

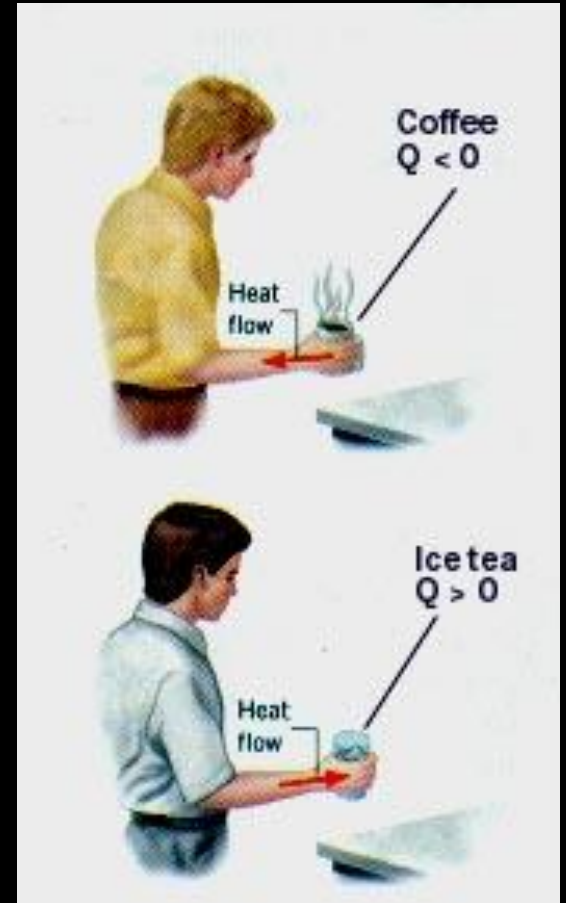
# Thermal Equilibrium

Hot Coffee  $\Rightarrow$  “Cold” Hand

“Warm” Hand  $\Rightarrow$  Ice Tea

Heat will flow from a hot object to a cold object until they are the same temperature.

When two objects are at the same temperature they are in thermal equilibrium.



# Formula--Specific Heat Capacity

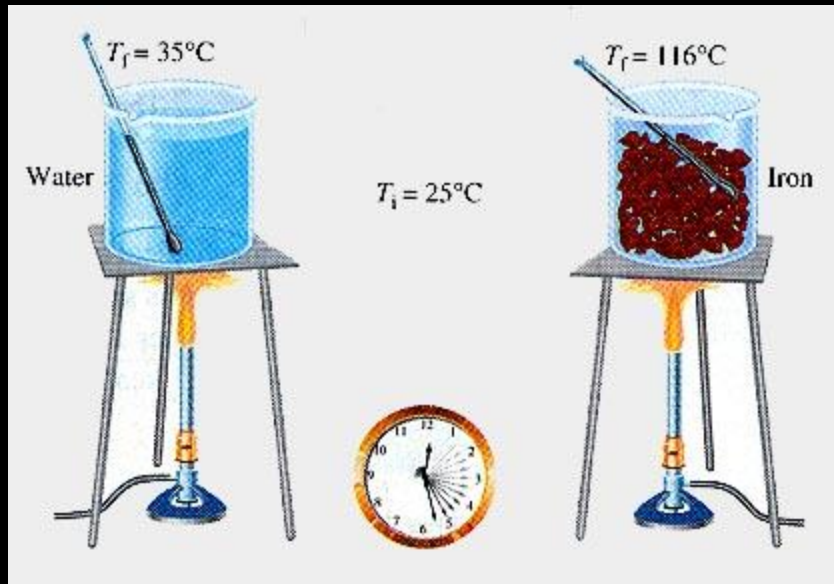
The quantity of heat needed to change a unit mass of the material by a unit amount in temperature.

It is a property of the material.

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$$Q = mc \Delta T$$

# Specific Heat of Water vs. Iron



Same heat is absorbed.

