P. Sci.

Unit 4

Chapter 15

Energy

Energy and Work

- Whenever work is done, energy is transformed or transferred to another system.

- Energy is the ability to do work.

- Remember – work is done only when an object moves.

- But - energy can be present in an object or a system when nothing is happening.

- However – it can only be observed when it is transferred from one object or system to another.

SI Unit of Energy

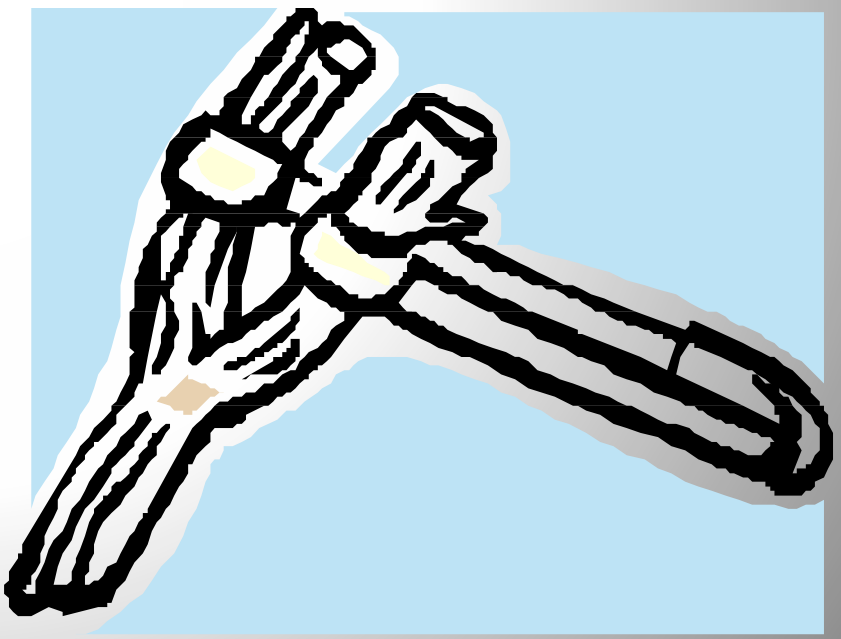
- Because the amount of energy transferred is measured by how much work is done – energy and work are expressed in the same unit.

Joules is unit of energy

Potential Energy

AKA – Energy of Position

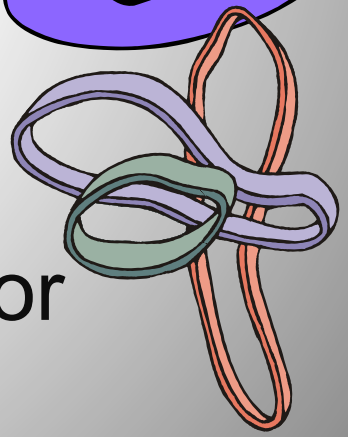
Potential Energy is energy that is Stored.



