

Radiation, Conduction, Convection

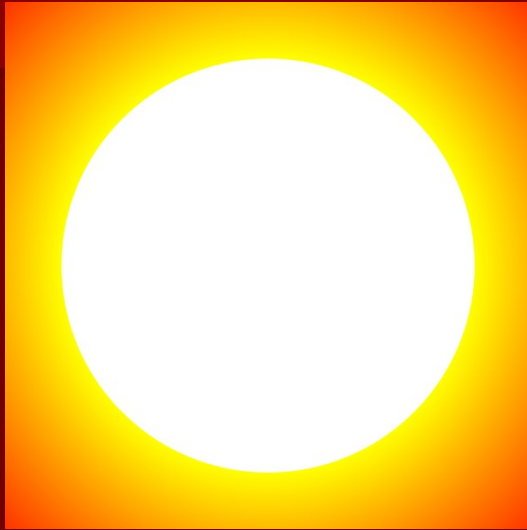
An Introduction to Heat Transfer

What is Heat?

I. Heat

- A. Heat is the transfer of **thermal energy** from one object to another.
- B. The amount of heat within an object is measured as **temperature**, usually in units of **Fahrenheit** or **Celsius**.
- C. Heat moves in one of three ways: **radiation**, **conduction**, or **convection**.

What is Heat?

