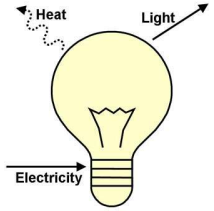
CHAPTER 13.3 & 13.4



ENERGY TRANSFORMATION

In an avalanche, a mass of loose snow, soil, or rock suddenly gives way and slides down the side of a mountain.

Why is an avalanche so dangerous?

The avalanche releases a great amount of energy.

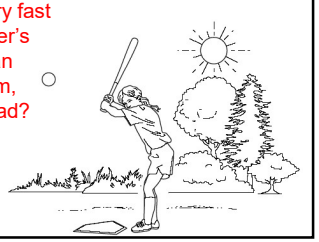
What is Energy?

- Energy is the ability to do work and cause matter to change.
- Energy is measured in **joules (J)**.

What else is measured in Joules?

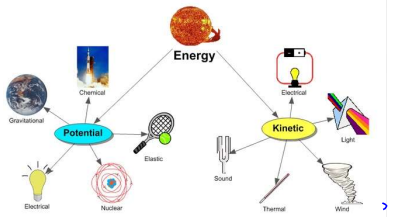
After the girl hits the ball, the ball moves very fast and has energy. When the ball hits the fielder's glove, it stops moving. Given that energy can never be destroyed but merely changes form, what happens to the energy the ball once had?

Energy changes to another form of energy. Ex. Heat from friction



What is Energy?

- There are two types of Energy:
  1. Kinetic Energy
  2. Potential Energy



- In these two types, there are many **different forms** of energy:
  - Chemical, mechanical, sound, thermal, radient, electrical, nuclear, gravitational

Potential Energy

- **Potential energy** is energy that is stored as a result of position or shape.
- Energy in a body of rest
  - Ex: Stretched rubber band, compressed spring

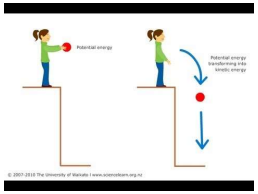


Figure 4. Examples of spring energy

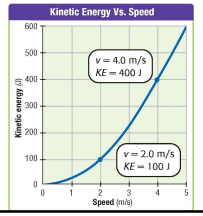
Potential Energy

Potential energy can be increased by
- Increasing height
- Increasing mass
- Increasing distance (stretched)
- Compress more

When this musician pulls the string of her cello to one side, the string is stretched and gains potential energy.

Kinetic Energy

- The energy of motion
- Depends on two things
  - Mass and velocity
- Kinetic energy depends on speed more than mass.



Potential or Kinetic?

Kinetic

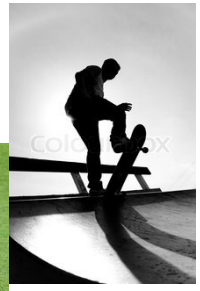
Potential

Potential

Potential or Kinetic?

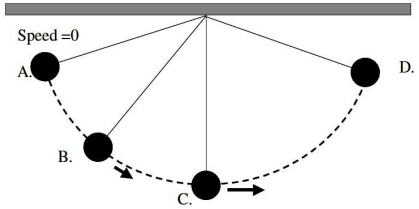
Kinetic

Potential



Potential

Potential and Kinetic Energy Transformation of a Pendulum



Describe the energy transformation from A. to B.

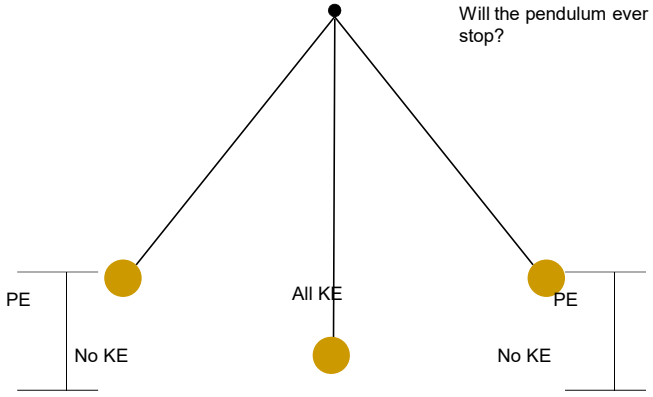
Describe the energy transformation from B. to C.