You can't see it but you know it's

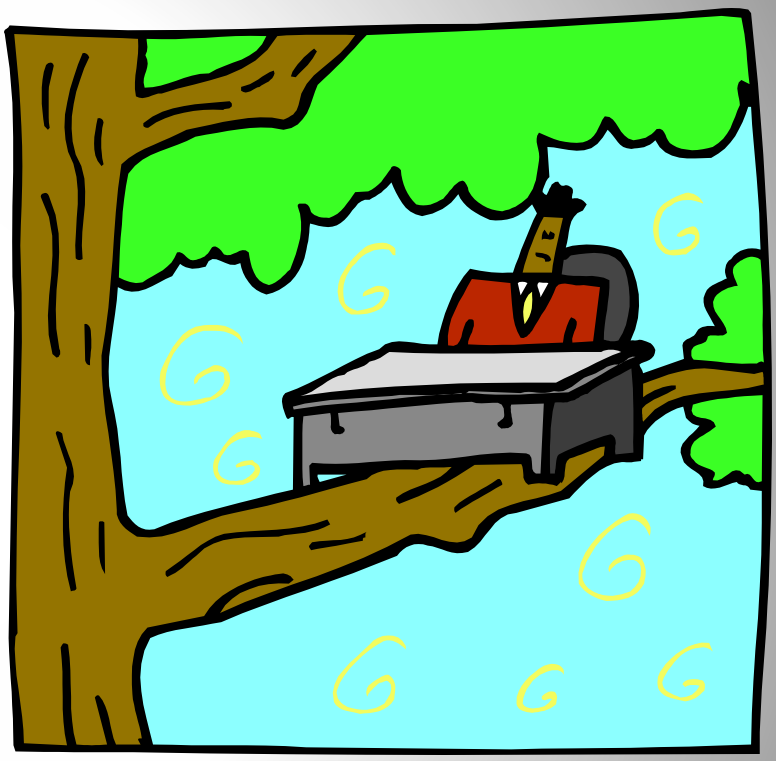
Types of Potential Energy

- Gravitational Potential Energy –Energy stored due to position (objects that are above Earth's surface).
- Chemical Potential Energy – Energy stored in chemical bonds such as food or fuel.
- Elastic Potential Energy – energy stored by something that can stretch or compress such as a rubber band or spring.



Gravitational Potential Energy

AKA - GPE



- Depends on mass and height.
- GPE = m g h

Or

- GPE = mass x free-fall acceleration x height

(mg = weight in Newtons)

Example

- A 65 kg rock climber ascends a cliff. What is the climber's gravitational potential energy at a point 35 m above the base of the cliff?

- 65kg = m

  35 m = h

  $9.8 m/s^2$ = g

  ? = GPE

GPE = mgh

GPE = 65 x 9.8 x 35

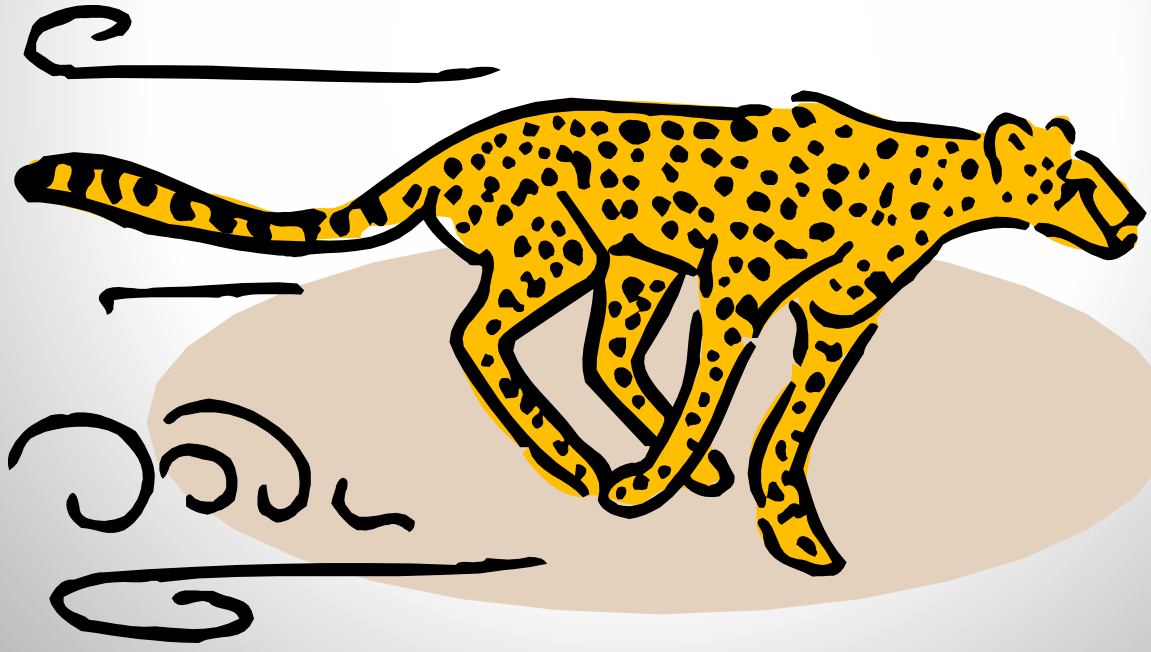
GPE = 22,295 J

Kinetic Energy

- is Energy in motion.