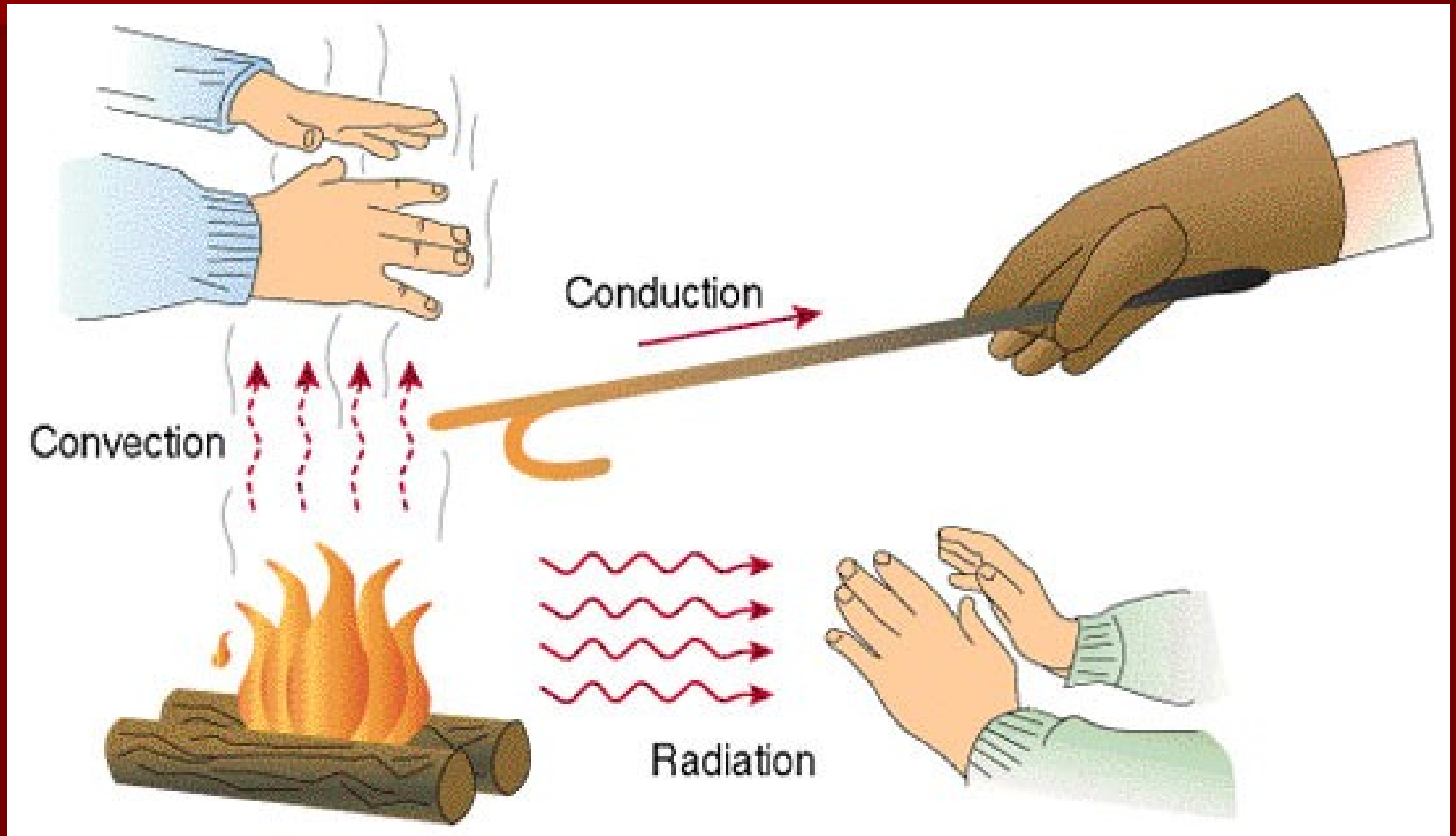


What is Heat?

II. Heat Transfer

- A. **Heat transfer** occurs when thermal energy moves from an object with a higher temperature to an object with a lower temperature.
- B. Heat will continue to move until both objects reach **thermal equilibrium**.
- C. The amount of energy in the transfer is measured as **joules**, **BTU's**, or **calories**.

What is Heat?

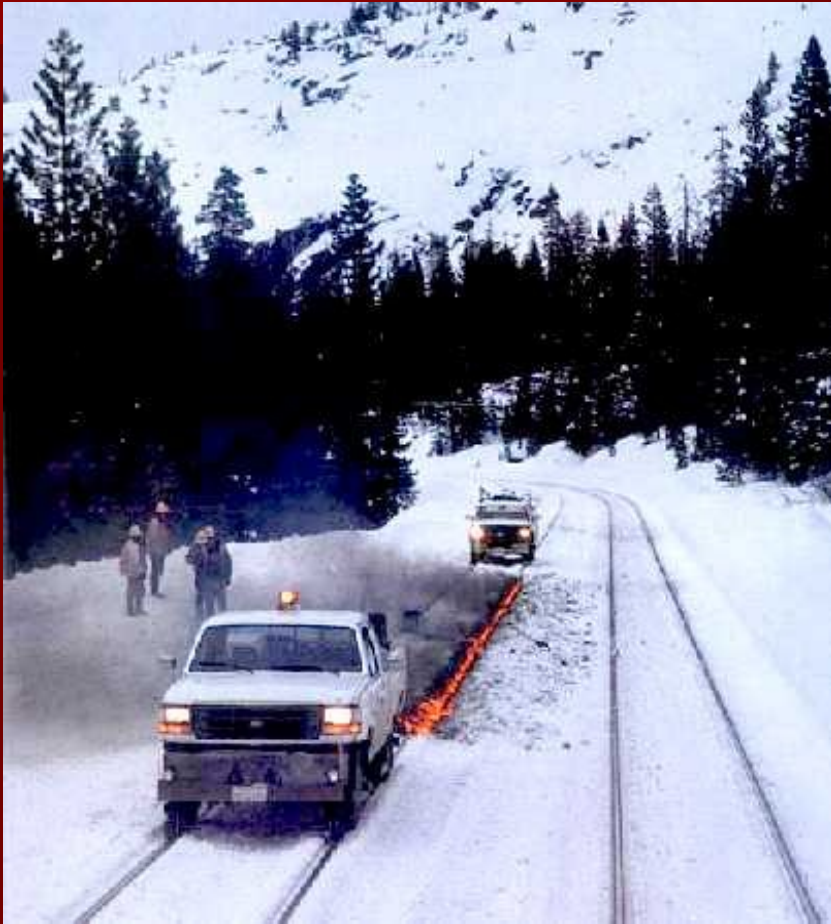


What is Heat?