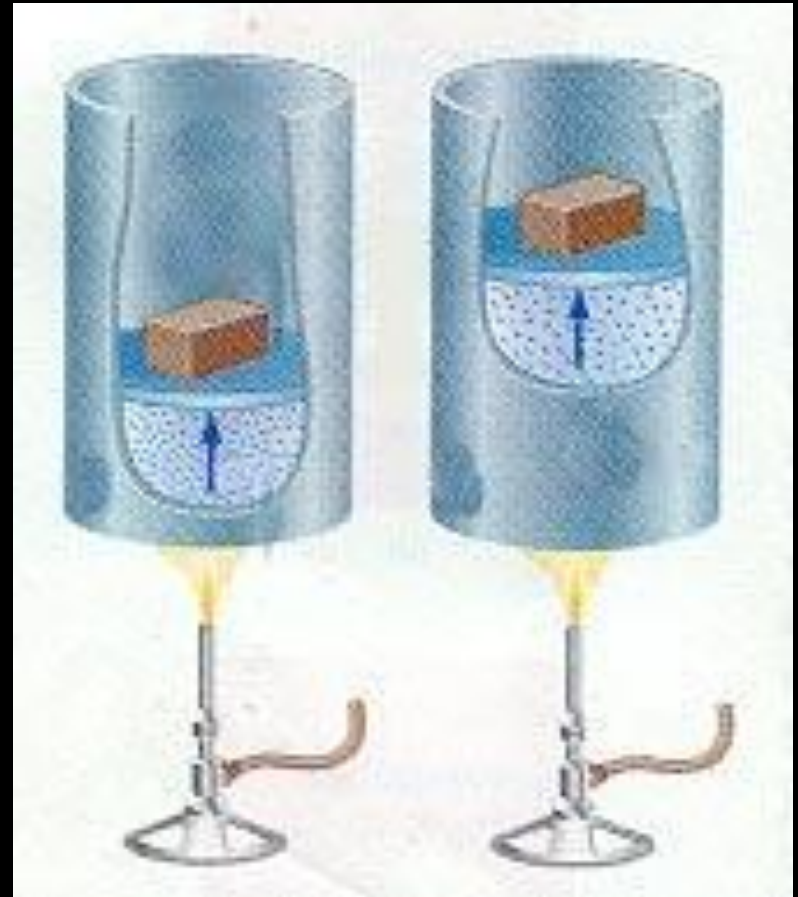
Iron's ability to store heat is less than water's.

Iron's temperature rises more than does the water's.



Heat can do work.