Describe the energy transformation from C. to D.

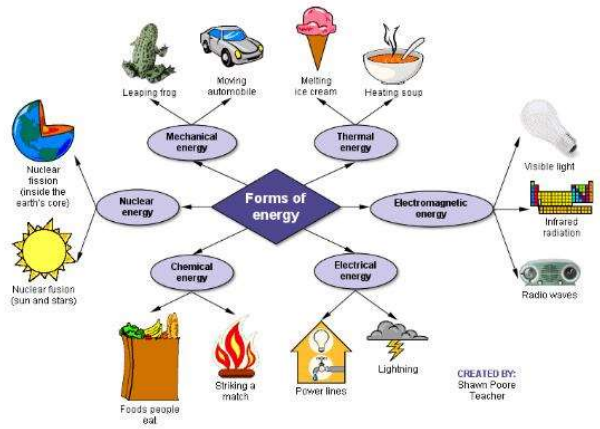
If not pushed, why does the pendulum not go as high when it swings back?

Where does lost potential energy go?

Example: A Pendulum



Forms of Energy



What Forms of Energy Are There?

Stored
Potential Energy

1. Chemical Energy
2. Nuclear Energy
3. Gravitational Energy

Motion
Kinetic Energy

1. Radiant Energy
2. Electrical Energy
3. Mechanical
4. Sound
5. Thermal Energy

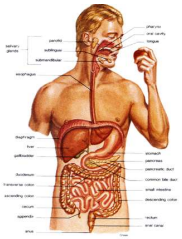
How will we ever remember these?
Just remember the sentence:
Cam Newton got really excited making stinky tacos.

Cam= **Chemical**
Newton= **Nuclear**
Got= **Gravitational**
Really= **Radiant**
Excited= **Electrical**
Making= **Mechanical**
Stinky= **Sound**
Tacos= **Thermal**

1. Chemical = Cam

- Energy stored in the bonds of atoms and molecules.

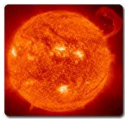
Example: Matches, Digestion, batteries



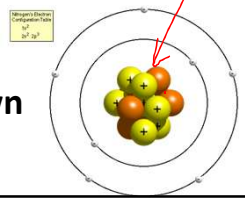
Plants convert sunlight into food.

2. Nuclear =Newton

- Energy stored in the nucleus of an atom. The energy that holds the nucleus together.
- The sun's energy comes from fusion – putting two hydrogen atoms to make helium atoms

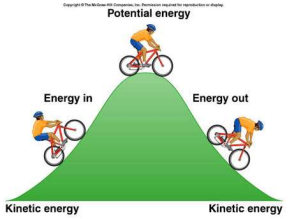


Example:
Breaking down Uranium



3. Gravitational Potential = Got

- Any time gravity supplies the force.
- Higher the position= more gravitational energy. Most often because it is raised off the ground.



Example: two plants at different heights

Gravitational Potential Energy

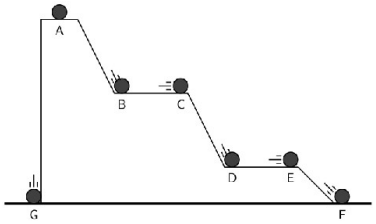
Video Clip

- Dependent on its mass, its height, and the acceleration due to gravity.

Gravitational Potential Energy

- The greater the height the more gravitational potential energy an object has.