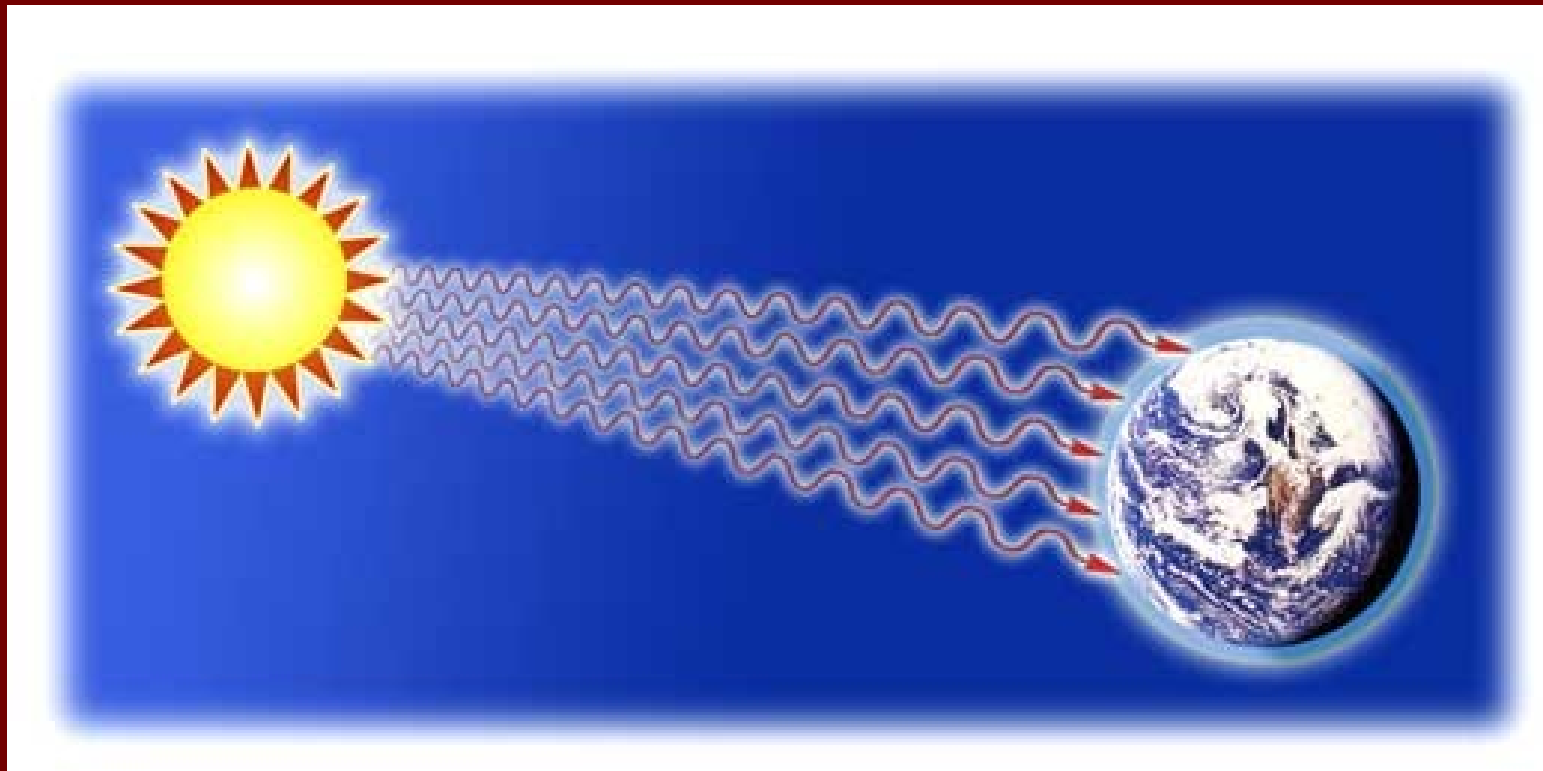
III. How Heat Transfer Works

- A. As the temperature of an object increases, the particles inside move faster and begin to move away from each other.
- B. As the particles move away, the object will *expand* in size.
- C. As thermal energy leaves the object, the particles move closer together and the object will *contract*.

What is Heat?



