Lesson Outline for Teaching

Chapter 8 Energy

Lesson 1: Forms of Energy

A. Energy

1. Energy influences everything in your life.
2. Energy is the ability to cause change.

B. Potential Energy

1. Potential energy is stored energy due to the interaction between objects and particles.
2. Objects with potential energy have the possibility to cause change.
3. Any object has gravitational potential energy if it has mass and height above Earth's surface.
4. Chemical energy is energy that is stored in and released in the bonds between atoms.
5. Nuclear energy is the energy stored in and released from the nucleus of an atom.
   - **a.** The energy released from the Sun comes from nuclear fusion.
   - **b.** During nuclear fusion, nuclei of atoms join together and release large amounts of energy.
   - **c.** During nuclear fission, the nucleus of an atom breaks apart, and energy is released.
   - **d.** Energy used in nuclear power plants to make electricity comes from nuclear fission.

C. Kinetic Energy

1. Kinetic energy is energy due to motion.
2. The kinetic energy of a moving object is related to the mass and the speed of the object.
   - **a.** An object must have mass and speed to have kinetic energy.
   - **b.** If two objects have the same mass, the object that moves with greater speed has greater kinetic energy.
3. Electric energy is the energy in an electric current.

D. Combined Kinetic Energy and Potential Energy

1. A(n) system is a collection of interacting objects, parts, or ideas that act together as a(n) whole.
2. In science, the environment is anything that is not part of the system.
3. The sum of the potential energy and the kinetic energy in a system is mechanical energy.
4. Thermal energy is the sum of the kinetic energy and the potential energy of the particles that make up an object.

E. Energy Carried by Waves

1. A(n) wave is a disturbance that transfers energy from one place to another without transferring matter.
2. Sound energy is energy carried by sound waves, which are waves that move through matter.
3. Electromagnetic waves are electric and magnetic waves that move perpendicularly to one another.
   - **a.** The energy carried by electromagnetic waves is radiant energy.
   - **b.** Electromagnetic waves travel through matter and also through spaces with little or no matter.
   - **c.** Forms of electromagnetic waves include visible light, ultraviolet waves, X-rays, gamma rays, and infrared rays.

Discussion Question

What is the difference between a sound wave and a light wave?

Sample answer: A sound wave requires matter, but a light wave can move through matter or through empty space. A light wave is an electromagnetic wave, and a sound wave is not.

Lesson Outline for Teaching

Lesson 2: Energy Transfers and Transformations

A. Law of Conservation of Energy

1. The law of conservation of energy states that energy can be transformed from one form to another, but it can't be created or destroyed.
2. Energy transfer takes place when energy moves from one object to another without changing form.
3. Energy transformation occurs when one form of energy is converted to another form of energy.
4. Work is the transfer of energy that occurs when a(n) force makes an object move in the direction of the force; work is only being done while the force is acting on the object.
5. Energy transformations are inefficient because some energy is transformed to a form of energy that is not usable.
6. A system can be open or closed.
   - **a.** A(n) open system is a system that exchanges matter or energy with the environment.
   - **b.** A(n) closed system is a system that does not exchange matter or energy with the environment.

B. Energy Transformations and Electric Energy

1. A(n) renewable energy resource is an energy resource that is replaced as fast as or faster than it is used.
   - **a.** Radiant energy from the Sun, or solar energy, is converted into electric energy in solar cells, also called photovoltaic cells.
   - **b.** Solar energy is sometimes transformed into thermal energy, which is used to convert water to steam; the steam turns a(n) generator, which transforms mechanical energy into electric energy.
   - **c.** Wind turbines are built in places where winds blow most of the time.
   - **d.** A(n) generator is turned by the turbine, changing kinetic energy of wind to electric energy.
   - **e.** In hydroelectric plants, the mechanical energy of falling water being channeled through a turbine is transformed to electric energy.
   - **f.** In a(n) geothermal plant, thermal energy from within Earth is transferred to water, creating steam, which is used to turn turbines in electric generators.
   - **g.** Burning biomass releases stored chemical energy, which can then be transformed to electric energy.

2. Most energy that we use comes from fossil fuels and nuclear energy.
3. A(n) nonrenewable energy resource is an energy resource that is available in limited amounts or that is used faster than it can be replaced in nature.
   a. Petroleum, natural gas, propane, and coal are fossil fuels.
   b. Fossil fuels are a concentrated form of chemical energy that came from plants and animals that lived millions of years ago.
   c. Some energy plants use fission to produce thermal energy.

Discussion Question

In your daily life, how can you use fewer nonrenewable resources?

Sample answers: Ride a bike or walk instead of taking a car or bus. Turn off electrical appliances and lights when they are not needed.

Lesson Outline for Teaching

Lesson 3: Particles in Motion

A. Kinetic Molecular Theory

1. The transfer of thermal energy depends on the movement of particles in the material.
2. The kinetic molecular theory of matter explains how particles move.
   - **a.** Particles make up all matter.
   - **b.** Particles are in constant, random motion.
   - **c.** Particles constantly collide with each other and with the walls of their container.
3. Temperature is the measure of the average kinetic energy of the particles in a material.
   - **a.** If the particles in a material have little kinetic energy, the material feels cold.
   - **b.** The SI unit for temperature is kelvin (K).
   - **c.** Another temperature unit often used by scientists is Celsius (°C).
4. Thermal expansion is the increase in volume that a material undergoes when its temperature increases.
   - **a.** At higher temperatures, the particles in matter move faster, requiring more volume because they collide more often, pushing each other apart.
   - **b.** Thermal contraction is the decrease in a material's volume when its temperature decreases.
5. Kinetic energy is transferred from one material to another one when their particles collide.
6. Heat is the movement of thermal energy from a region of higher temperature to a region of lower temperature.
7. Materials are said to be in thermal equilibrium when the temperatures of materials that are touching are equal.

B. Heat Transfer

1. Conduction is the transfer of thermal energy due to collisions between particles in matter.
2. Radiation is the transfer of thermal energy by electromagnetic waves.
3. Convection is the transfer of thermal energy by the movement of the particles from one part of a material to another.

C. Heat and Changes of State

1. When thermal energy is added to solid ice, its temperature increases until it starts to melt, changing to liquid water.
2. When thermal energy is removed from liquid water, its temperature decreases until it starts to freeze, changing to solid ice.

3. When thermal energy is added to liquid water, its temperature increases until it starts to vaporize, changing to a(n) gas.
4. When thermal energy is removed from a gas, it changes to a(n) liquid through a process called condensation.
5. Sublimation occurs when a solid absorbs energy and changes directly to a gas without first becoming a(n) liquid.
6. Deposition occurs when a gas changes directly to a solid without first becoming a(n) liquid.

D. Conductors and Insulators

1. Thermal energy moves quickly in a thermal conductor.
2. Thermal energy moves slowly in a thermal insulator.

Discussion Question

Describe the changes in energy and temperature that occur when a frozen puddle changes to water vapor.

As the ice absorbs energy from its surroundings, the temperature rises until the ice starts to melt. The melting ice continues to absorb energy while it melts, but its temperature does not change until all the ice is melted. The temperature of the liquid water rises until the water starts to vaporize. The temperature does not rise while vaporization occurs.