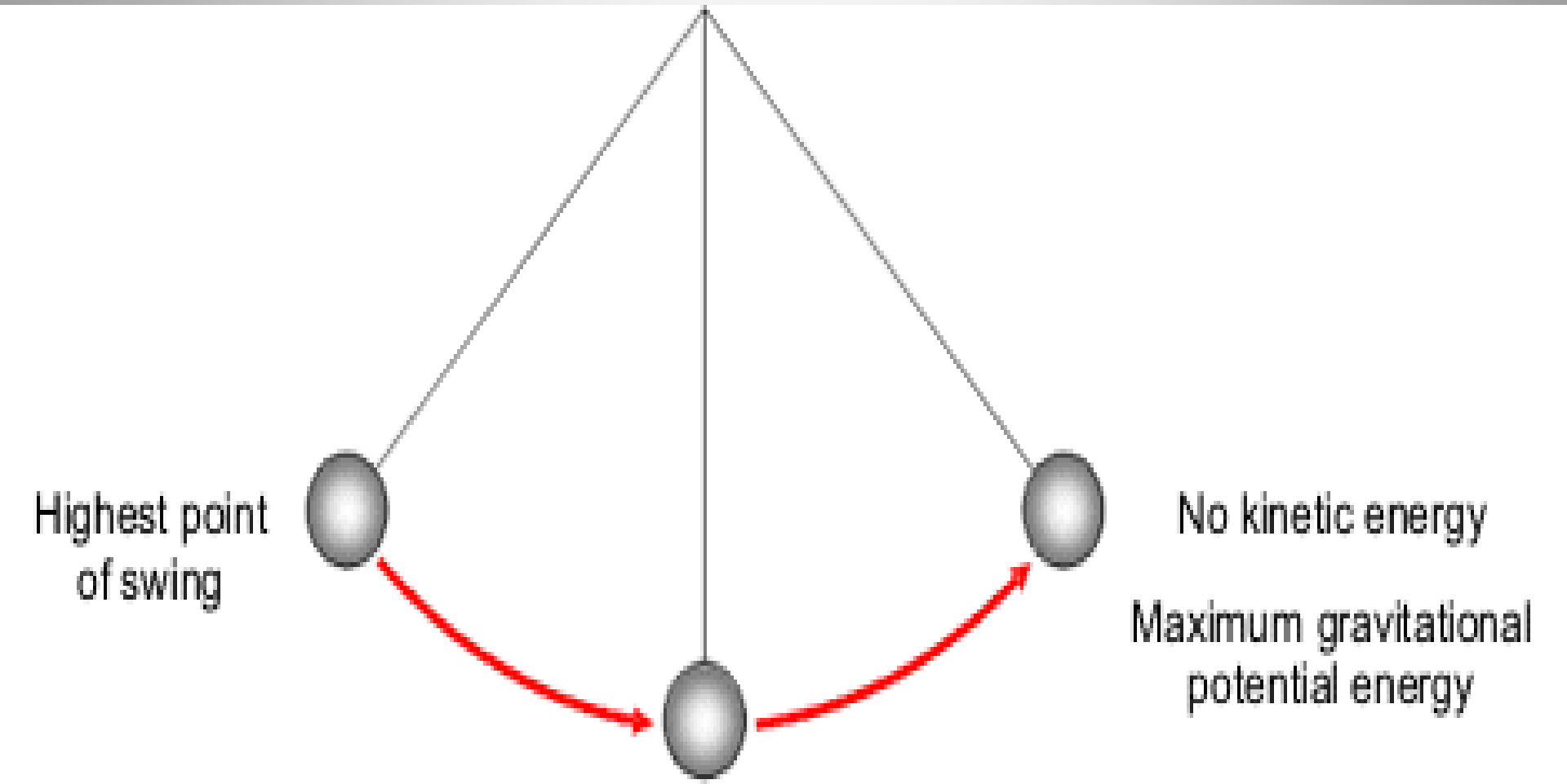


Mechanical Energy:

- Total Energy of motion and position of an object
- Potential energy + Kinetic energy
- Can be all potential, all kinetic, or some of each



The law of conservation of energy: energy can neither be created or destroyed



- Potential energy depends on mass, gravity, and the height of an object
- Gravitational Potential Energy = mass X gravity X height
  - *m X g X h* or weight X height (why?)
  - Weight is expressed in Newtons (N) mass X Gravity (9.8 m/sec)

1. A 37 N object is lifted to a height of 3 meters. What is the potential energy of this object
2. A 30 kg child climbs 15 meters up a tree. When he stops to have a look around, what is the child's potential energy

A 37 N object is lifted to a height of 3 meters. What is the potential energy of this object?

1. Identify the information given to you in the problem:
    - weight = 37 N
    - height = 3 meters
2. Insert the information into the gravitational potential energy formula:
    - GPE = weight x height
    - GPE = 37 N x 3 meters
3. Solving the problem gives a potential energy value of 111 J

A 30 kg child climbs 15 meters up a tree. When he stops to have a look around, what is the child's potential energy?

1. First we identify the information provided in the problem:

- **mass = 30 kg**
- **height = 15 meters**

2. Right away, you should note that you are not given the weight of the child, but rather the mass. First you must convert the child's mass to his corresponding weight on Earth.