Radiation

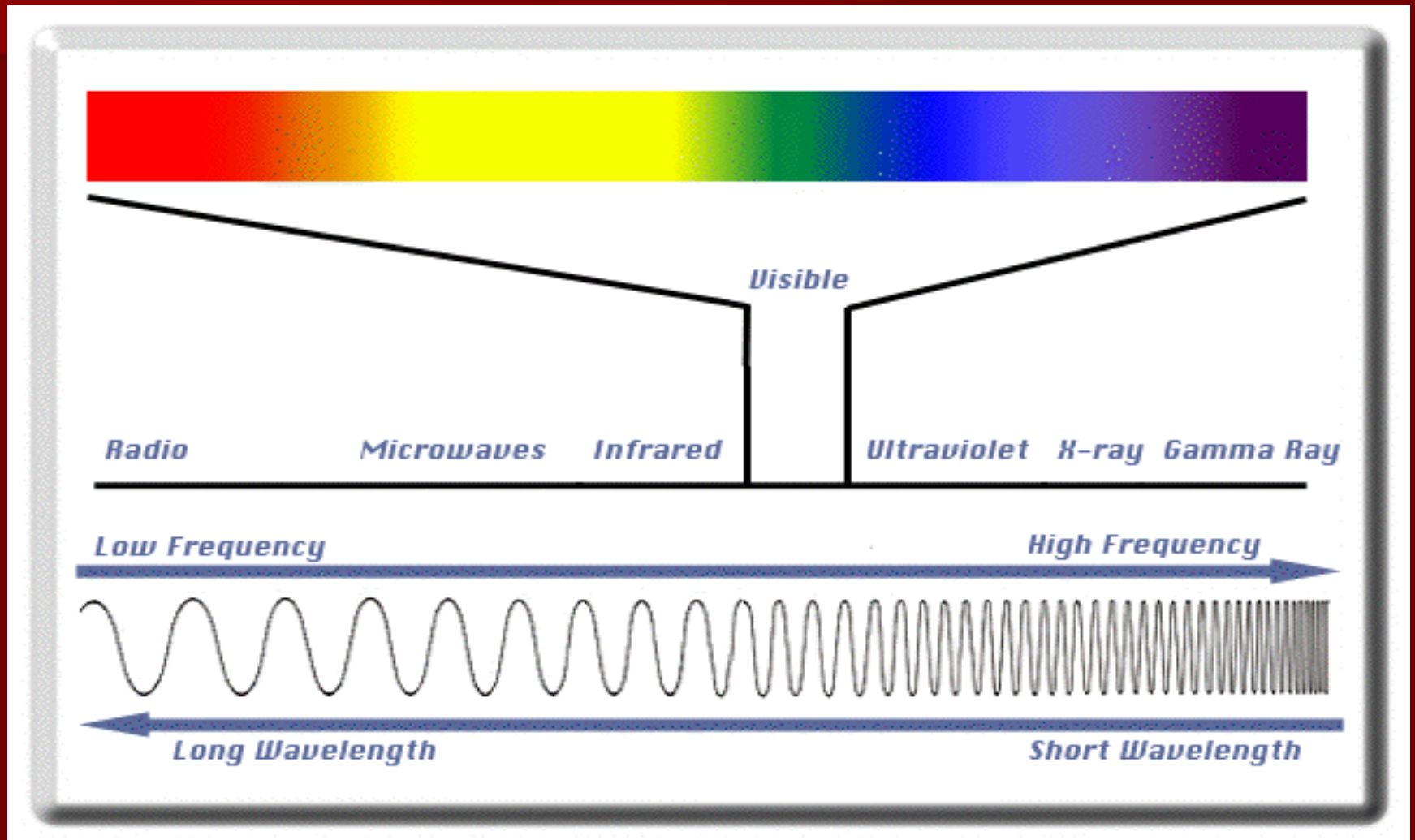


Radiation

IV. Radiation

- A. **Radiation** is a form of heat transfer that occurs when **electromagnetic waves** move through space.
- B. Types of electromagnetic waves:
1. radio waves
 2. microwaves
 3. x-rays
 4. light