- Note:

  Kinetic energy depends more on speed than on mass.



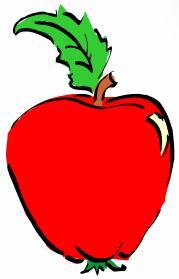
Kinetic Energy

AKA = KE

- KE = ½ mass x velocity ^{2}

OR

KE = ½ m v ^{2}



Example

- What is the kinetic energy of a 44kg cheetah running at 31 m/s?
- 44 kg = m

  31 m/s = v

  ? = KE

$KE = \frac{1}{2} (44) \times (31)^2$

$KE = 22 \times 961$

$KE = 21142\ J$

$KE = \frac{1}{2} m v^2$

Forms of Energy

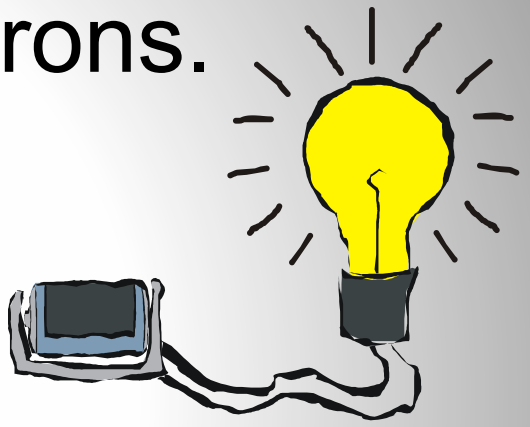
- Forms of Energy

Kinetic	Potential	
Mechanical	Thermal	chemical
Electrical	Electromagnetic	Nuclear

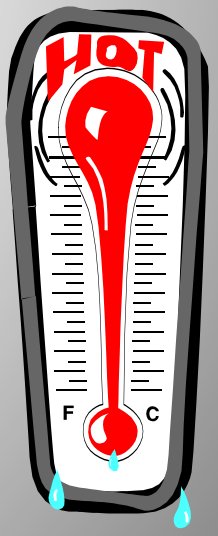
- Each of these forms of energy can be converted into other forms of energy

Forms of Energy

- **Electrical energy**: results from the flow of charged particles or electrons. Electric charges can exert forces that do work

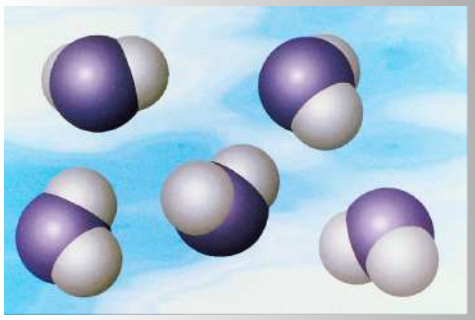


- **Thermal Energy**: energy given off as heat (friction). The total potential and kinetic energy of all the microscopic particles in an object.

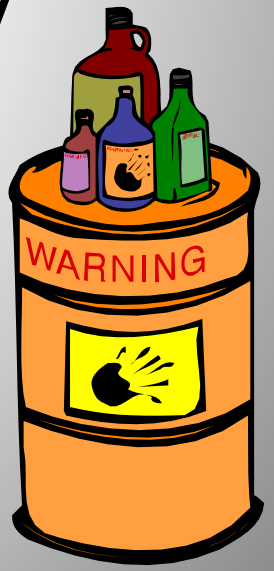


Forms of Energy cont.