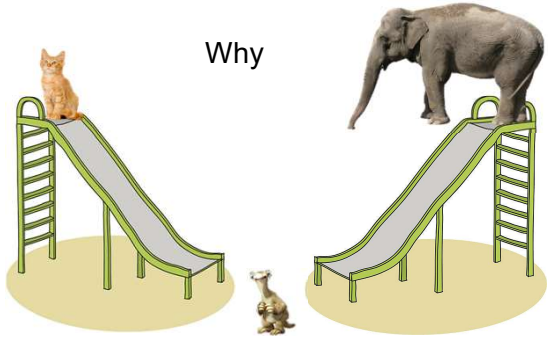
In the image below, where is the greatest GPE found?



Gravitational Potential Energy

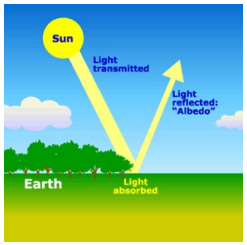
Which has more gravitational potential energy?

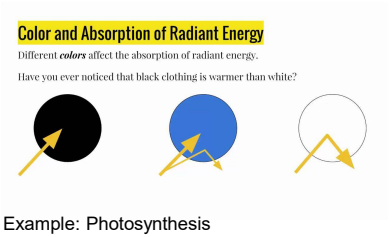
Why



4. Radiant = Really

- Light energy that travels in waves (electromagnetic)

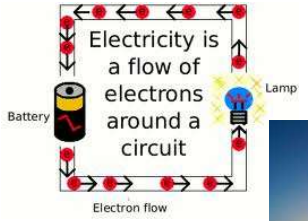




Example: Photosynthesis

5. Electrical = Excited

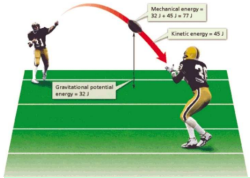
- Movement of <u>electrons</u>.



Example: lamp, computer, lightning

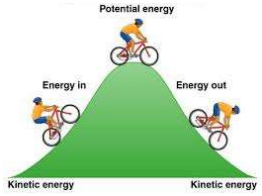
6. Mechanical = Making

- The sum of the potential and kinetic energy an object uses to do work.
- An object in motion.
- The movement of a substance from one place to another.



Example: Riding a bike

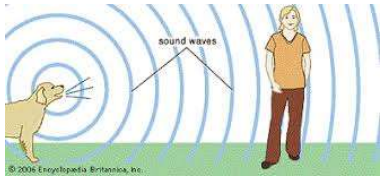
Mechanical Energy



7. Sound = Stinky

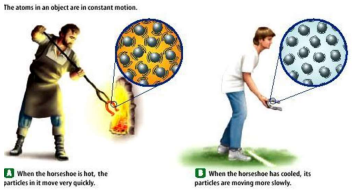
- Movement of energy through substances in waves.

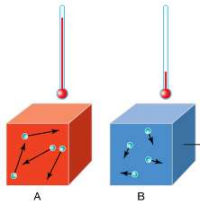
Example: bell



8. Thermal =Tacos

- The vibration or movement of atoms and molecules in an object.
- Ex: Heat





Example: stove boiling water

What form of Energy?

Sound

Chemical

Radient

Electrical

Nuclear

Mechanical

What form of Energy?

Thermal

Chemical

Radiant

Chemical

Gravitational

Try this…..

- Name at least three forms of energy you see in the picture. Tell how you know it's that form of energy.

Try this…..

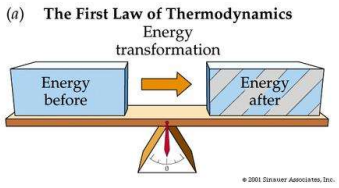
- Name the forms of energy you see in the picture. Tell how you know it's that form of energy.

This family is using the chemical energy of burning wood to produce thermal energy for heating marshmallows.

