
Energy
How We Get Matter to Work For US!

What is Energy?

- The ability to do work (cause an object to move)
- Expressed in joules (J)
- When one object does work on another, energy is transferred from the first object to the second object

Types of Energy

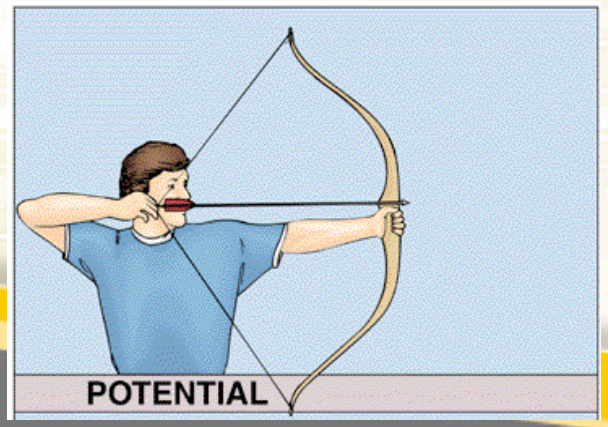
1. **Kinetic Energy = energy of motion**
   - all moving objects have kinetic energy
   - Used to do work
   - Calculated: $\text{kinetic energy} = \frac{\text{mass} \times \text{velocity}^2}{2}$

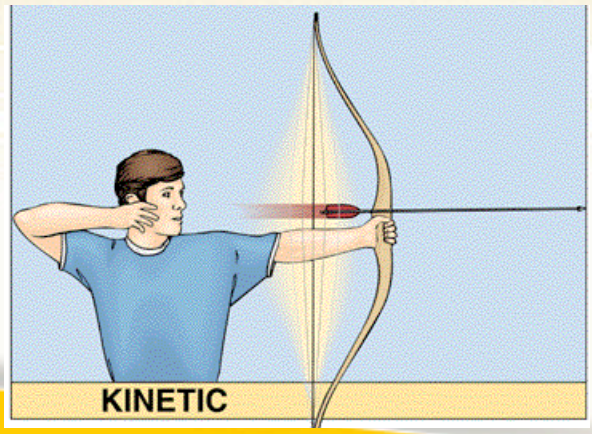
Types of Energy

2. Potential Energy = energy in an object due to its position

Example:

A stretched bow string has potential energy because the energy of the work you did to pull it back gets stored