- **Mechanical Energy** - is the energy associated with the motion or position of an object. The sum of potential and kinetic energy in a system
  (Usually involves movement of an object)

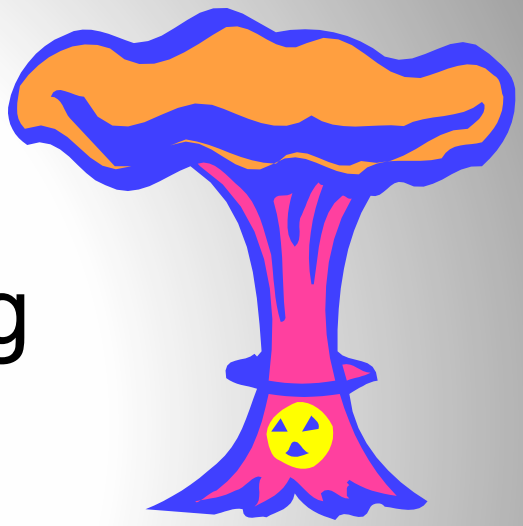


- **Chemical Energy** – is the energy stored in chemical bonds – when the bonds are broken, the released energy can do work.

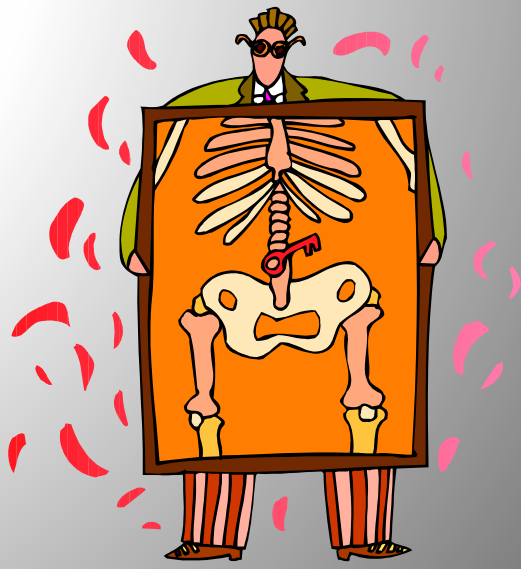


Forms of Energy cont.

- **Nuclear Energy**: energy stored in atomic nuclei – nuclear fission releases energy by splitting nuclei apart, nuclear fusion releases energy by combining 2 nuclei into a larger nuclei.