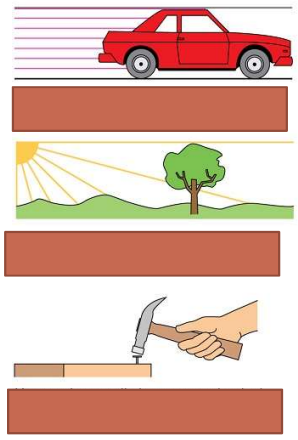
Law of Conservation of Energy

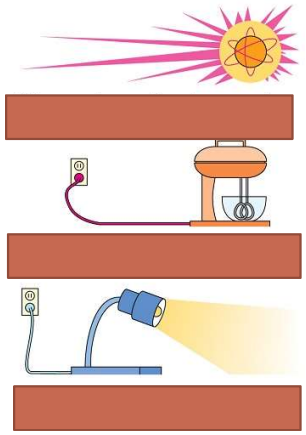
- First law of Thermodynamics:
  - For any system, the net change in energy equals the energy transferred as work and as heat.
  - A version of the law of conservation of energy
    - Energy can change forms, but cannot be created or destroyed

Whenever the total energy in a system increases, it must be due to energy that enters the system from an external source.



For the following images, identify how energy has been transformed.





Examples of Conservation of Energy

For each of the following examples, how is the energy being conserved?

Example 1: Gas in a Car

Chemical energy → mechanical energy

Example 2: Radio

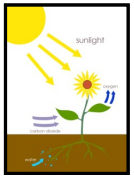
Electrical energy → sound

More Practice

For each picture, determine the energy transformation taking place.

More Practice

For each picture, determine the energy transformation taking place.

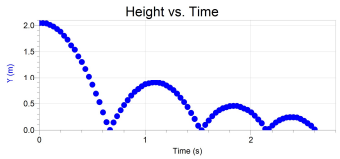


More Practice

For each picture, determine the energy transformation taking place.

Think about this…..

- When you bounce a ball, why doesn't it bounce as high the second time, or the third, or the fourth?



Energy Transformation

The process of changing energy from one form to another is **energy conversion.**

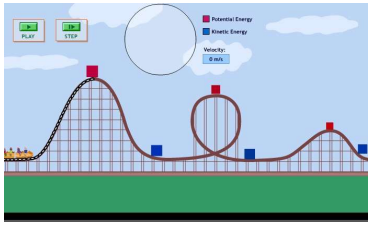
- **Ex:** The striking of a match

•Muscles use chemical energy to move (mechanical energy) the match.

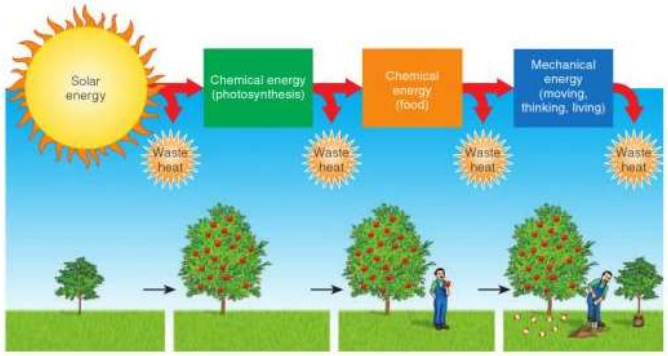
•Chemical energy(the match) is converted into thermal energy (heat) and electromagnetic energy (light) in the flame.

Law of Conservation of Energy

- States:
  - Energy can't be created or destroyed but it does change from one form to another.
  - Same as matter
  - The total energy remains constant, it just changes its form



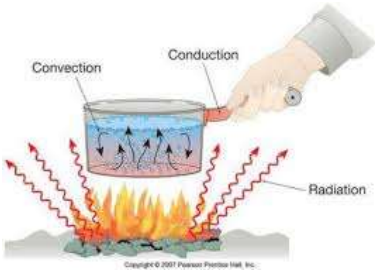
Law of Conservation of Energy



14.2 Energy Transfer

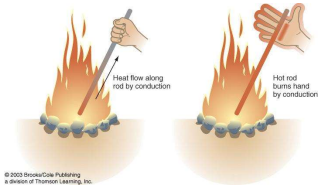
Heat can be transferred 3 different ways:

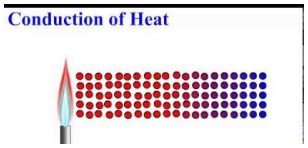
1. Conduction
2. Convection
3. Radiation



1. Conduction

- Transferred of energy by direct contact with materials
- Works best in some solids, then liquids least in gases.