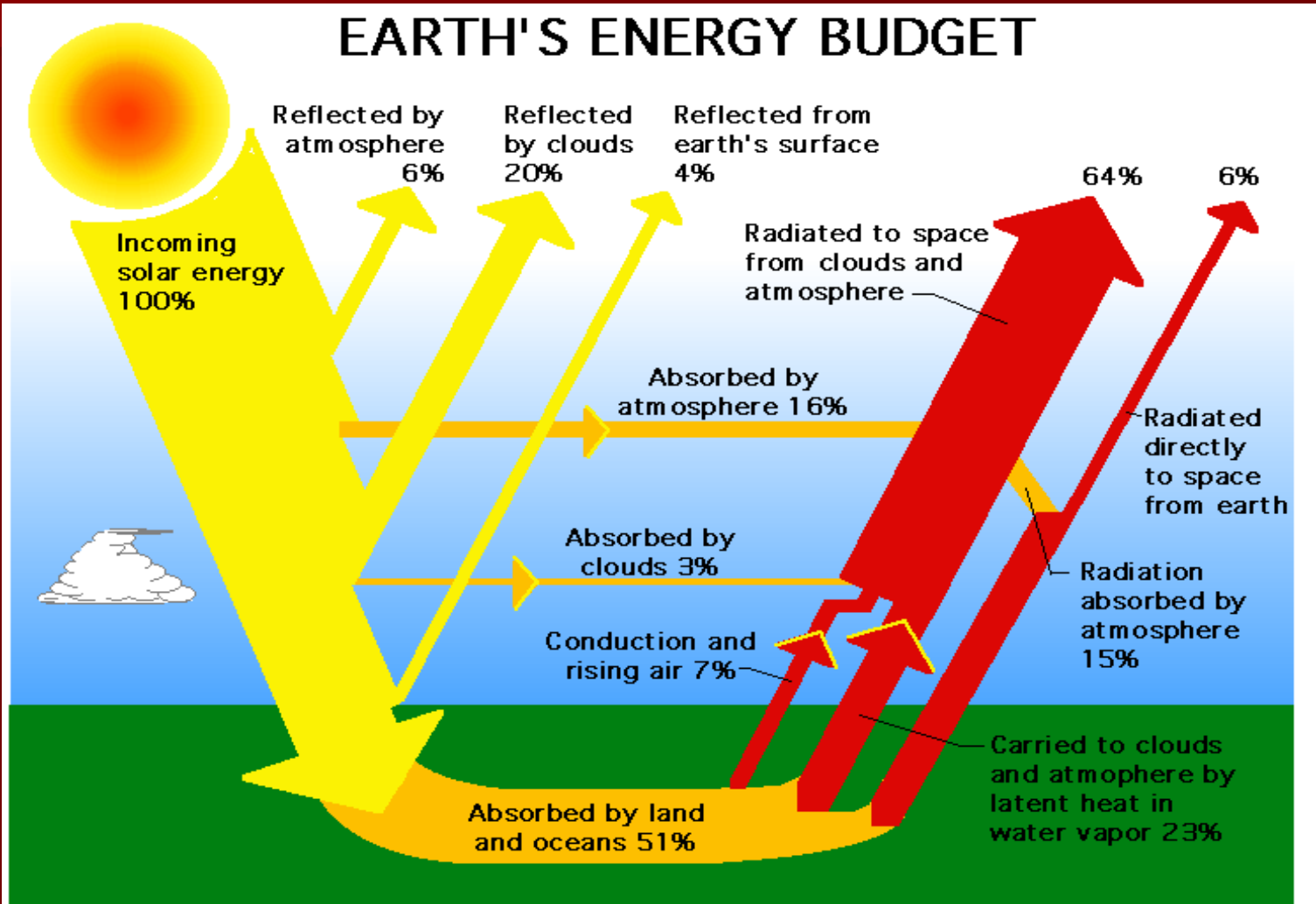
Radiation



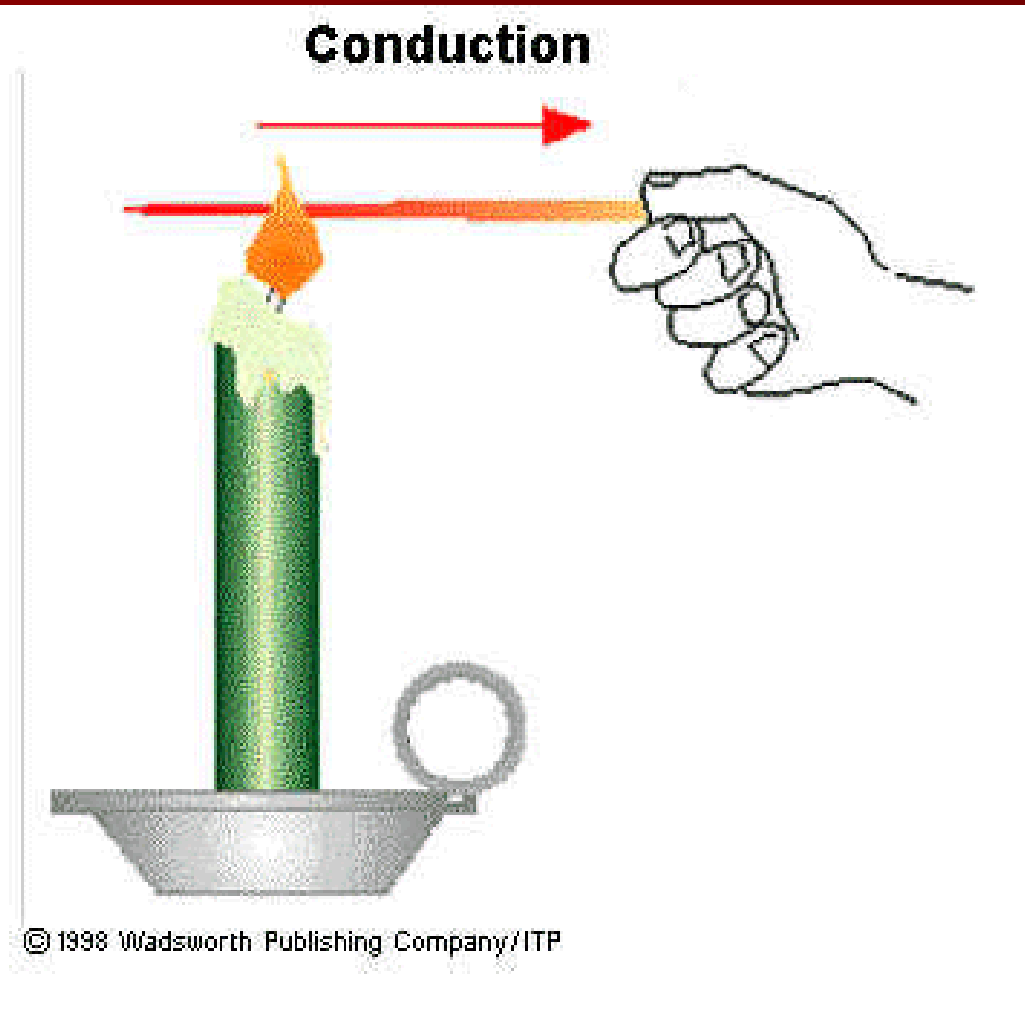
Radiation

- C. Light is a type of electromagnetic wave that carries thermal energy.
1. light from the sun travels 93 million miles to the earth.
 2. as light waves enter Earth's atmosphere, they strike particles in the air and ground and *disperse* their thermal energy.
 3. this process warms the air and ground and provides most of the heat for the planet.

Radiation



Conduction



Conduction

V. Conduction

- A. **Conduction** is the transfer of thermal energy through the direct contact of particles.
- B. Heat flows from the warmer object into the cooler object until they both reach the same temperature.
(thermal equilibrium)

Conduction

- C. The faster moving particles in the warmer object collide with the slower moving particles in the cooler object.
 1. as they collide, they give up some of their energy to the slower moving particles.

Conduction

2. the slower moving particles gain thermal energy and pass it along to other particles.