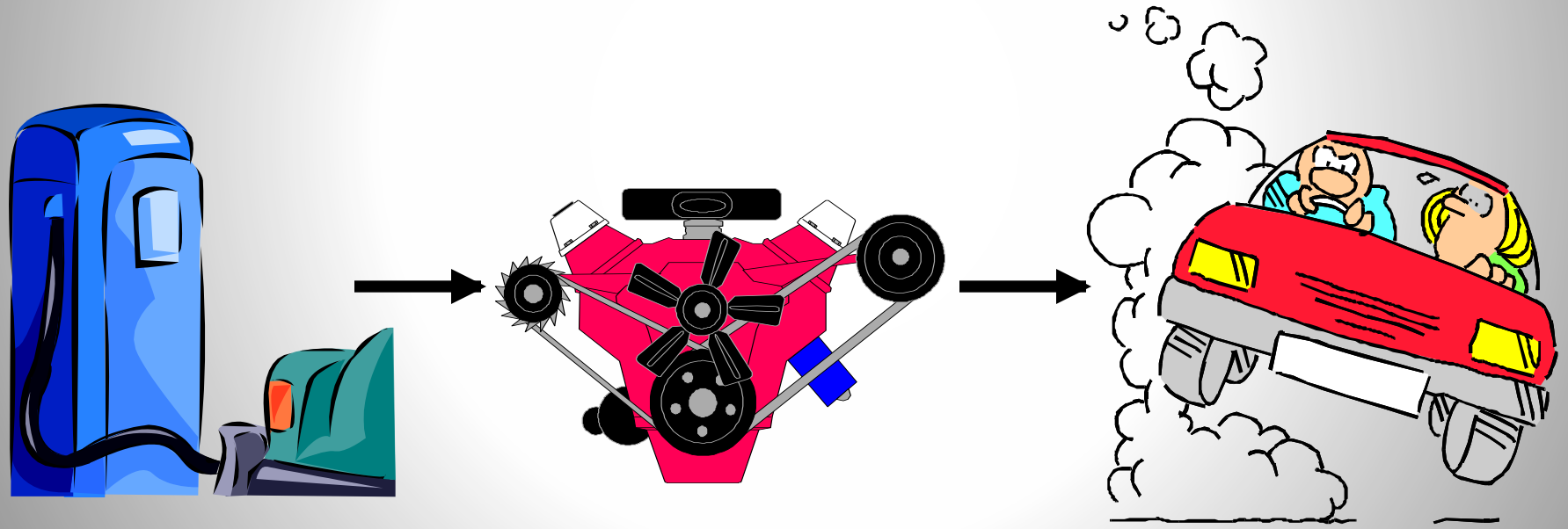


- **Electromagnetic Energy**: a form of energy that travels through space in the form of waves. Visible light and X-rays are examples.



Energy Conversions

- The process of changing energy from one form to another.



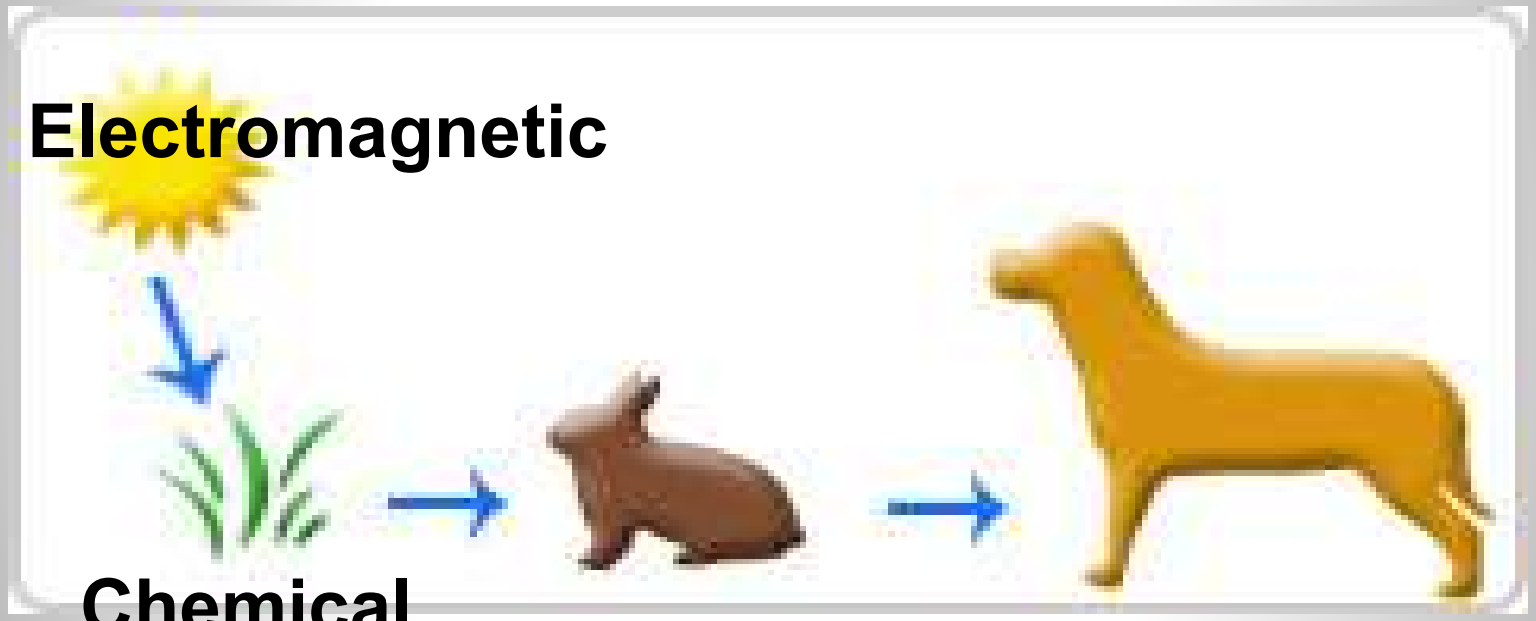
Chemical Mechanical Kinetic

Law of Conservation of Energy

- Energy cannot be created nor destroyed it can only be changed.
- Energy can be transferred to another object/system or to another form (potential to Kinetic)

Identify the energy transformations.