- **weight = mass x gravity**
- **weight = 30 kg x 9.8 m/sec^2**
- **weight = 294 N**

3. Now, insert the information for weight and height into the gravitational potential energy formula:

- **GPE = weight x height**
- **GPE = 294 N x 15 meters**

4. Solving the problem gives a potential energy value of

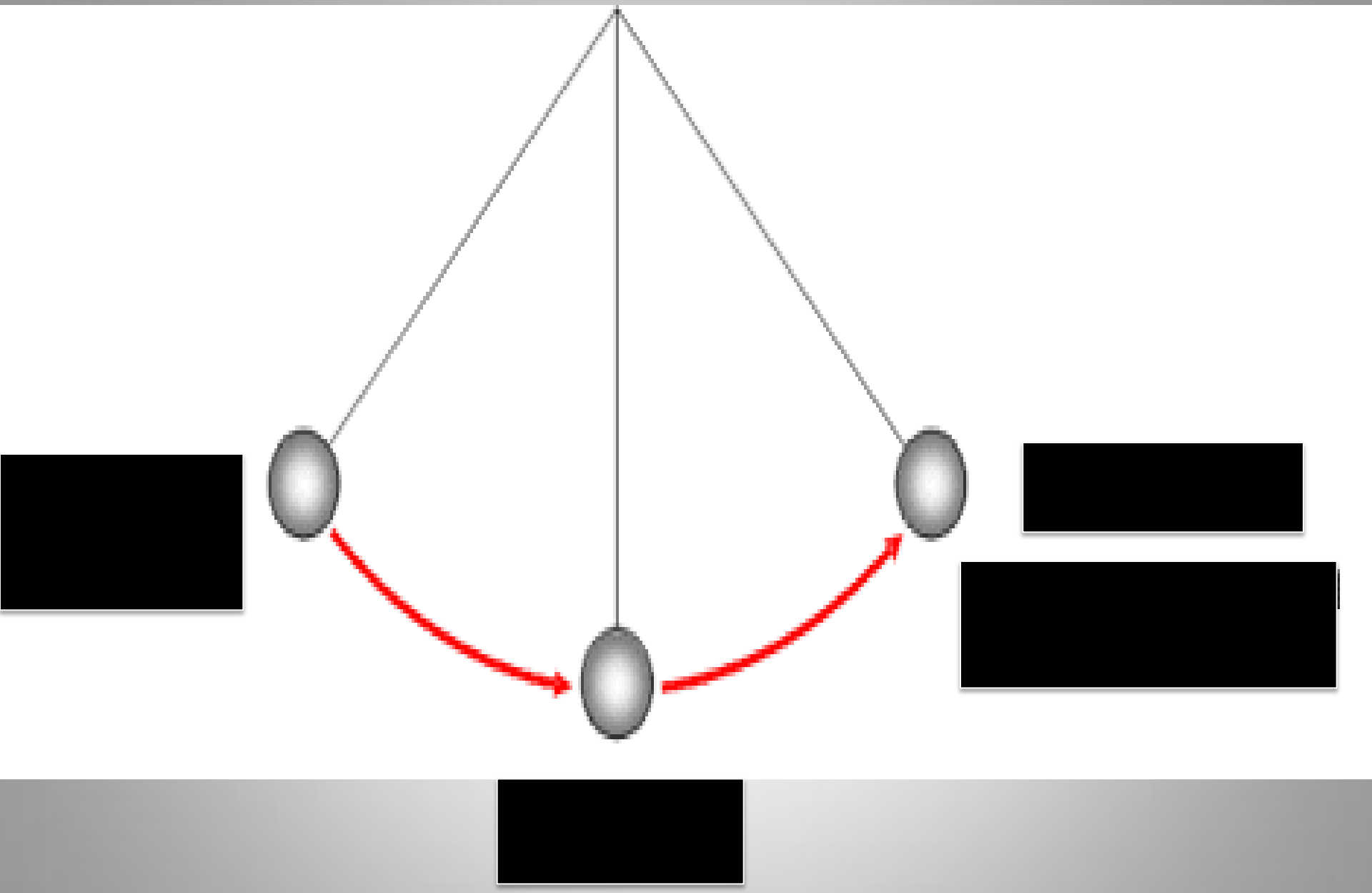
Kinetic energy depends on speed and mass

$$\text{kinetic energy} = \frac{mv^2}{2}$$

kinetic energy is measured in joules (J)

$$\text{kinetic energy} = \frac{mv^2}{2}$$

1. A sprinter with a mass of 100 kg and a velocity of 10 m/s.
2. An arrow with a mass of .02 kg and a velocity of 100 m/s.
3. A car with a mass of 1000 kg and a velocity of 20 m/s.
4. A train with a mass of 1,000,000 kg and a velocity of 30 m/s.
5. A 500 gram ball traveling at 10 m/s.



Identify the following as having either potential or kinetic energy:

Coal

Mr. Dawson rolling down a hill

The ball flying through the air

burning coal

A thrown baseball

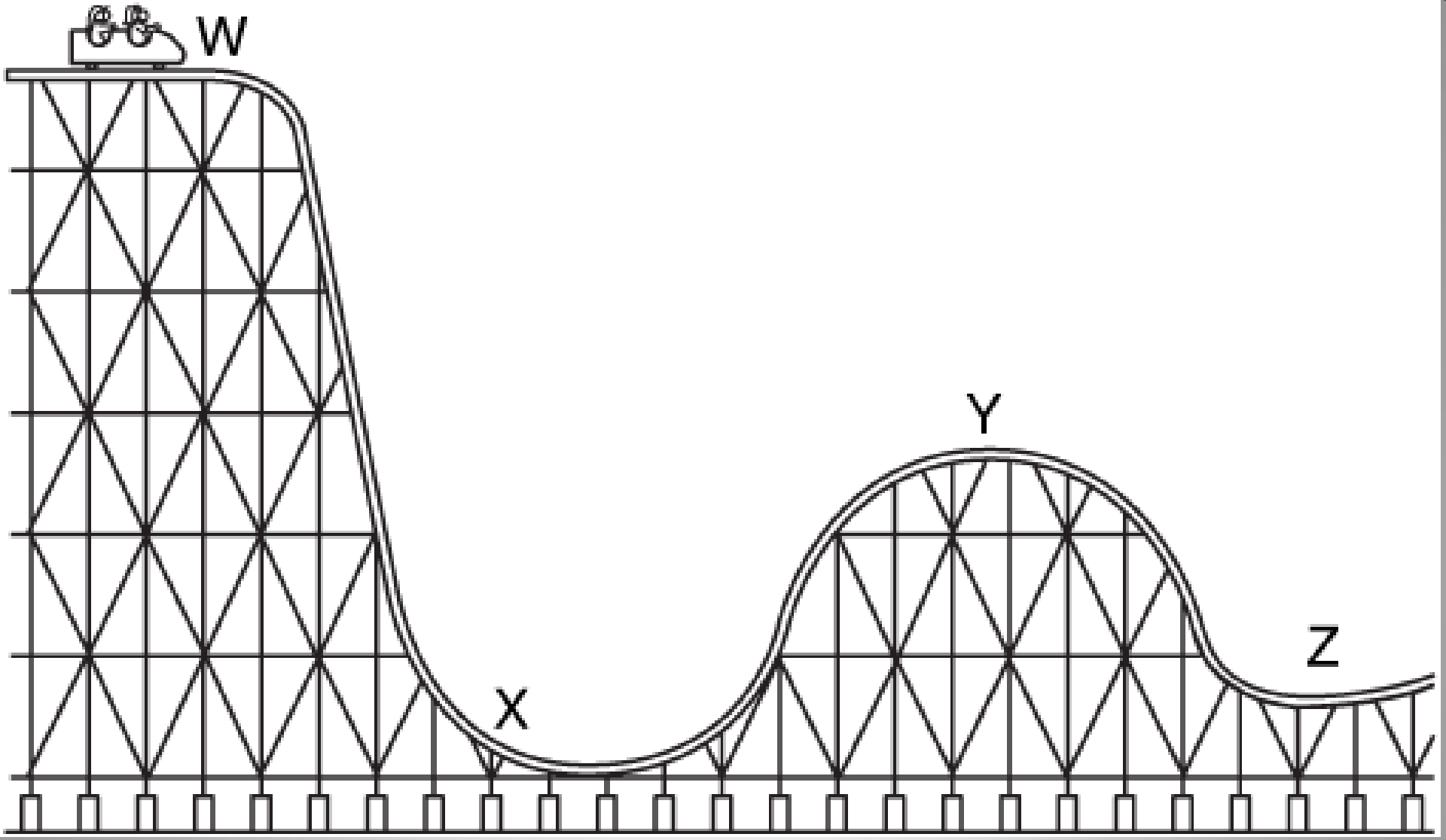
a lit match

a car racing up a hill

Mr. Curtright swinging on a swing

Humpty dumpty sat on a wall

Humpty dumpty had a great fall


W
X
Y
Z

Identify the following as having more or less potential and kinetic energy:

1. **A. A .5 Kg ball sitting 2 meters off the ground**

   B. A .2Kg ball 15 meters in a tree

2. **A. A 50 Kg dog moving at 20 m/s**

   B. a 20 Kg dog moving 40 m/s

3. **A. A 2N flag at the top of a 15 meter pole**

   B. A 1N flag at the top of a 20 meter pole

On your paper

- Draw yourself jumping on a trampoline. Place yourself:
  - On the trampoline stretched almost to the ground
  - In the air just after you leave the trampoline
  - In the air at the top of the jump
- Identify min/max potential energy and min/ max kinetic energy

GPE and KE Examples

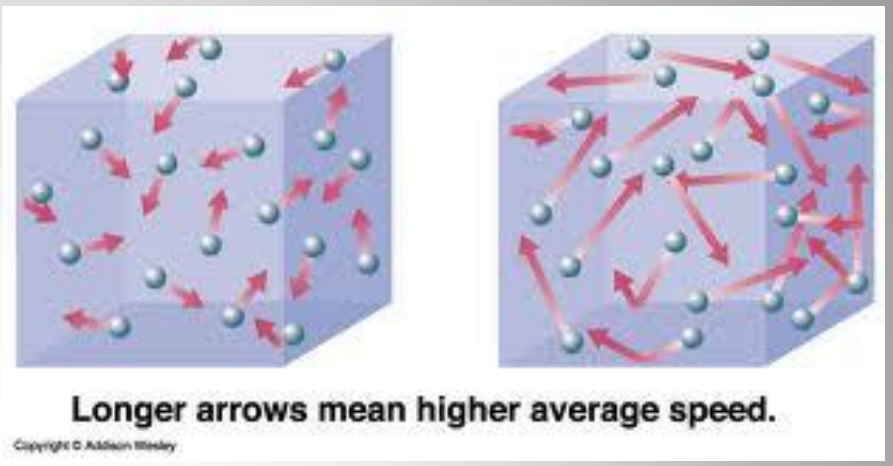
- http://www.youtube.com/watch?v=qZ4FFWvZtyo
- http://www.youtube.com/watch?v=Jnj8mc04r9E&feature=related