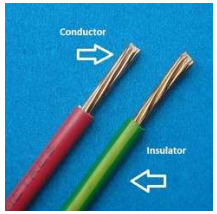




Conduction

- **Conductors**– materials that allow heat to pass through them
- Most metals (copper, aluminum, steel

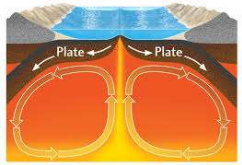
- **Insulators**– materials that don't let heat pass through them well
- Rubber, plastics, glass, air



2. Convection

- Transferring energy by moving fluids
- Liquids (water) and gases (air) are fluids
- When heated they expand, become less dense
- They rise, replaced by cooler denser fluids
- Make a circular flow called a convection current

Remember:
Hot–Rises → Less Dense
Cold–Falls → More Dense



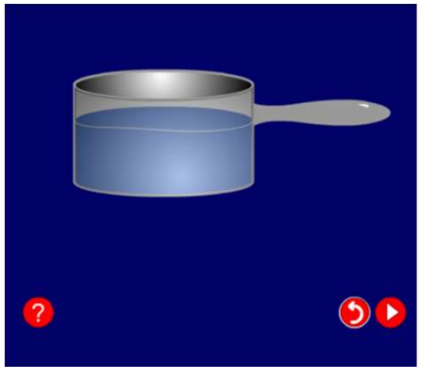
Clip

Water movement

Cools at the surface

Convection current

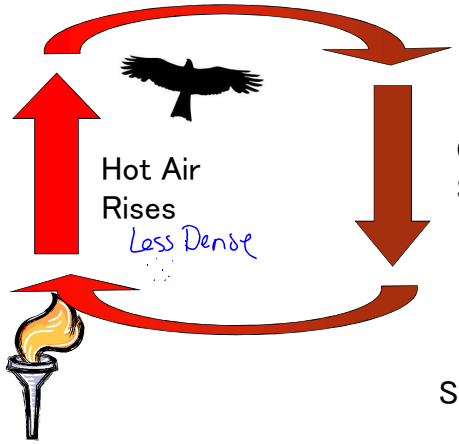
Cooler water sinks



Hot water rises

Convection Current

Draw this as your picture



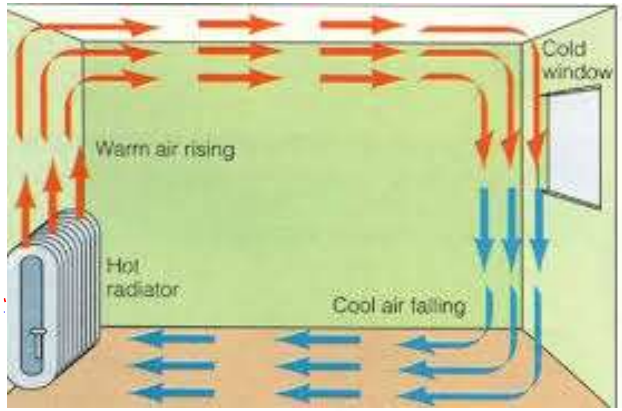
Hot Air Rises
Less Dense

Cool Air Sinks
more dense

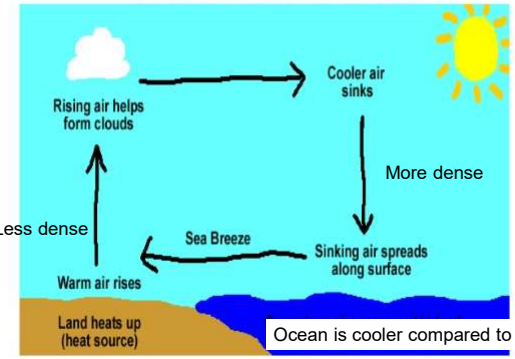
Same in water

Clip

Convection Current



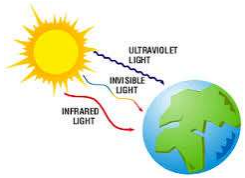
Sea Breeze

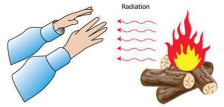


3. Radiation

- Energy transferred by **electromagnetic waves**
  - Ex: infrared radiation, visible light, ultraviolet rays
- Can travel through empty space (no medium). **No air**
- When wave hit object they make the molecules move faster.

Medium= (material)



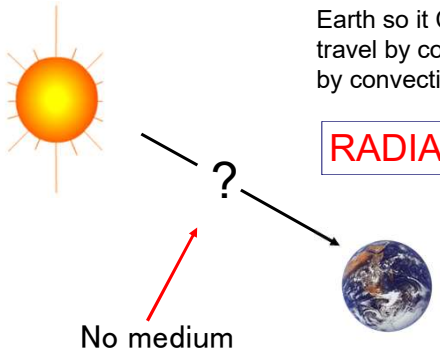


The third method of heat transfer

How does heat energy get from the Sun to the Earth?

There are no particles between the Sun and the Earth so it CANNOT travel by conduction or by convection.

RADIATION



Radiation

Radiation travels in straight lines

True/~~False~~

