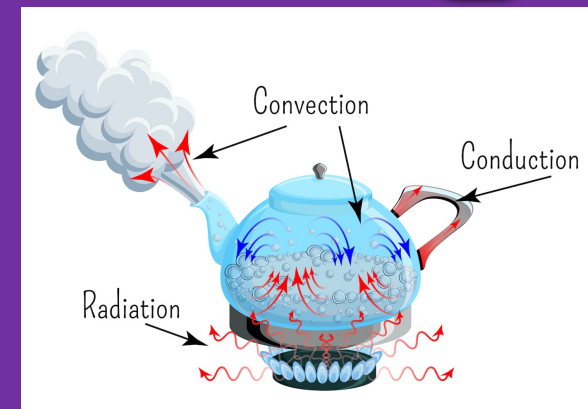
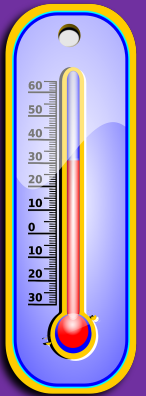
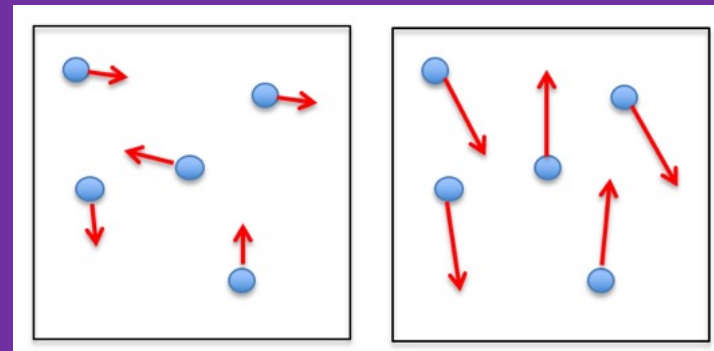


# Thermal Energy, Temperature and Heat

- Thermal Energy vs. Temperature
- Heat and Heat Transfer
- Conduction
- Convection
- Radiation
- Specific Heat Capacity
- Quantity of Heat Gained or Lost ( $Q$ )



# Preview File

Please enjoy this preview of your Student Version of the presentation. Please note within this sample file:

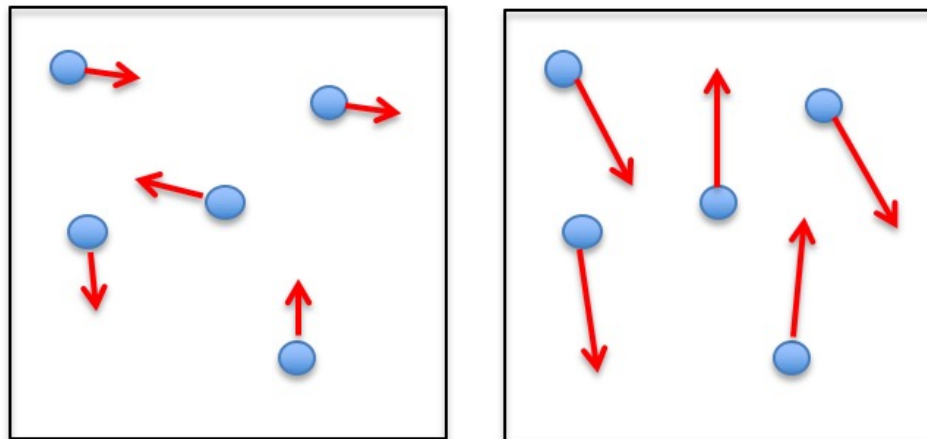
- Some slides appear blank because they have been removed
- Student versions have portions of the text removed which is given in the teacher version and appear as \_\_\_\_\_ which the students are to fill in
- Other slides may have ..... on them, this represents writing that has been removed on this sample