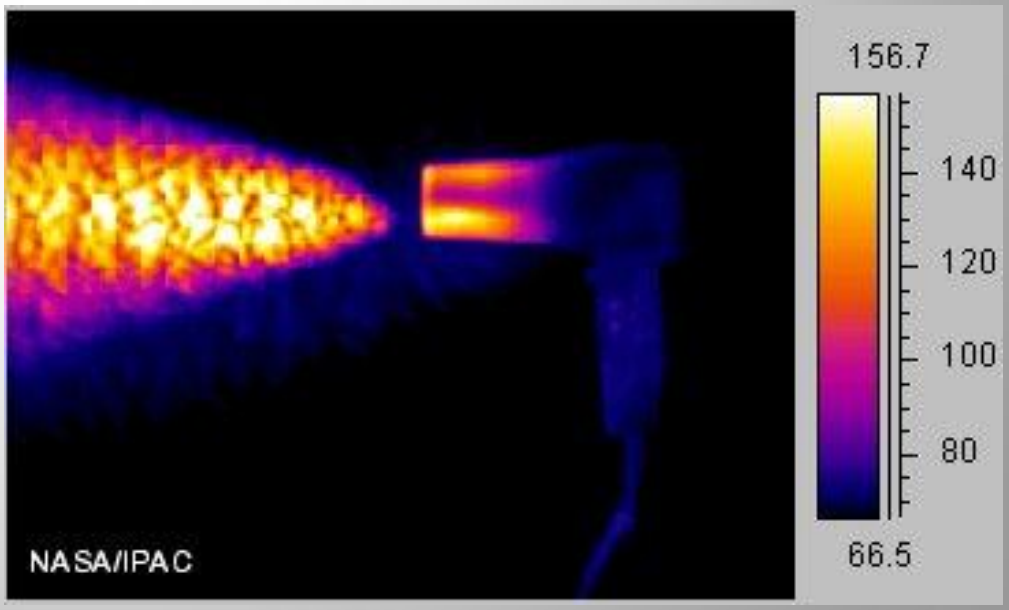
BrainPop

- http://www.brainpop.com/science/energy/potentialenergy/
- http://www.brainpop.com/science/energy/kineticenergy/

Thermal Energy

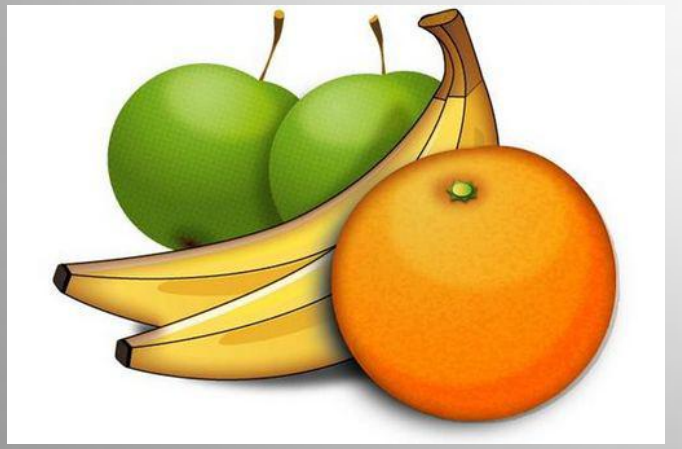
- Total energy of the particles that make up an object.
- All particles of matter are in motion
- Kind of Kinetic energy
- Particles move faster at higher temperatures.
- The faster the particles move, the greater the kinetic energy and the greater the object's thermal energy.





Chemical Energy

- potential energy of a compound
- Energy that is stored in the chemical composition of matter in chemical energy.
- Energy that is held in chemical bonds

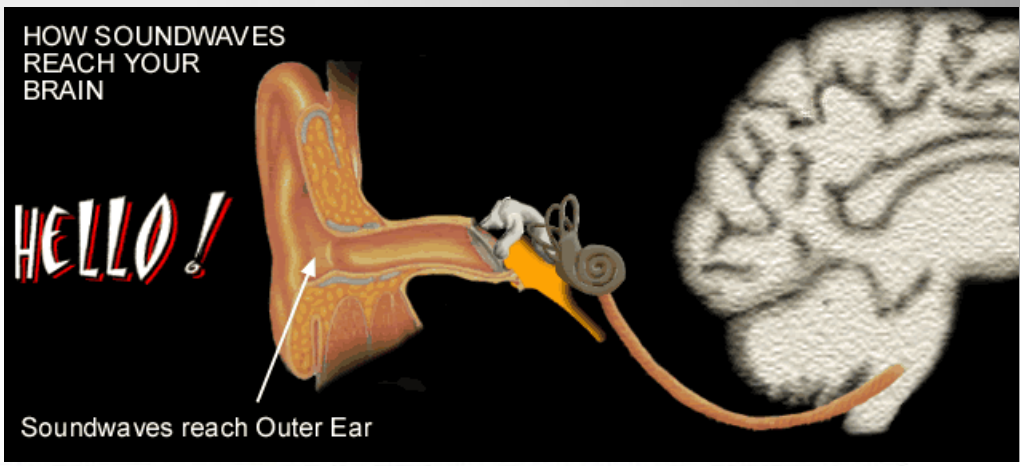


Electrical Energy:

- **the energy of moving electrons**
- **A form of potential and kinetic energy**

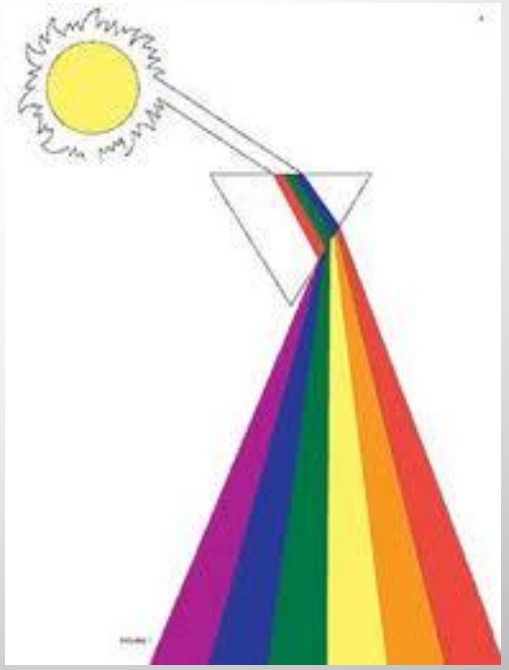
Sound Energy

- an object's vibrations send waves through the air
- Causes other objects to vibrate as sounds are transmitted.