**Heat** from  
flame provides  
energy  
to do work

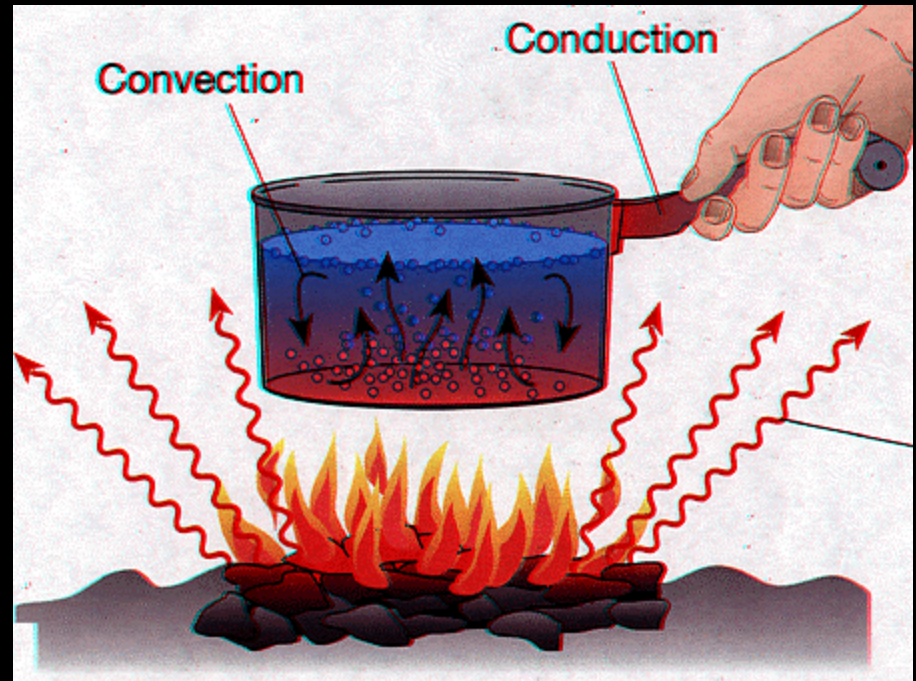


# First Law of Thermodynamics

- Whenever heat is added to a system, it transforms to an equal amount of some other form of energy.
- Heat Added = Increase in internal energy + external work done by the system.

# Three Types of Thermal Energy Transfer

1. Convection
2. Conduction
3. Radiation



# Conduction

- **Conduction** moves heat from one particle to the next.



# Cold Tile

- Thermal energy moves more quickly from your feet.





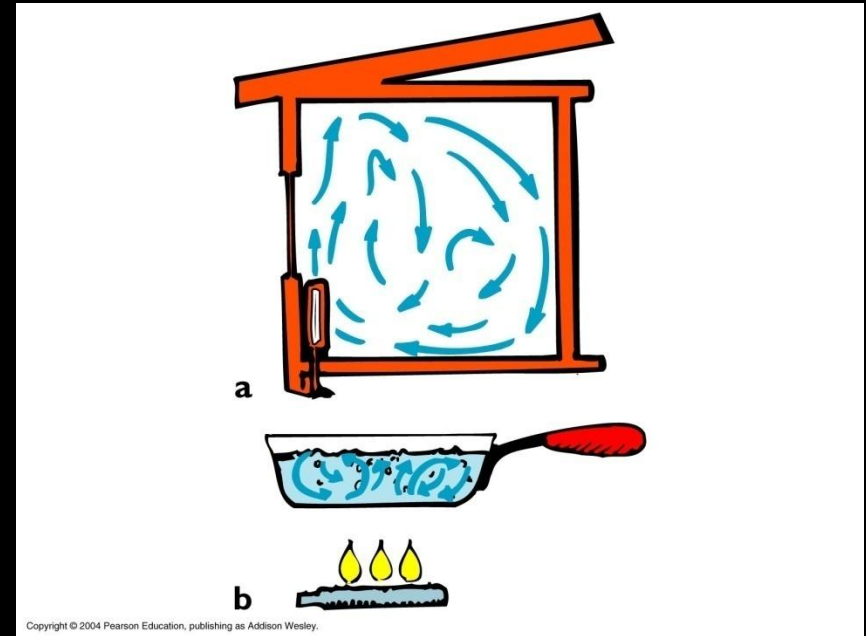
Which home has more insulation in the attic?

# Convection

- is the transfer of heat through the flow of liquids or gases
- The material itself moves from one place to another.
- Examples:
  - Hot air rises through a chimney.
  - House heating