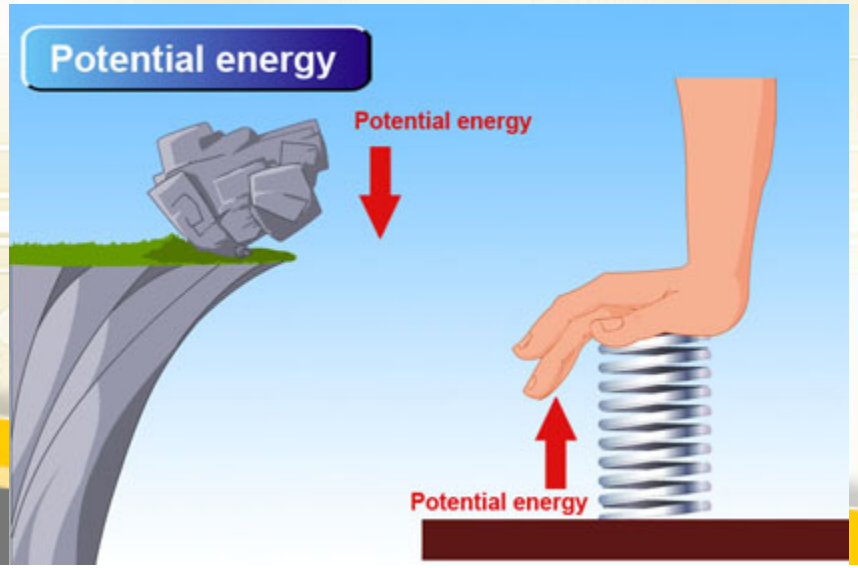


Types of Potential Energy

- Gravitational – stored energy due to position

  Gravitational potential energy = weight x height

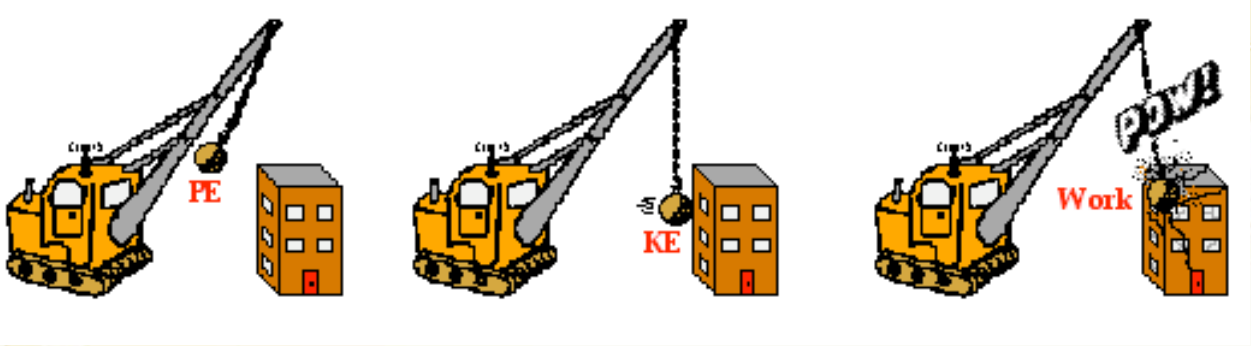
- Elastic – stored energy due to shape



Combining Energies

Mechanical Energy = the amount of work an object can do because of its kinetic and potential energies

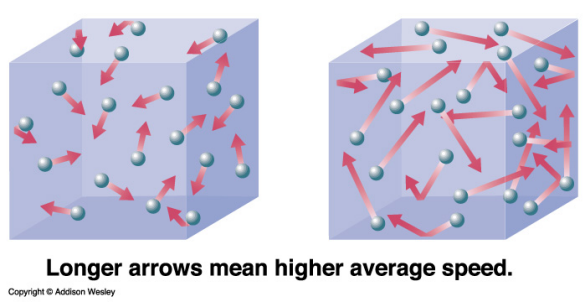
- Could be all potential energy, all kinetic energy, or some of each



Mechanical energy = potential energy + kinetic energy

Other Forms of Energy

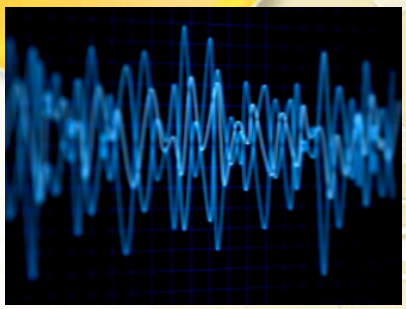
- **Thermal Energy** – due to random motion of particles; faster particles = more thermal energy



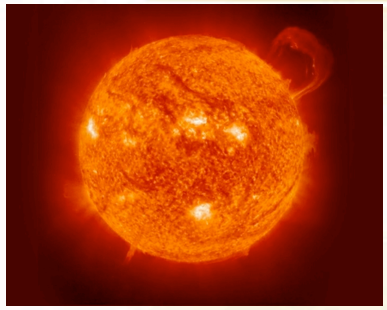
- **Chemical Energy** – energy of a chemical compound that changes as its atoms are rearranged (like food)

- **Electrical Energy** – energy of moving electrons

Other Forms of Energy



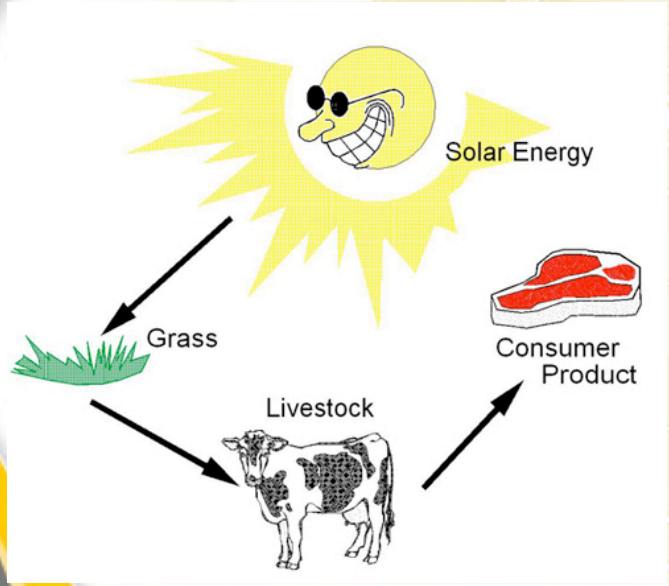
- Sound Energy – caused by an object's vibrations



