

Thermal Energy

Underlined words and phrases are to be filled in by students on the Note-taking Worksheet.

Section 1 Temperature and Heat

- **A.** <u>Temperature</u>—related to the average kinetic energy of an object's atoms or molecules
- **B.** Thermal energy—the sum of the kinetic and potential energy of all the atoms in an object
 - 1. Thermal energy increases as temperature increases.
 - 2. At constant temperature, thermal energy increases if mass increases.
- C. Thermal energy that flows from something at a higher temperature to something at a lower temperature is called **heat**.
- **D.** <u>Specific heat</u>—amount of heat needed to raise the temperature of 1 kg of a material by 1 degree C or K
- E. Changes in thermal energy can be calculated as change in thermal energy equals mass times change in temperature times specific heat.
 - 1. When heat flows into an object and its temperature rises, the change in temperature is <u>positive</u>.
 - **2.** When heat flows out of an object and its temperature decreases, the change in temperature is <u>negative</u>.
 - 3. A <u>calorimeter</u> is used to measure specific heat.

Discussion Question.

How do temperature and heat differ? Heat is thermal energy that flows from something warmer to something cooler; temperature is related to kinetic energy of atoms in a substance.



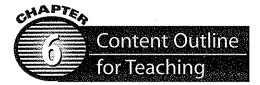
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Transferring Thermal Energy Section 2

- A. <u>Conduction</u>—transfer of thermal energy through matter by direct contact of particles
 - 1. Kinetic energy is transferred as particles collide.
 - 2. Solids, particularly metals, are good heat conductors.
- **B.** The transfer of energy by the motion of heated particles in a fluid is called **convection**.
 - 1. Convection <u>currents</u> transfer heat from warmer to cooler parts of a fluid.
 - 2. Convection currents create <u>rain forests</u> and <u>deserts</u> over different regions of Earth.
- **C. Radiation**—energy transfer by electromagnetic waves
 - 1. Some radiation is <u>absorbed</u> and some is <u>reflected</u> when it strikes a material.
 - 2. Heat transfer by radiation is <u>faster</u> in a gas than in a liquid or solid.
- **D.** Most living things control the flow of heat by using special features such as fur, <u>blubber</u>, or scales.
- **E.** <u>Insulator</u>—material that does not let heat flow through it easily
 - 1. Gases such as <u>air</u> usually make better insulators than liquids or solids.
 - 2. A <u>vacuum</u> layer in a thermos is a good insulator because it contains almost no matter to allow conduction or convection to occur.

Discussion Ouestion.

What state of matter generally makes a good heat conductor? Heat insulator? Solids generally conduct heat better than liquids or gases; gases usually make better insulators than liquids or solids.



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Section 3 Using Heat

- A. Heating systems—warm homes and buildings
 - 1. <u>Forced-air</u> system—fuel heats air, which is blown through ducts and vents; cool air is returned to the furnace to be reheated.
 - 2. <u>Radiator</u> system—hot water or steam in a radiator transfers thermal energy to the air
 - 3. <u>Electric</u> heating system—electrically heated coils in ceilings or floors heat air by conduction
- B. Solar energy—energy from the Sun
 - 1. Passive solar heating does not use mechanical devices to move heat.
 - **2.** Active solar heating systems use **solar collectors** to absorb radiant energy, which is circulated through the building.
- C. <u>Heat engine</u>—an engine that converts thermal energy into mechanical energy
 - **1.** An <u>internal combustion</u> engine burns fuel inside the engine in chambers or cylinders.
 - **2.** Internal combustion engines convert only about <u>26</u>% of the fuel's chemical energy to mechanical energy.
- **D.** <u>Heat mover</u>—device that removes thermal energy from one location and transfers it to another location at a different temperature
 - **1.** A <u>refrigerator</u> contains a coolant that absorbs heat from the inside of the refrigerator and releases it on the outside as heat.
 - 2. Air conditioners cool warm air.
 - 3. Heat pumps can both cool and warm air.
 - **4.** The human body stays cool by <u>evaporation</u> of sweat.

Discussion Question

What are three types of heating systems? Forced-air systems, radiator systems, and electric systems

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