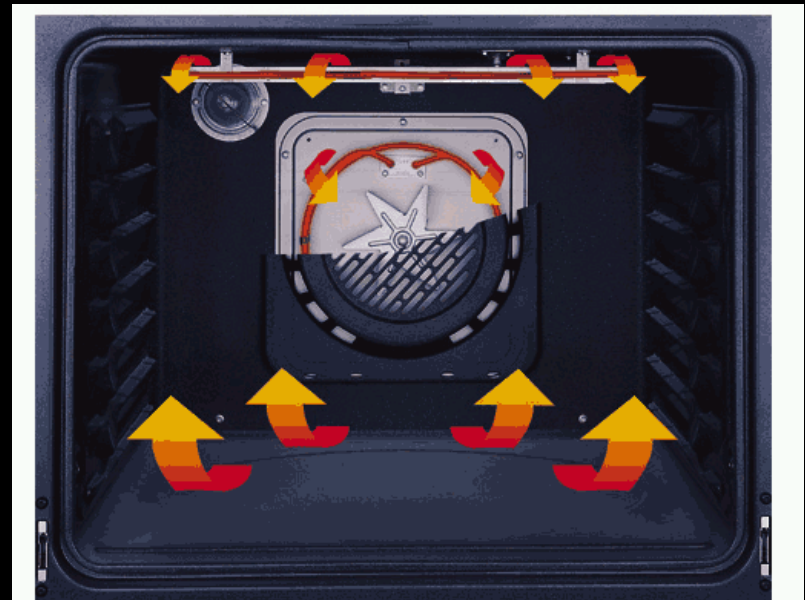
# Convection Currents

- Convection currents in a gas
- Convection currents in a liquid



# Convection Ovens

- Ovens with a fan inside.
- Cooking is sped up by the circulation of heated air.

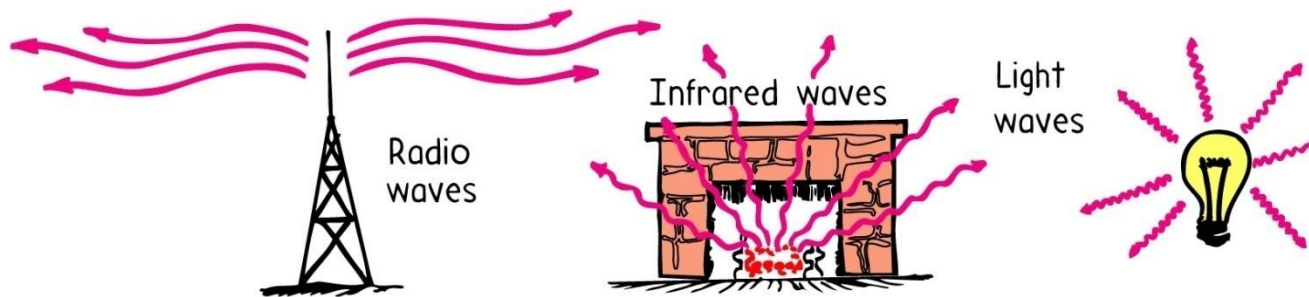


GE Profile™ wall ovens provide excellent convection heat capability. Roasts are beautifully browned, yet tender and juicy inside. Cookies are baked to golden perfection. And meats are broiled to your liking.

# Radiation

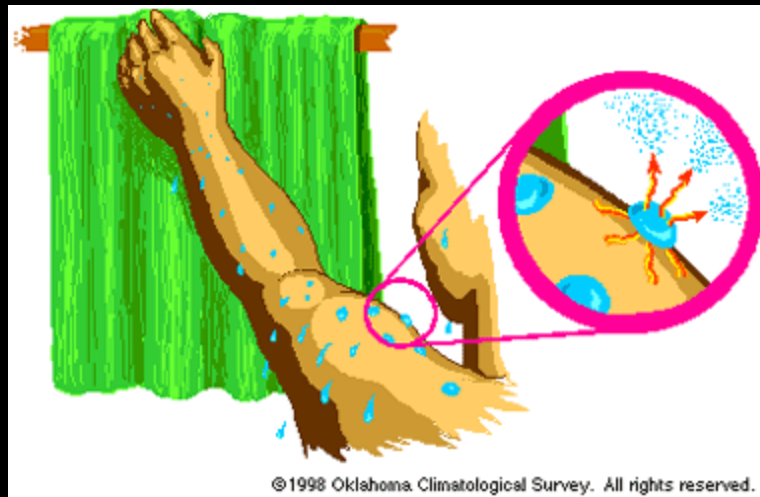
- Radiation is heat transfer by the emission of electromagnetic waves which carry energy away from the emitting object.

# Types of Radiation



# Evaporation

- The change of phase at the surface of a liquid as it passes to the gaseous state.



Evaporation is a cooling process.



# Condensation

- The change of phase from a gas to a liquid.
- Water vapor from surrounding air liquefies.
- Temperature of water in glass increases.



# Review: Evaporation and Condensation

- Outside the shower the water is evaporating.
  - ⇒ Cold
- Inside the shower the steam is condensing.
  - ⇒ Warm



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# Energy and Change of Phase