D. Solids are better **conductors** than liquids, and liquids are better conductors than gases.

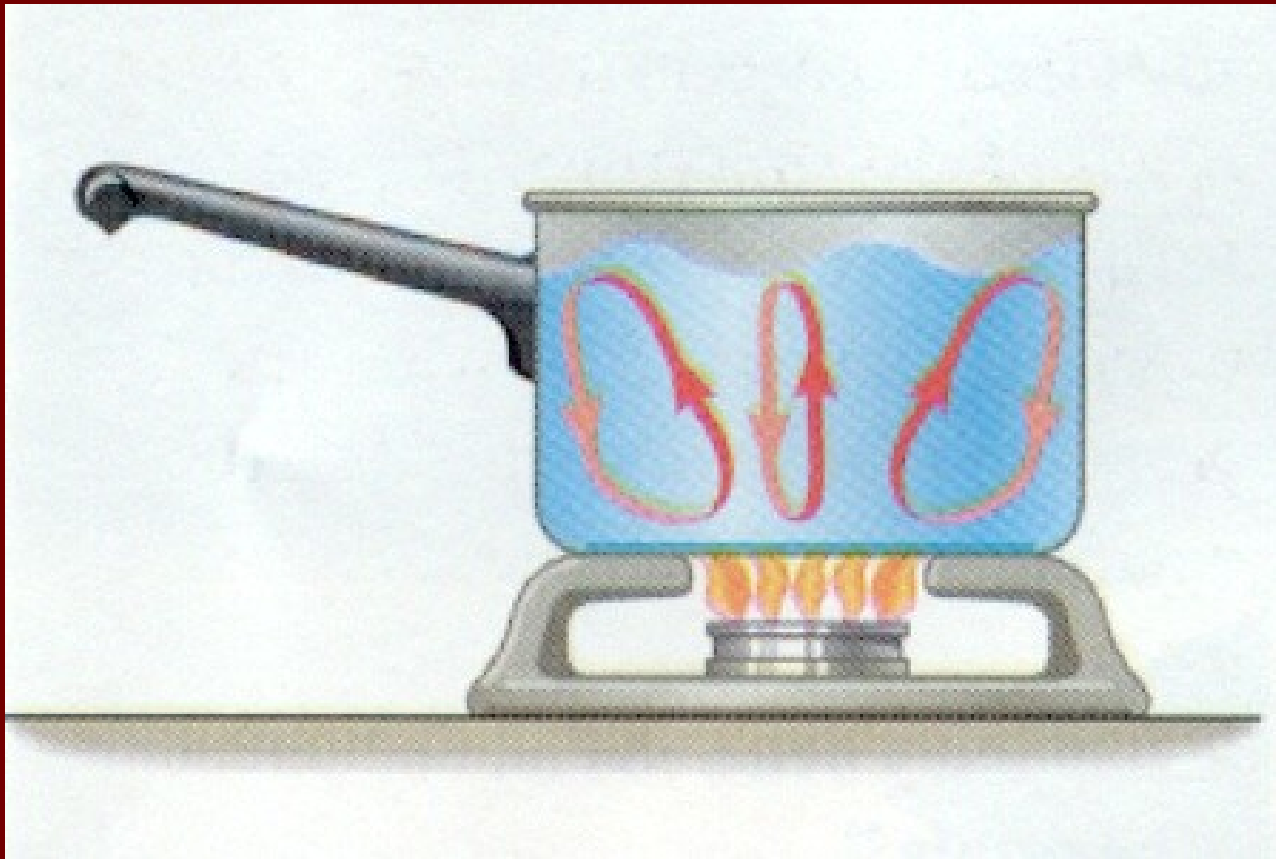
1. metals are good conductors

2. air is a bad conductor

Conduction

- E. The ability to transfer heat within an object is called *thermal conductivity*.
1. gold, silver and copper have high thermal conductivity.
 2. they are also good conductors of electricity.
 3. glass and wool have low thermal conductivity.
 4. they make good *insulators*.

Convection



Convection

VI. Convection

A. **Convection** is the transfer of thermal energy through currents.

B. Convection occurs in liquids and gases.

C. As liquids and gases gain thermal energy, they expand and decrease in density.

Convection

- D. Warmer areas of liquids and gases rise to the cooler areas.
 1. the cooler areas then take the place of the warmer areas.
 2. this movement of particles creates a current of thermal energy throughout a substance.

Convection