- Light Energy – produced by vibrations of electrically charged particles

- Nuclear Energy – energy from the nucleus of an atom; powers the sun

Energy Conversions

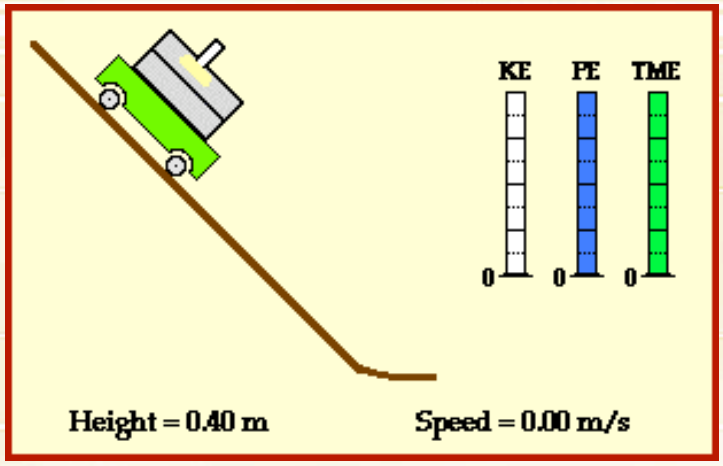


- Energy Conversions - a change from one form of energy to another
- Any form of energy can change into any other form of energy
- Often one form of energy changes into more than one form

Examples of Energy Conversions

1. Gravitational Potential to Kinetic:

Cart at the top of the hill has maximum potential energy

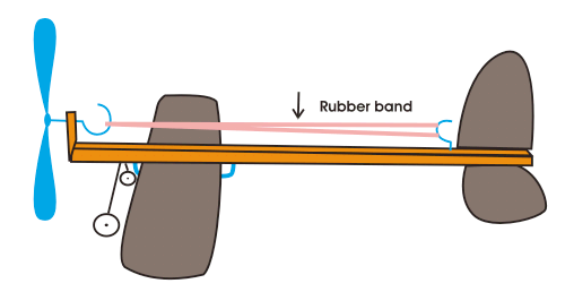


As it speeds down, it changes from potential to kinetic. As it reaches the bottom, it has maximum kinetic energy

Examples of Energy Conversions

2. Elastic Potential to Kinetic Energy

The wound up rubber band has potential energy because the work done to change the shape is stored

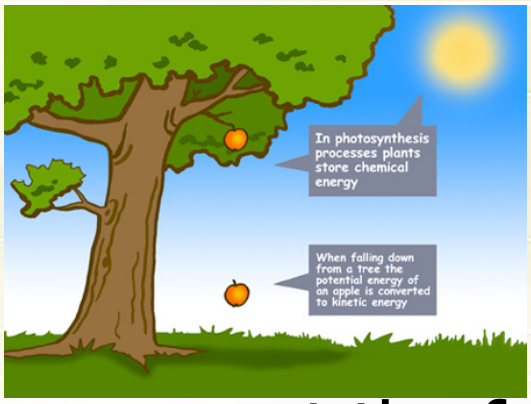


When let go, the elastic energy is transferred to move the plane, thus causing Kinetic Energy

Examples of Energy Conversions

3. Light Energy to Chemical Energy

Light energy is converted in photosynthesis to make sugar. This chemical has stored energy.



Other living things can eat the fruit from the plant and convert the chemical energy into thermal or other kinetic energy

Examples of Energy Conversions

4. Electrical to Kinetic/Thermal/Sound Energy

Electrical energy enters the hair dryer and is converted to kinetic energy to spin the motor

The electrical energy is also converted into thermal energy in wires that heat up

The fan run by the motor forces air out, which is heard by the user.

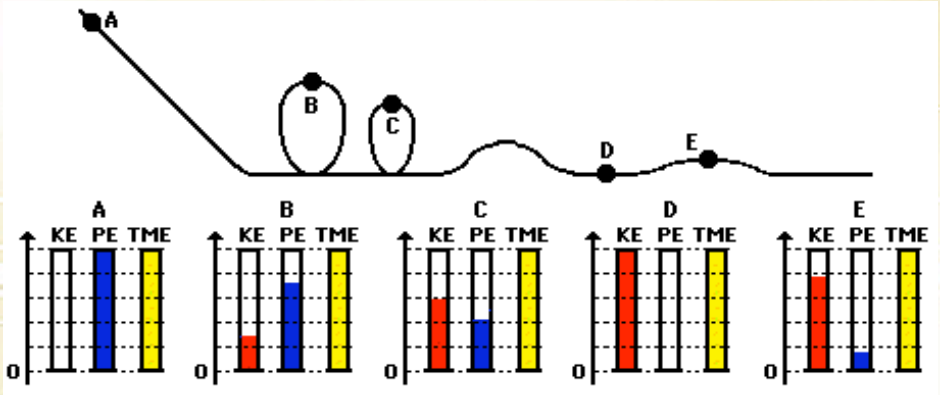
Energy Conversions are Important!

