

CHAPTER 7 LESSON 1: FORMS OF ENERGY

Vocabulary

<ul style="list-style-type: none">• Energy• Kinetic energy• Potential energy• Work	<ul style="list-style-type: none">• Mechanical energy• Sound energy• Thermal energy	<ul style="list-style-type: none">• Electric energy• Radiant energy• Nuclear energy
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What is Energy?

- **Energy** is the ability to cause change.
- Energy can cause changes in the motions of objects.

Kinetic Energy – Energy of Motion

- **Kinetic energy** is energy due to motion.
- All moving objects have kinetic energy.
- The faster and object moves, the more kinetic energy it has.
- If two objects move at the same speed, the object with more mass has more kinetic energy.
- The kinetic energy (KE) of an object depends on its speed and its mass. The vertical bars in the picture below show the kinetic energy of each vehicle.



Potential Energy – Stored Energy

- **Potential energy** is stored energy due to the interactions between objects or particles.
- The gravitational potential energy stored between an object and Earth depends on the object's weight and height.
- Elastic potential energy is energy stored in objects that are compressed or stretched.
- Chemical potential energy is energy stored in the chemical bonds between atoms.

Energy and Work

- **Work** is the transfer of energy that occurs when a force is applied over a distance.
- Work depends on both force and distance.
- You only do work on an object if that object moves.

The girl does work on the boxes as she lifts it. The work she does transfers energy to the box. The colored bars show the work that the girl does (W) and the box's potential energy (PE).



All energy can be measured in joules (J).

Forms of Energy:

- **Mechanical energy:** the total energy of an object or group of objects due to large-scale motions and interactions.
 - The mechanical energy of a basketball increases when a player shoots the ball. However, the mechanical energy of a pot of water does not increase when you hear the water.
- **Sound energy:** the energy that sound carries.
 - When you pluck a guitar string, the string vibrates and produces sound. Vibrating objects emit sound energy. However, sound energy cannot travel through a vacuum such as the space between Earth and the Sun.
- **Thermal energy:** energy due to the motion of particles that make up an object.
 - All objects and materials are made of particles that are always moving. Because these particles move, they have energy.
 - Thermal energy moves from warmer objects to colder objects. When you heat objects, you transfer thermal energy to those objects from their surroundings.
- **Electric energy:** the energy that an electric current carries.
 - Electric appliances, such as fans and dishwashers, change electric energy into other forms of energy.
- **Radiant energy:** the energy that electromagnetic waves carry.
 - The Sun gives off energy that travels to Earth as electromagnetic waves. Unlike sound waves, electromagnetic waves can travel through a vacuum.
 - Light waves, microwaves, and radio waves are all electromagnetic waves.
 - Sometimes radiant energy is called light energy.
- **Nuclear energy:** energy that is stored in the nucleus of an atom.
 - At the center of every atom is a nucleus.
 - In the Sun, nuclear energy is released when nuclei join together.
 - In a nuclear power plant, nuclear energy is released when the nuclei of uranium atoms are split apart.

CHAPTER 7 LESSON 2: ENERGY TRANSFORMATIONS

Vocabulary

- Law of conservation of energy
- Friction

Changes between Forms of Energy

- The changes from one type of energy to another type of energy are called energy transformations.

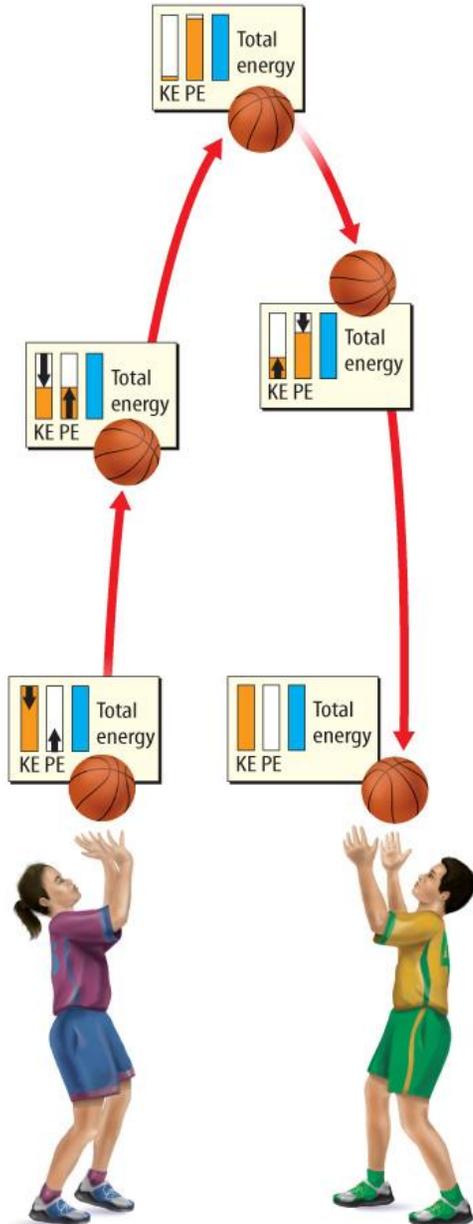
A microwave oven changes electric energy into radiant energy.



