Thermal Energy

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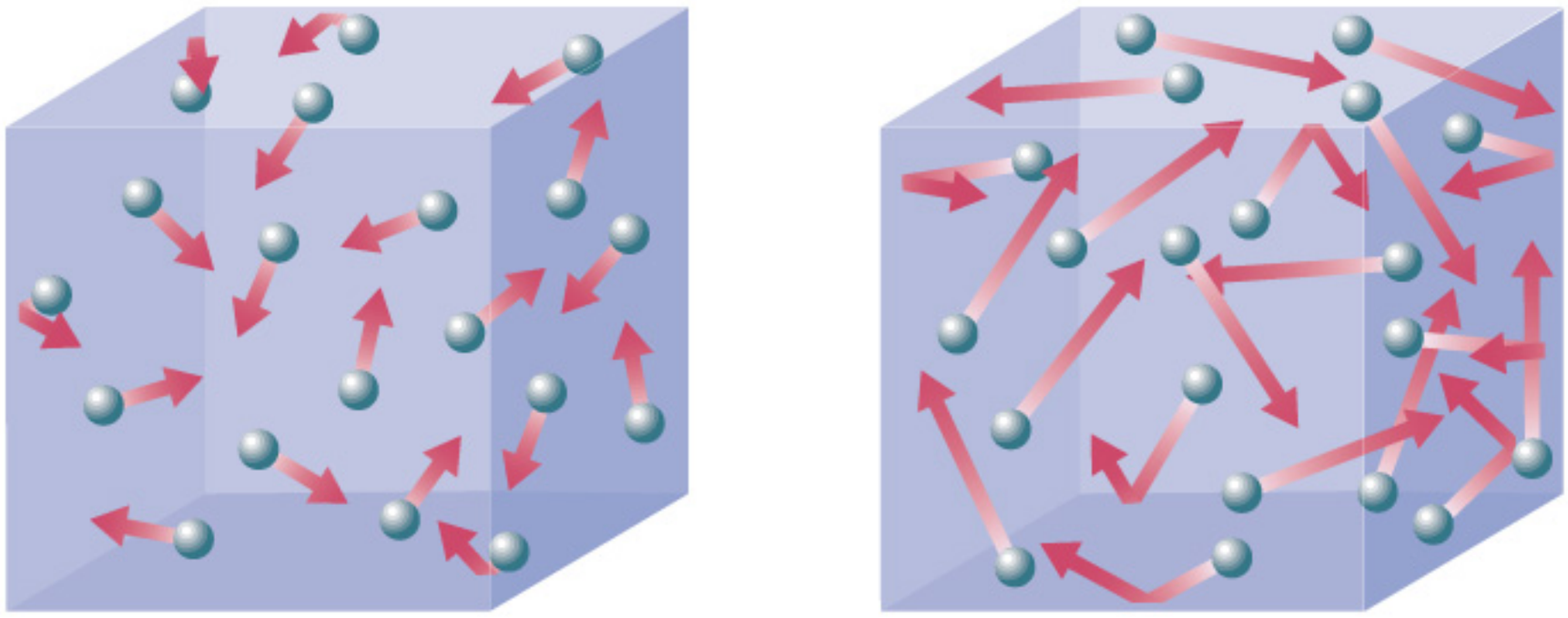
- **Thermal energy** is the **<u>total kinetic energy</u>** of the molecules in an object

- The molecules in a hot object move faster → more kinetic energy → more thermal energy