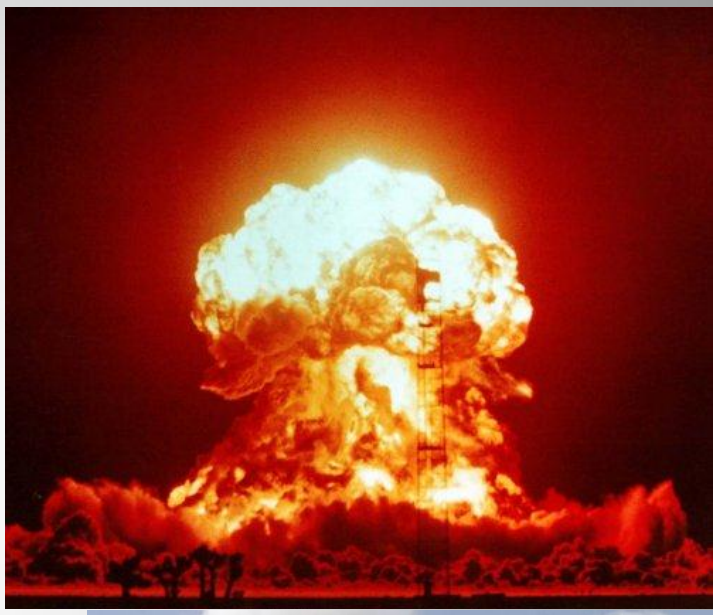
Light Energy

- **Produced by the vibrations of electrically charged particles**
- **Electromagnetic radiation**

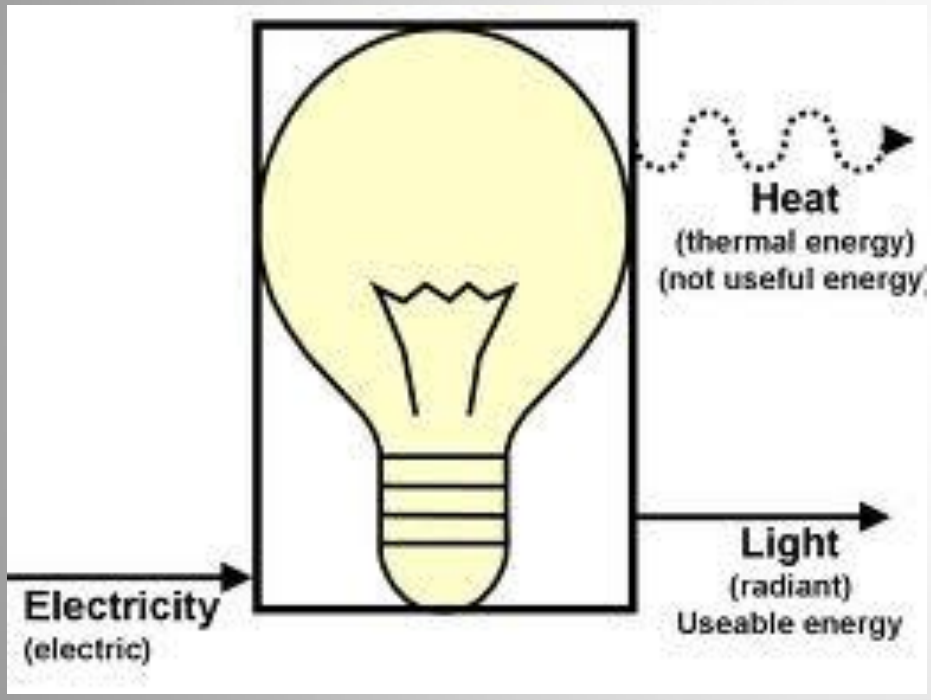


Nuclear Energy

- The energy associated with changes in the nucleus of an atom.
- Can be due to the splitting (fission) or the joining (fusion) of atomic nuclei.
- The releasing of energy from a small loss of mass in an atomic reaction