Radiation can travel through a vacuum

True/~~False~~

Radiation requires particles to travel

~~True~~/False

Radiation travels at the speed of light

True/~~False~~

Radiation requires a medium to travel

~~True~~/False

Radiation questions

Why are houses painted white in hot countries?

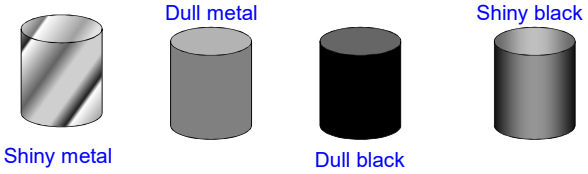
White reflects heat radiation and keeps the house cooler.

Why are shiny foil blankets wrapped around marathon runners at the end of a race?

The shiny metal reflects the heat radiation from the runner back in, this stops the runner from getting cold.

Emission experiment

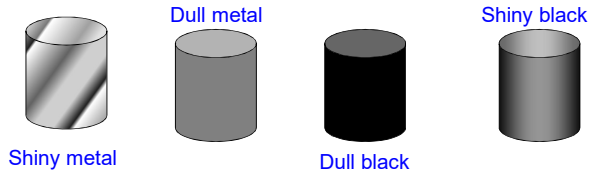
Four containers were filled with warm water. Which container would have the warmest water after ten minutes?



The shiny metal container would be the warmest after ten minutes because its shiny surface reflects heat radiation back into the container so less is lost. The dull black container would be the coolest because it is the best at emitting heat radiation.

Absorption experiment

Four containers were placed equidistant from a heater. Which container would have the warmest water after ten minutes?



The dull black container would be the warmest after ten minutes because its surface absorbs heat radiation the best. The shiny metal container would be the coolest because it is the poorest at absorbing heat radiation.

3. How does heat energy reach the Earth from the Sun?

A. Radiation
B. Conduction
C. Convection
D. Insulation

4. Which is the best surface for reflecting heat radiation?

(A.) Shiny white
B. Dull white
C. Shiny black
D. Dull black

5. Which is the best surface for absorbing heat radiation?

A. Shiny white
B. Dull white
C. Shiny black
(D.) Dull black