The paid full version of your resource includes  
both Google Slides and PowerPoint and is  
Google Classroom Ready



# Thermal Energy vs. Temperature

- \_\_\_\_\_
  - \_\_\_\_\_
- Temperature is a measure of the average kinetic energy of the atoms or molecules of a substance
  - If particle motion increases, temperature increases
  - If left together long enough, temperature between two substances will equal out



Longer arrows mean higher average speed

# Check Your Understanding

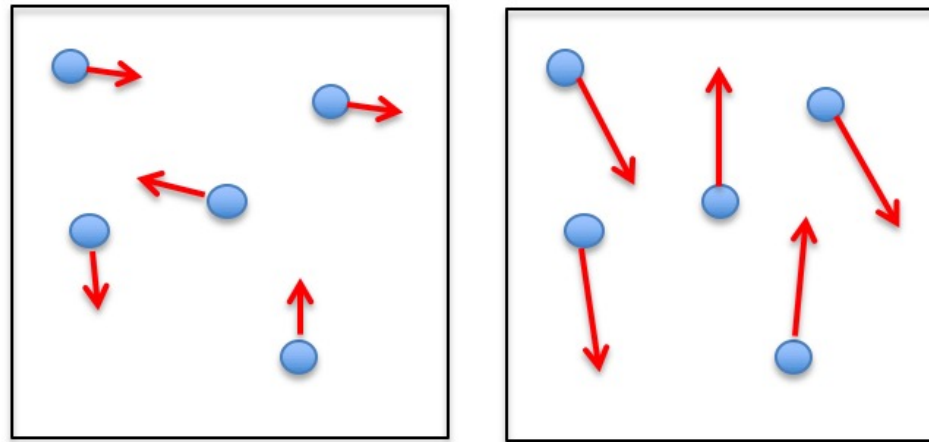
If you have two samples of water each at  $100^{\circ}\text{C}$  but sample A contains 1.0 kg of water and sample B contains 2.0 kg of water:

- a) Which sample's molecules have a higher average kinetic energy? What does this value represent?
- b) Which sample has a greater thermal energy? Why?

**This Slide Has Been  
Removed**

# Thermal Energy vs. Temperature vs. Heat

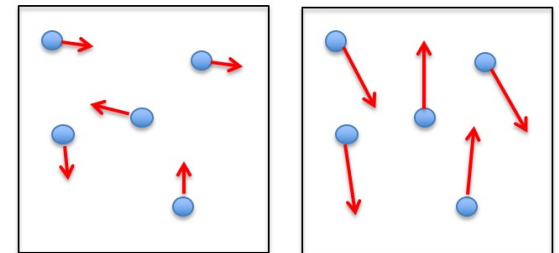
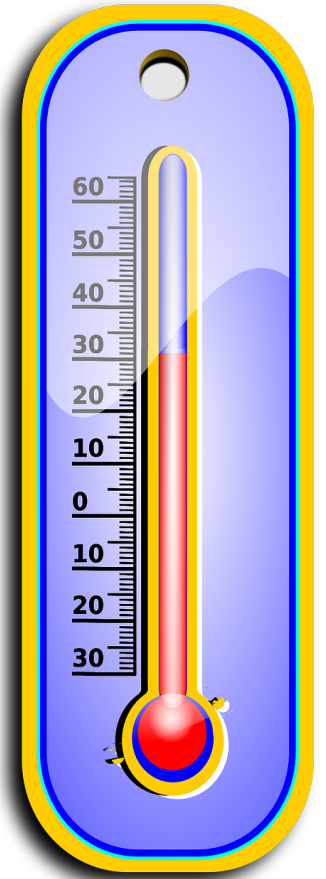
- Thermal Energy is the total energy of a substance ( $E_K + E_g$ )
- Temperature is a measure of the average kinetic energy of the atoms or molecules of a substance
- \_\_\_\_\_



As heat was added to the molecules on the right, they gained kinetic energy. As they gained more kinetic energy their temperature increased.