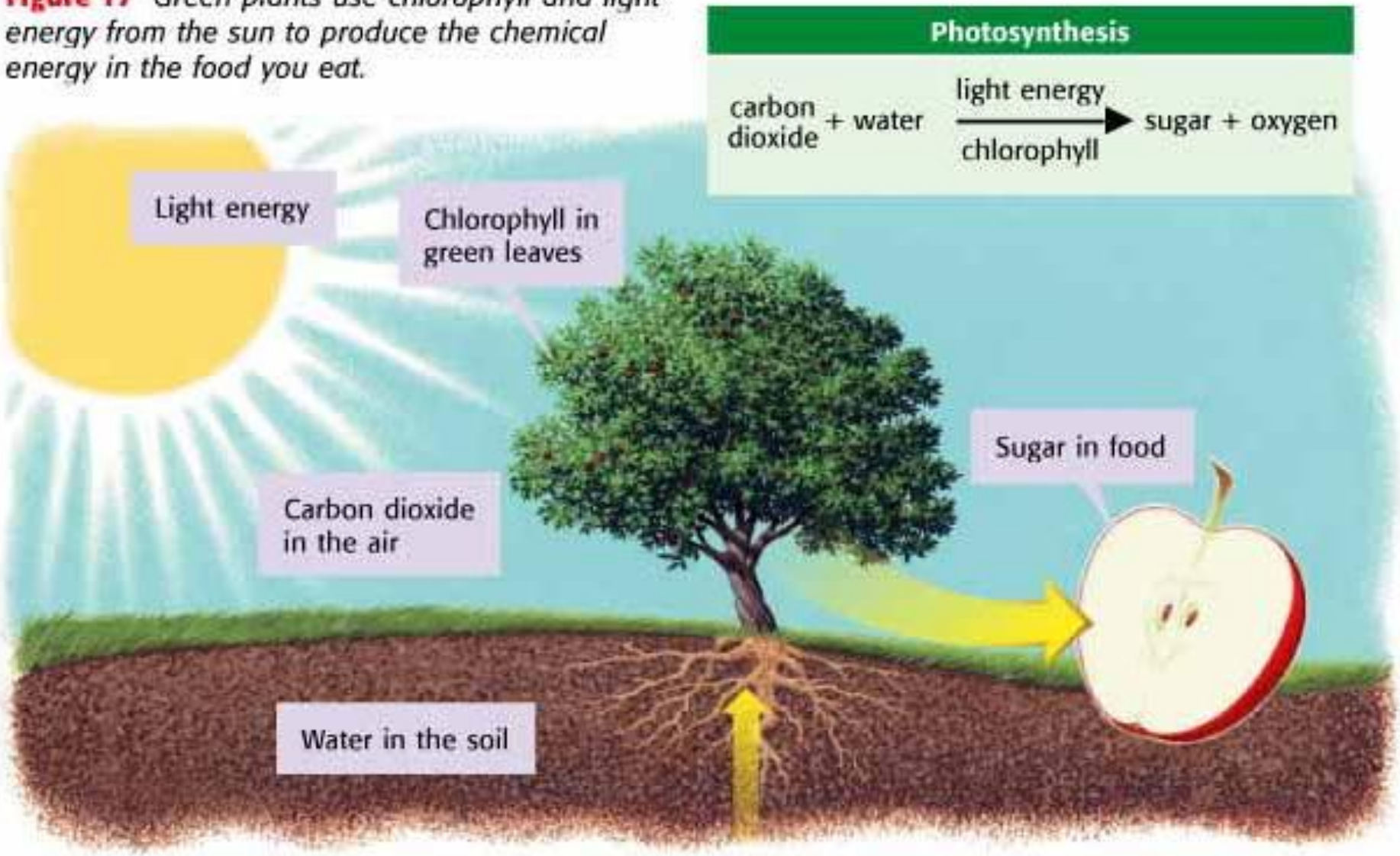


Energy Conversion: a change from one form of energy to another



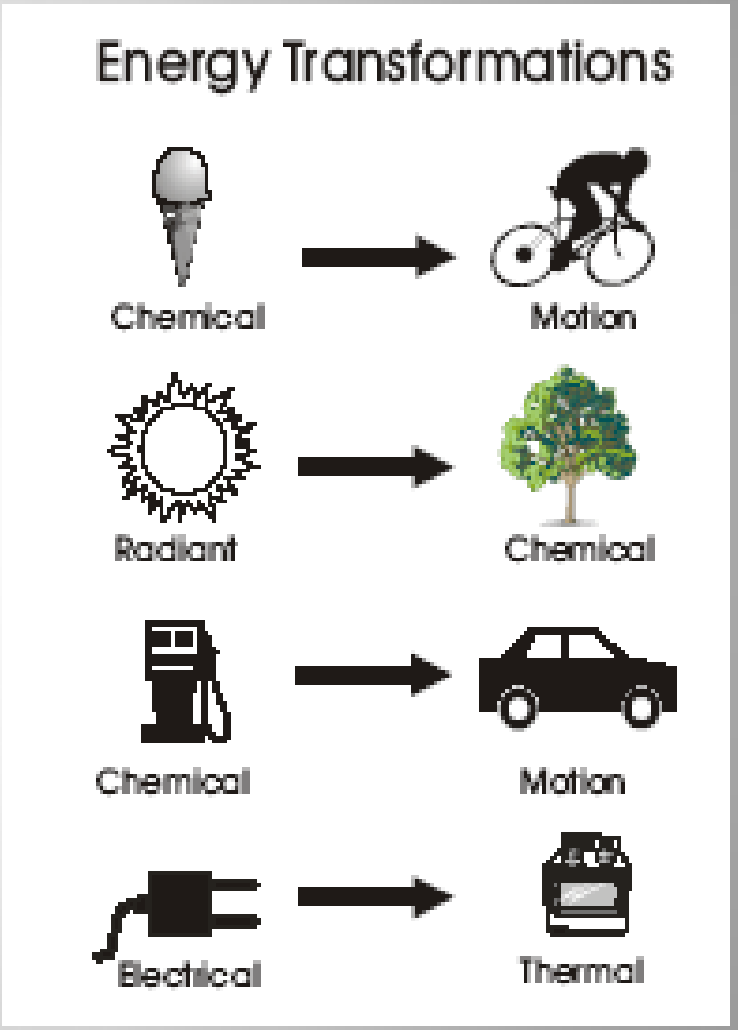
Machines convert energy

Figure 17 *Green plants use chlorophyll and light energy from the sun to produce the chemical energy in the food you eat.*



Conversion

- **There is a balance of energy on the universe**
- **Whenever there is an energy conversion, some unwanted forms of energy can emerge**
  - **<u>Friction</u>**
  - **Thermal energy- caused by friction and is wasted energy because it is not used to do work**
  - **<u>Thermal energy is created in all energy conversions</u>**



Practice

For each of the following examples, tell what type of energy you start with and what type/types of energy you finish with:

1. Hair Dryer
2. Alarm Clock
3. Battery
4. Light Bulb
5. Blender
6. Automobile
7. Your body
8. Lawn Mower
9. Car stereo
10. Television

Temperature: A measure of the average kinetic energy of the particles in an object.