Energy conversions are needed for everything we do:

- Heat our homes
- Convert food into energy to move
- Machines (like the car!!) in everyday life

Law of Conservation of Energy

- The Law of Conservation of Energy states that "Energy cannot be created or destroyed."
- This means that energy cannot disappear – it has to just change forms



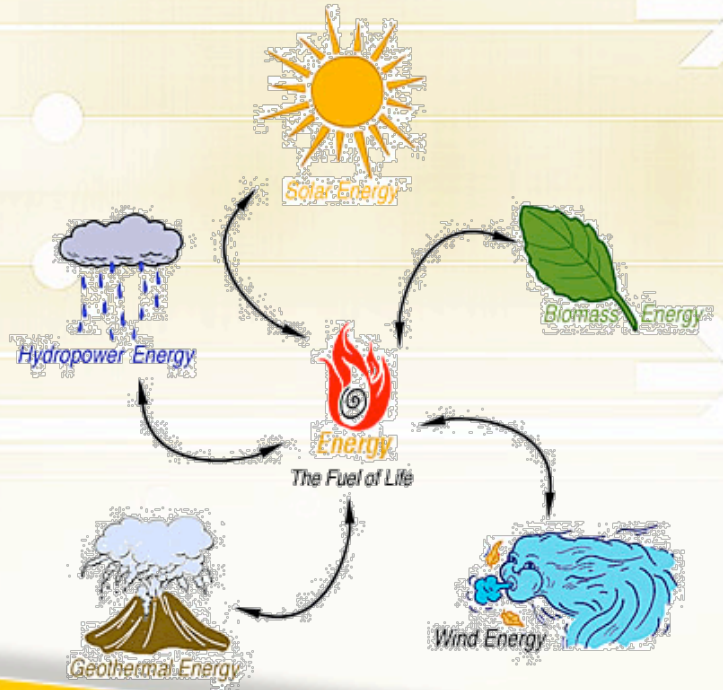
- The total amount of energy in a system is always the same

ENERGY RESOURCES

What Are Energy Resources?

- **Energy Resource** = natural resource that can be converted into other forms of energy to do useful work

- Two types:
  - Nonrenewable
  - Renewable

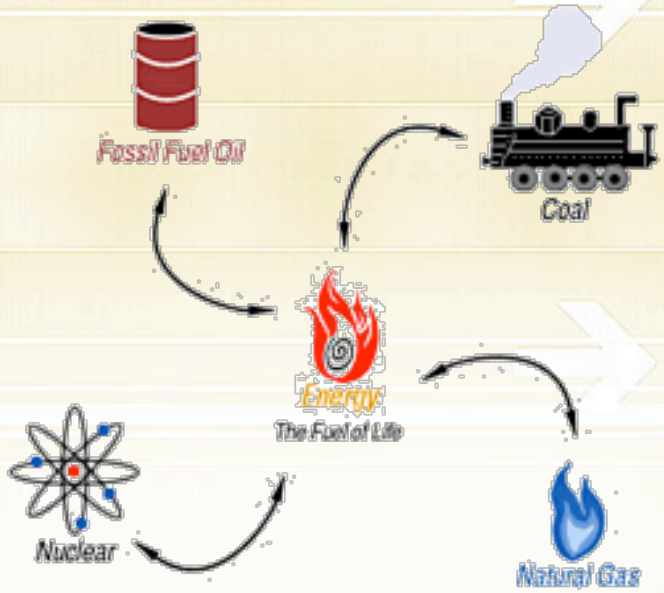


Nonrenewable Resources

- Resources that cannot be replaced or are replaced much more slowly than used

Examples:

Fossil Fuels (oil, natural gas, coal) made from remains of plants & animals from millions of years ago



Renewable Resources

- Resources that are naturally replaced more quickly than they are used
- Some are considered limitless (solar, wind)
- Examples:
  - Solar energy
  - Hydroelectric energy
  - Wind energy
  - Geothermal energy