# Heat

- What is Heat? Heat is energy. Objects cannot possess heat, they can only possess energy.
- When heat is added to a system, energy is added to the atoms
  - This increases the thermal energy and temperature



- \_\_\_\_\_

# Heat Transfer

- Heat moves from one system to another because of differences in system temperatures
- If you have two identical systems with equal temperatures, there will be no flow of energy
- When you have two systems with different temperatures, the energy will flow from hot to cold
  - not necessarily true if you are going from a higher thermal energy to lower thermal energy

- \_\_\_\_\_

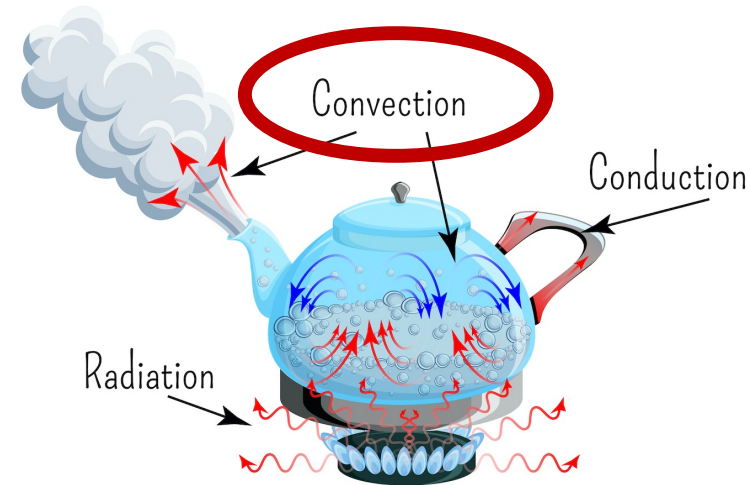


Energy flowing from the hot coffee into the colder surroundings

**This Slide Has Been  
Removed**

# Convection

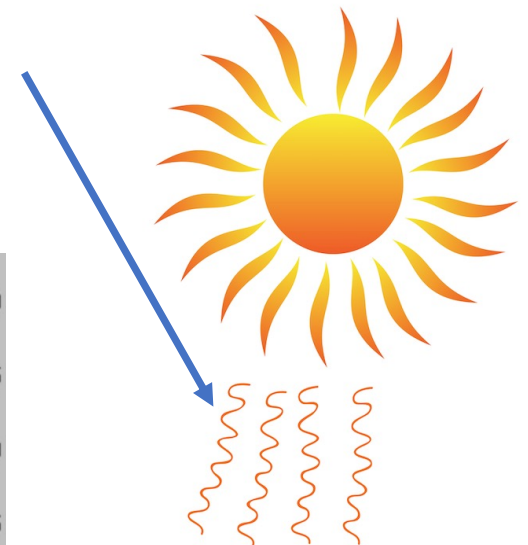
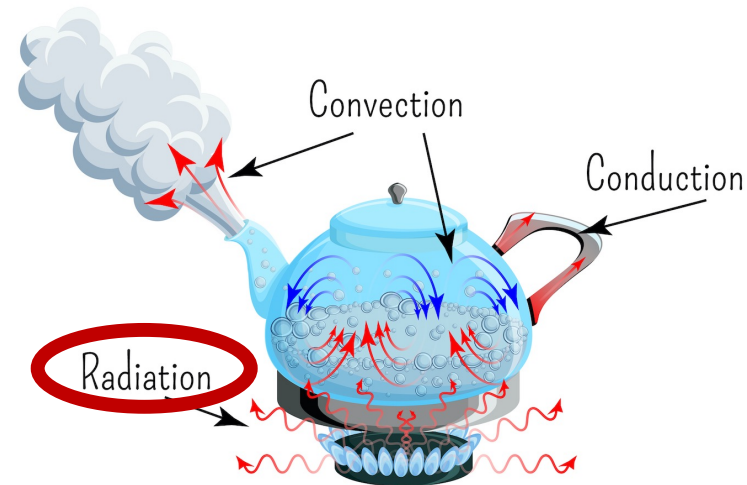
- \_\_\_\_\_
- Particles of the fluid move around, carrying energy with them
- This hot fluid is less dense causing it to rise while the cold fluid moves down
- The thermal .....
- i.e. ovens, home furnaces, kettles, fires