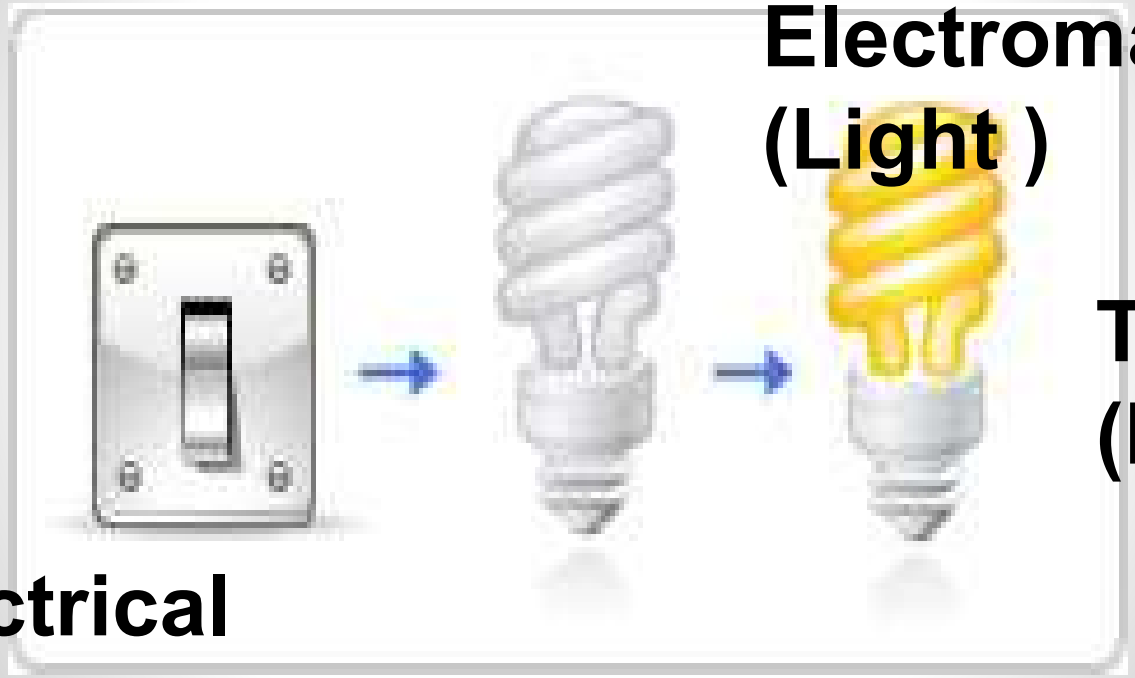
1. **Nuclear**
2. **Electromagnetic**



Chemical

Mechanical (movement & storage)

Identify the energy transformations.