1. Electric energy flows from electric outlet through power cord into microwave.
2. Microwave changes electric energy into microwaves that carry radiant energy to the popcorn.
3. Radiant energy is converted to thermal energy as the popcorn absorbs the waves, causing the popcorn to get hot and pop.

Changes between Kinetic and Potential Energy

- Energy changes between kinetic energy (KE) and potential energy (PE) when a ball is thrown and moved upward and then downward.



- As the ball moved upward, its speed and kinetic energy decrease, but the potential energy is increasing because the ball's height is increasing.
- At the ball's highest point, the gravitational potential energy is the greatest, and the ball's kinetic energy is the least.
- As the ball moves downward, potential energy decreases. At the same time, the ball's kinetic energy increases.
- When the ball reaches the player's hand again, its kinetic energy is at a maximum value again.

The Law of Conservation of Energy

- According to the [law of conservation of energy](#), energy can be transferred from one form into another or transferred from one region to another, but energy cannot be created or destroyed.
- [Friction](#) is a force that resists the sliding of two surfaces that are touching.

Friction and the Law of Conservation of Energy

- What happens to mechanical energy when you apply the bicycle brakes and the bicycle stops?
- A moving bicycle has mechanical energy. When you apply the brakes, the bicycle's mechanical energy is not destroyed.
- The mechanical energy is transformed into thermal energy. Friction between the brake and moving wheel transforms mechanical energy into thermal energy.
- There is always friction between any two surfaces that are rubbing against each other.

Using Energy

- When you use energy, you usually change it from one form into another.
- All forms of energy can be transformed into thermal energy.
- During photosynthesis, a plant transforms the Sun's radiant energy into chemical energy that it stores in chemical compounds.
- When energy changes form, some thermal energy is always released.
- Scientists often refer to thermal energy that cannot be used as waste energy.
- Whenever energy is used, some energy is transformed into waste energy.

CHAPTER 7 LESSON 3: THERMAL ENERGY ON THE MOVE

Vocabulary

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| <ul style="list-style-type: none">• Heat• Conduction• Thermal conductor | <ul style="list-style-type: none">• Thermal insulator• Convection• Radiation |
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Heat

- Heat is thermal energy moving from a region of higher temperature to a region of lower temperature.
- Objects contain thermal energy, not heat
- The movement of thermal energy causes changes in temperature.
- Two objects in contact with each other at the same temperature are said to be in thermal equilibrium.

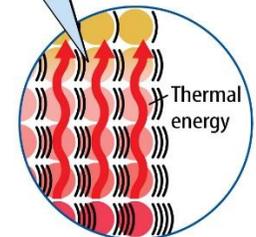
Conduction

- Conduction is the transfer of thermal energy due to collisions between particles in matter.

Conduction occurs in solids, liquids, and gases.

When faster-moving particles collide with nearby particles as slower speeds, thermal energy is transferred.

Thermal energy is transferred from faster particles to slower particles by collisions.



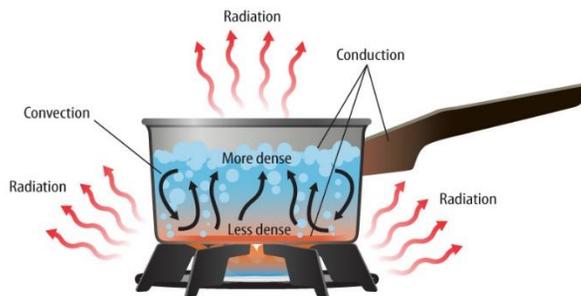
- A material in which thermal energy moves quickly is called a thermal conductor.
- Solids are better thermal conductors than liquids and gases.
- Most metals are excellent thermal conductors.
- A material in which thermal energy moves slowly is a thermal insulator.
- A winter coat filled with an air-trapping material is a good example of a thermal insulator.

Convection

- **Convection** is the transfer of thermal energy by the movement of particles from one part of a material to another.
- Convection occurs in liquids and gases.
- Begins when part of a liquid or gas becomes warmer than the rest of it.
- The cooler, denser liquid or gas falls, pushing the warmer, less dense liquid or gas to the top.

Radiation

- **Radiation** is the transfer of thermal energy from one object to another by electromagnetic waves.
- Radiation transfers thermal energy through matter or through space, where no matter exists.
- Occurs between objects that are not in contact.
- All objects give off electromagnetic waves, but most are not visible.
- Extremely hot objects emit visible light.
- Electromagnetic waves carry energy and radiation transfers this thermal energy from objects at higher temperatures to objects at lower temperatures.



1. Thermal energy from the burner is transferred into water by conduction.
2. Thermal energy is transferred out of hot water by radiation and conduction.
3. Cycles of rising and sinking water transfer thermal energy throughout water by convection.