# Radiation

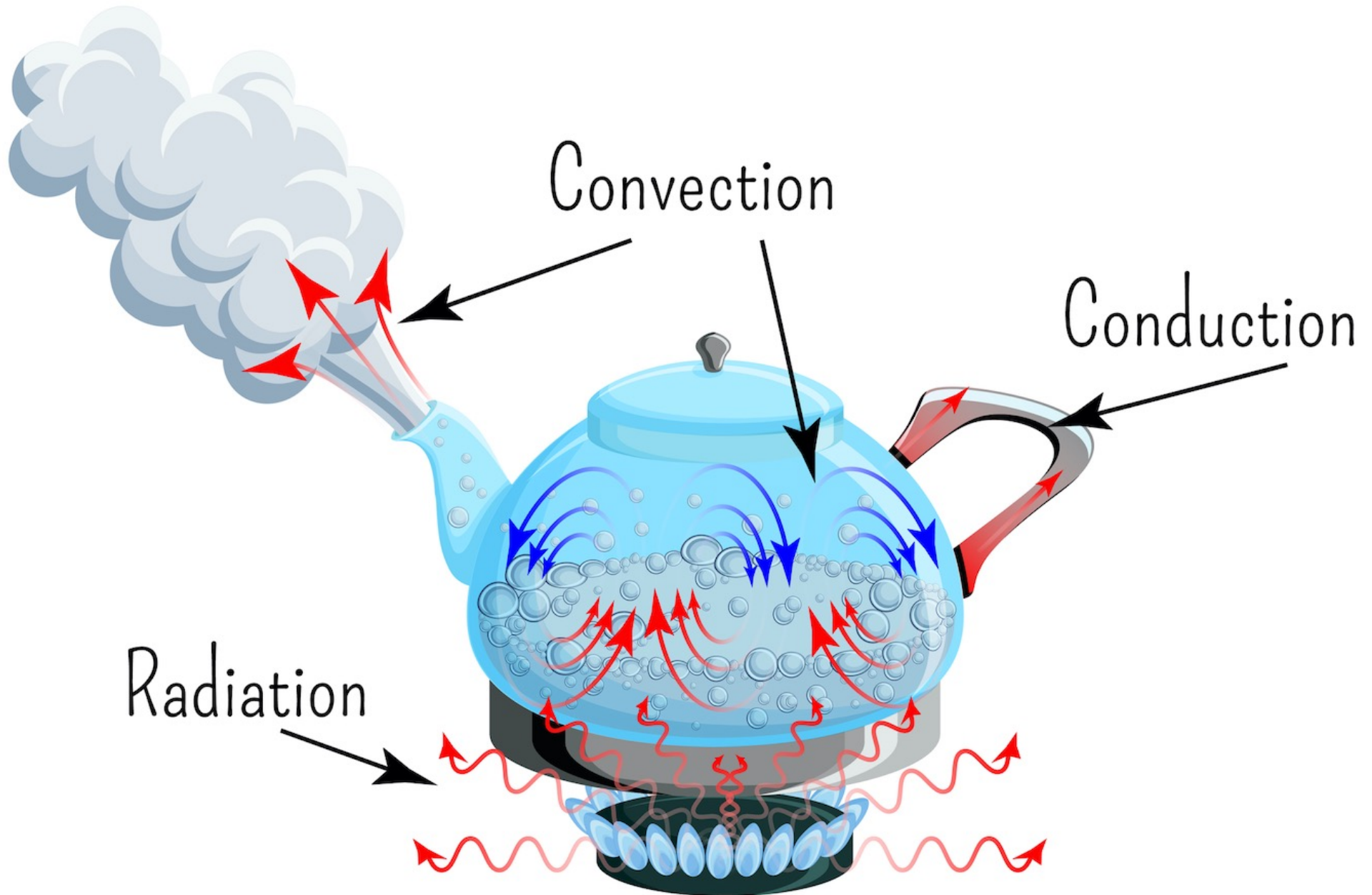
- Transfer of heat via electromagnetic radiation (i.e. visible light, microwaves and infrared)
- The sun transfers heat using all aspects of the EM spectrum