Figure 1 *The gas particles on the right have more kinetic energy than those on the left. So, the gas on the right is at a higher temperature.*

Thermal Expansion: materials expand as their temperature increases

Heat is the transfer of thermal energy between two objects

Energy is always transferred from the higher temperature object to the lower temperature object to reach equilibrium

Conduction: transfer of thermal energy from one object to another through direct contact

Conductor: transfers energy well

Insulator: does not transfer energy well

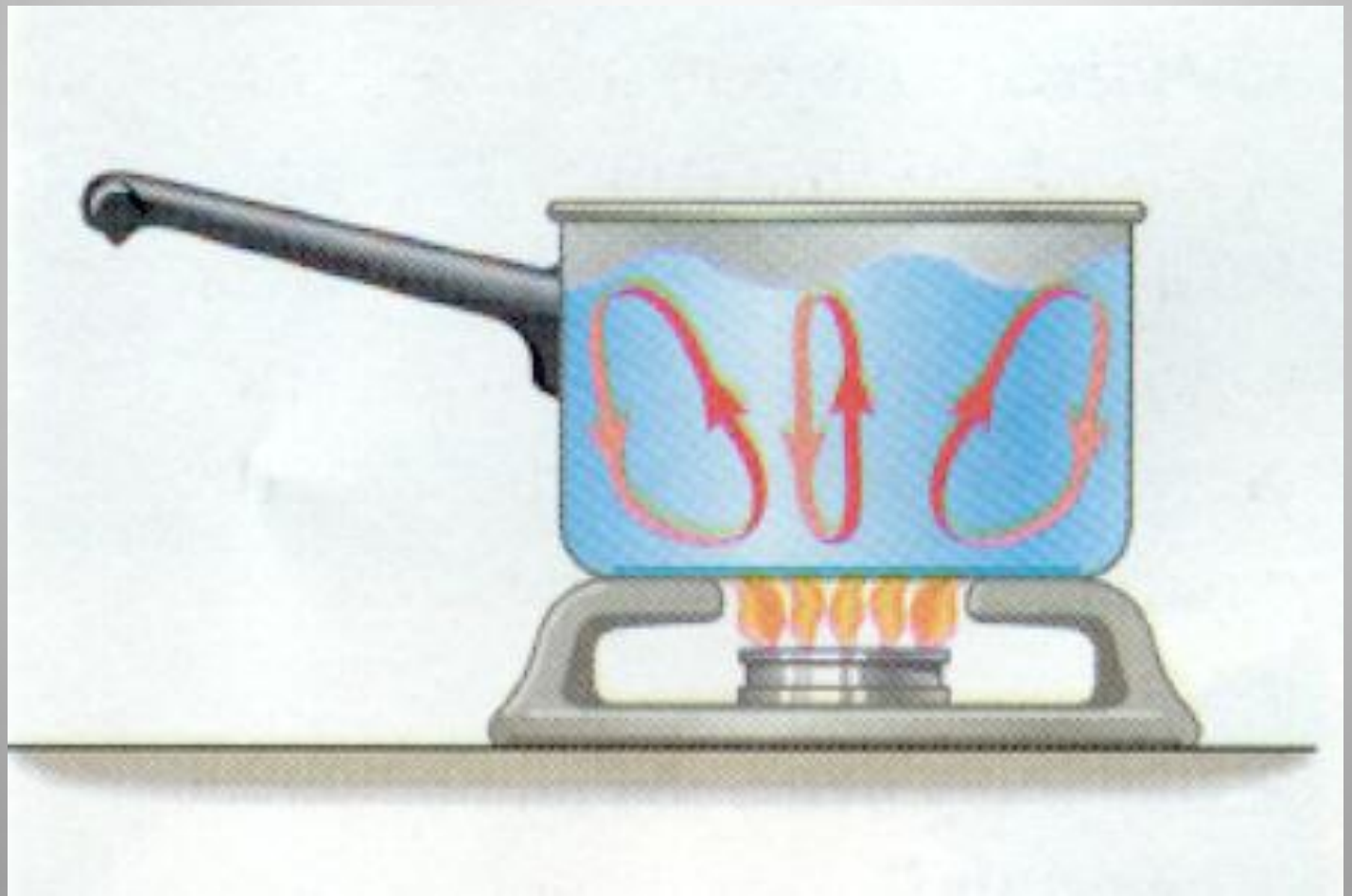
Conductors	Insulators
Curling iron	Flannel shirt
Iron skillet	Oven mitt
Cookie sheet	Plastic spatula
Copper pipes	Fiberglass insulation
Stove coils	Ceramic bowl