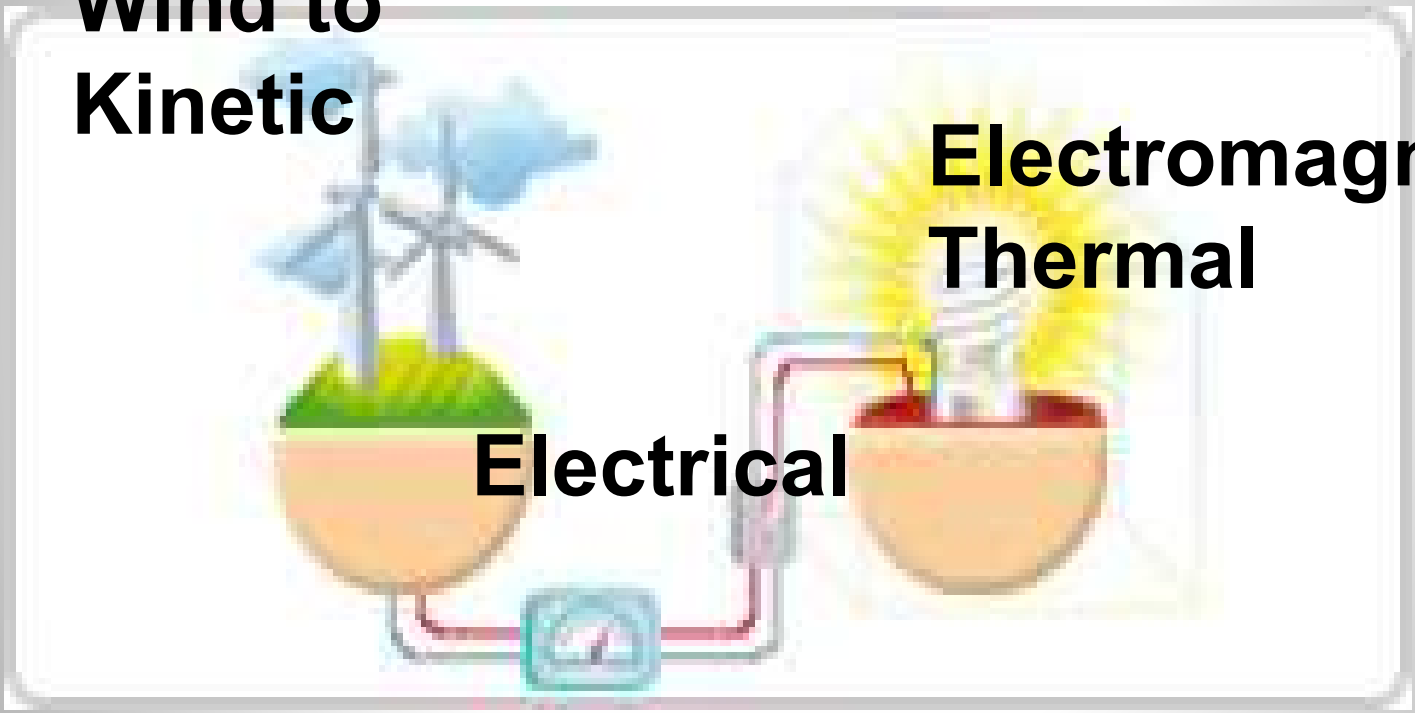


Electrical

Electromagnetic (Light)

Thermal (Heat)

Identify the energy transformations.



Conservation of energy practice

- Recall that mechanical energy is the sum of potential and kinetic energy
- **ME = PE + KE**
- Or $(KE + PE)_{beginning} = (KE + PE)_{end}$
- Potential energy is energy of position
  - **PE= m g h**
- Kinetic energy is energy of motion
  - **KE= ½ m v^2**
- Can use these equations to find unknown information about a system.

Mechanical Energy

http://www.mrwaynesclass.com/energy/coasterANDenergy2.swf

Watch the red bars and how they change as the roller coaster moves throughout the track.

Total Mechanical Energy is CONSTANT
Potential energy is high _____
Kinetic energy is high _____
Potential energy is low _____
Kinetic energy is low _____
What is happening to the energy in the system?

Practice

a) Sitting still at the top of a 40.0 m hill a 68.2 kg car what is the cars potential and kinetic energy

PE = (68.2 kg) (9.8 m/s^2) (40.0m)= 26734.4 J

KE = 0 J (sitting still)

b) What is the mechanical energy of the car at the top of the hill

ME = PE + KE = 26734.4 J + 0 J = 26734.4 J

c) At the bottom of the hill how much potential and kinetic energy does the car have.

PE = (68.2 kg) (9.8 m/s^2) (0m) = 0 J

KE = ME – PE = 26734.4 J - 0 J = 26734.4 J

Thats all for today