- \_\_\_\_\_



**This Slide Has Been  
Removed**

# Heat transfer methods



# Check Your Understanding

Answer the following questions using terms learned from this lesson.

1. Why would putting a metal skewer into a potato decrease cooking time?
2. Why do clothes irons have plastic handles?
3. Why does smoke rise up the chimney?
4. Why is the floor the best place to put a heater?
5. Why .....

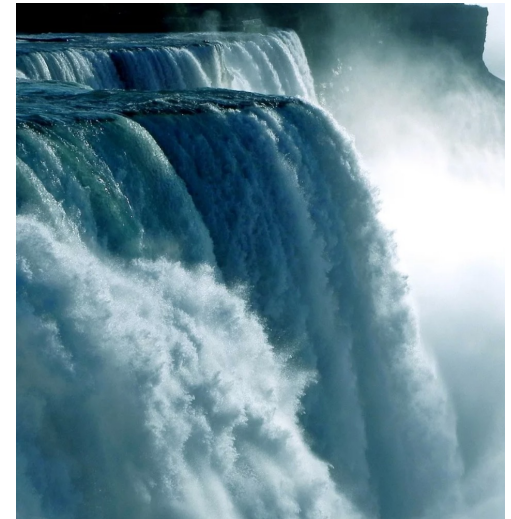
# Calculating Heat Transfer

## Specific Heat Capacity

- 

---

- i.e. water molecules hold heat better than steel molecules and therefore, heat is transferred much faster in steel than in water



**This Slide Has Been  
Removed**

# Quantity of Heat Gained or Lost ( $Q$ )

- The amount of heat gained or lost by a body
- $Q = mc\Delta t$
- $Q$  is a measure of heat energy therefore, the units are in J
- \_\_\_\_\_

# Check Your Understanding

How much heat is needed to raise the temperature of 2.2 kg of water ( $c = 4.18 \times 10^3 \text{ J/kg} \cdot ^\circ\text{C}$ ) from  $20.0^\circ\text{C}$  to the boiling point? Give your answer in MJ.

$$Q = mc\Delta t$$

# Some Specific Heat Capacities

| Substance | Specific Heat Capacity<br>(J/kg•°C) |
|-----------|-------------------------------------|
| Glass     | $8.4 \times 10^2$                   |
| Iron      | $4.5 \times 10^2$                   |
| Water     | $4.18 \times 10^3$                  |
| Alcohol   | $2.5 \times 10^3$                   |

# The Principle of Heat Exchange

- When heat is transferred from one system to another, .....

- Therefore,

$$Q_{\text{lost}} = Q_{\text{gain}}$$

&

$$Q_{\text{lost}} + Q_{\text{gain}} = 0$$

- \_\_\_\_\_

# Check Your Understanding

A 200-g piece of iron at 350°C is placed in 300 g of 10°C water to be cooled quickly. Determine the final temperature of the iron and the water. Notes: 1)  $t_f$  for water and iron will equal 2) The object that loses energy has a  $-Q$  value.

$$c_{\text{water}} = 4.18 \times 10^3$$

$$c_{\text{iron}} = 4.5 \times 10^2$$

$$Q = mc\Delta t$$