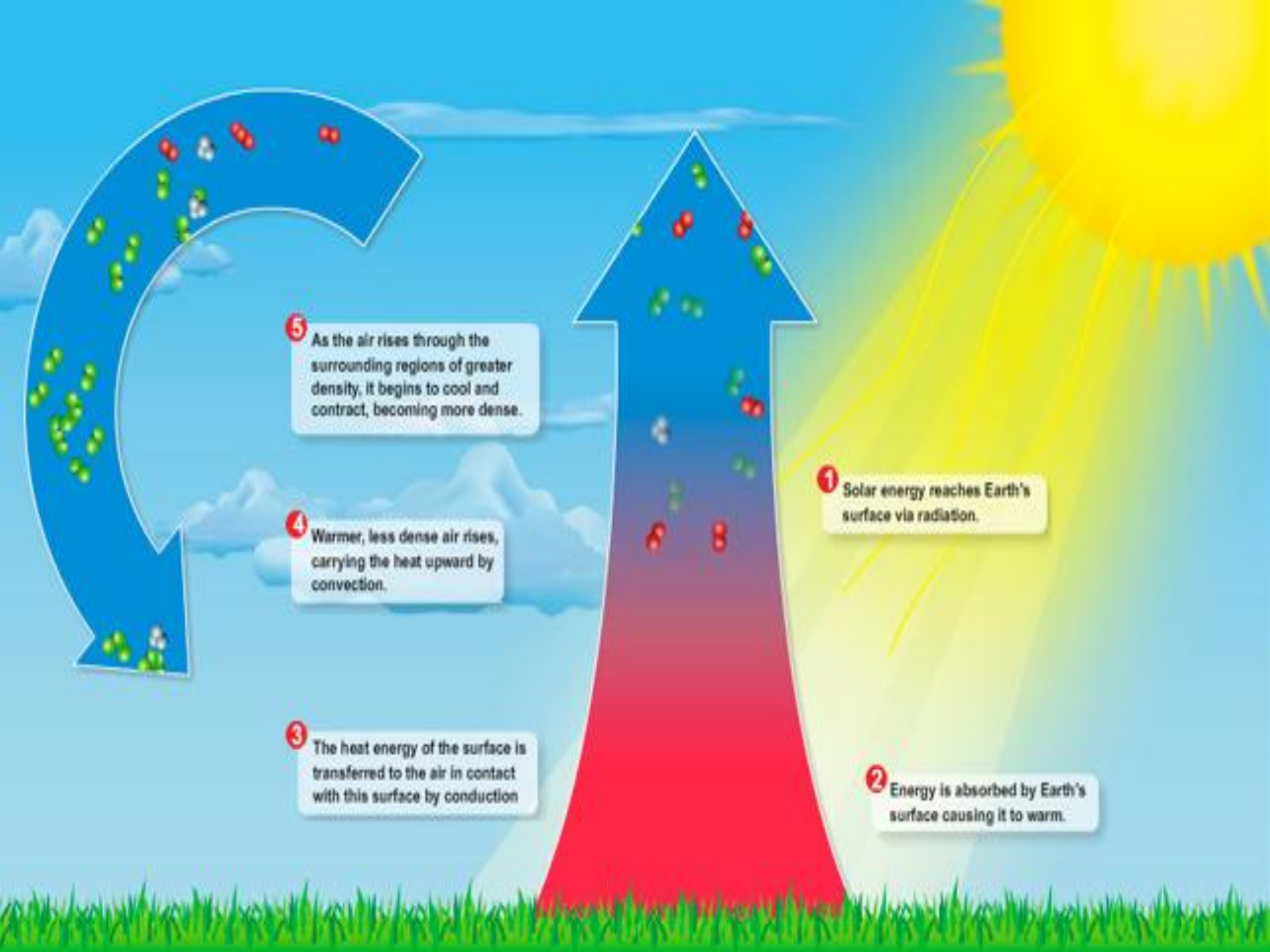
Radiation: transfer of energy through air or space as electromagnetic waves

Dark colors absorb more heat than light colors

this color absorbs more heat	than this color

Convection: transfer of thermal energy by the movement of a liquid or gas




5 As the air rises through the surrounding regions of greater density, it begins to cool and contract, becoming more dense.
4 Warmer, less dense air rises, carrying the heat upward by convection.
3 The heat energy of the surface is transferred to the air in contact with this surface by conduction
1 Solar energy reaches Earth's surface via radiation.
2 Energy is absorbed by Earth's surface causing it to warm.

Project Directions

Fold your paper into fourths. You will have 8 squares (front & back).

In each square, define, give two examples of, and illustrate the following:

1. **Kinetic energy**
2. **Potential energy**
3. **Thermal energy**
4. **Chemical energy**
5. **Electric energy**
6. **Nuclear energy**
7. **Sound energy**
8. **Light energy and YOUR NAME**

Throughout your day, you come into contact with many different forms of energy.

In two paragraphs, describe your daily routine and tell about the different forms of energy you encounter throughout the day. Be sure to include at least 5 times you encounter energy.

Two objects were lifted by a machine. One object had a mass of 2 kilograms, and was lifted at a speed of 5 m/sec. The other had a mass of 4 kilograms and was lifted at a rate of 3 m/sec.

a. Which object had more kinetic energy while it was being lifted?

b. Which object had more potential energy when it was lifted to a distance of 10 meters? Show your calculation.

You are on roller blades on top of a small hill. Your potential energy is equal to 1,000.0 joules. The last time you checked your mass was 60.0 kilograms.

a. What is your weight in Newtons?

b. What is the height of the hill?

c. If you start skating down this hill, your potential energy will be converted to kinetic energy. At the bottom of the hill, your kinetic energy will be equal to your potential energy at the top. What will be your speed at the bottom of the hill?