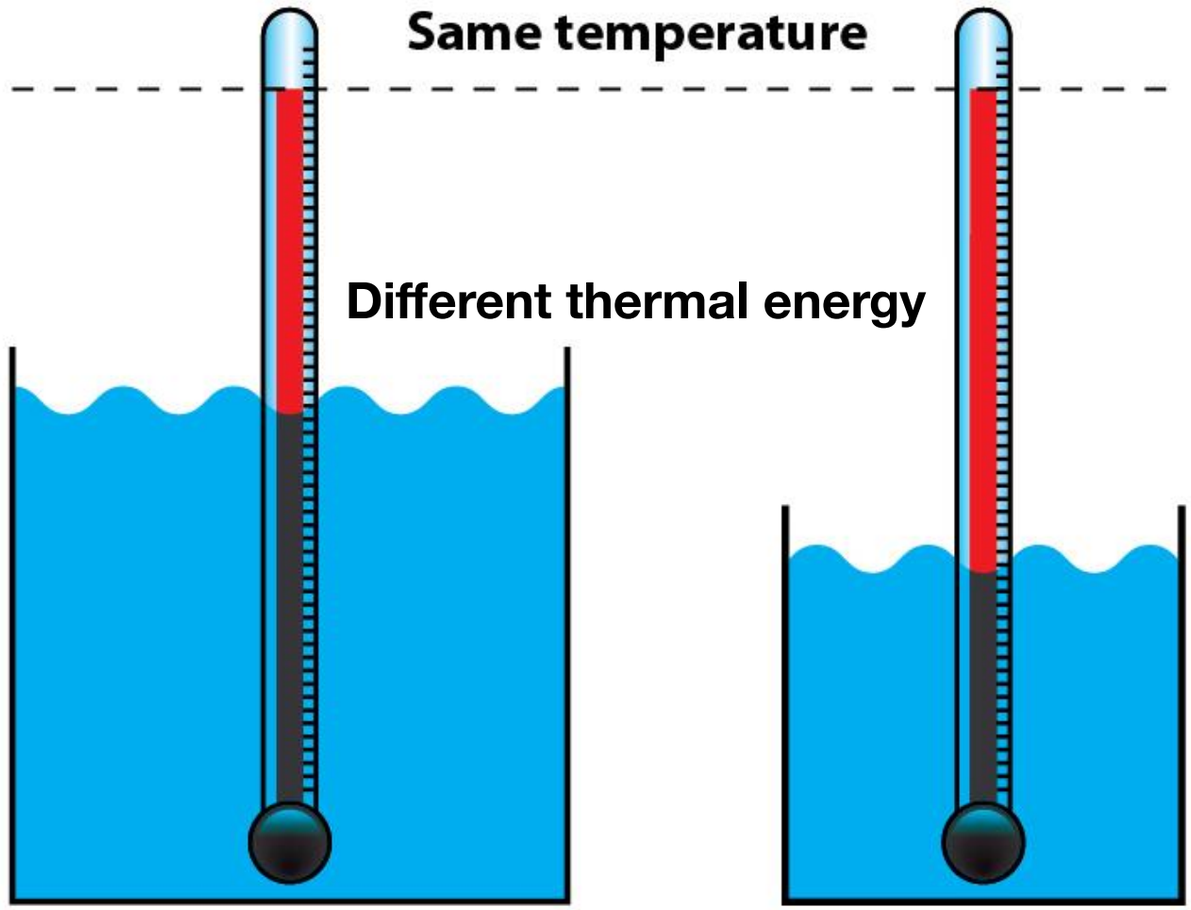


Longer arrows mean higher average speed.

Temperature

- **Temperature** is the **<u>average kinetic energy</u>** of the molecules in an object

- ex. a puddle of water and a swimming pool may both be at room temperature but the swimming pool will have more thermal energy



Heat

- **Heat** is the energy transferred between two objects of different temperature

$$Q = mc\Delta T$$

- **Q : Heat (J)**
- **m : mass (kg)**
- **c : specific heat capacity (J/kg·K)**
- **ΔT : change in temperature (K or °C)**

Specific Heat Capacity

- **Specific heat capacity** is the amount of energy needed to raise the temperature of 1 kg of a substance by 1 K

Material	Specific Heat Capacity (J/kg·K)
Lead	130
Copper	385
Iron	450
Glass	664
Methanol	2450
Water	4180

Example

How much work is required to heat 2 L of water from 20°C to 100°C?

1 L of water has a mass of 1 kg. Water has a specific heat capacity of 4180 J/kg·K.

Conservation of Energy

- Suppose two objects of different temperature are placed in contact.

- The heat lost by one will be equal to the heat gained by the other.

$$Q_A = -Q_B$$

- Thermal energy will be transferred until the objects are at the same temperature. (ie. $T_{A,f} = T_{B,f} = T_f$)

Example

A 2.8 kg chunk of aluminum at 1500°C is plunged into 55 L of fresh water at 10°C. What is the final temperature at which they meet?

Aluminum has a specific heat capacity of 903 J/kg·K; water has a specific heat capacity of 4180 J/kg·K.