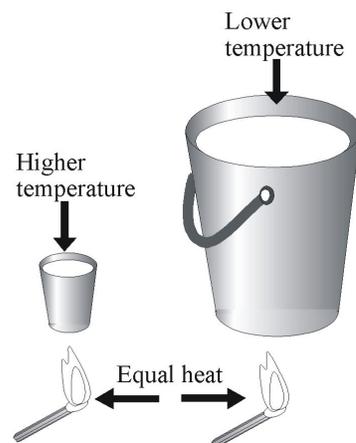


## Calculating Joules

When you heat a solid, its temperature generally goes up. There is a relationship between heat and temperature, but they are not the same thing. It would take a lot more energy to heat up the ocean than to warm a cup of tea. The ocean has a larger mass. It has many more molecules to share energy with. Mass is not the only thing that influences the way the temperature changes in response to heat. When the same sun beats down on the beach, the sand gets a lot hotter than the water. Water has a higher heat capacity than sand. The relationship between mass, temperature change, specific heat, and energy are shown below.



$$Q = mC_p\Delta T$$

$Q$  = heat (J)       $m$  = mass in grams

$\Delta T$  = change in temperature [ $\Delta T = T_f - T_i$ ]

$T_f$  = final temperature

$T_i$  = starting temperature

$C_p$  = 4.18 J/g°C

### Sample Problem

How many joules are needed to heat 50.0 grams of water from 20.00°C to 25.00°C?

$$\Delta T = 25.00^\circ\text{C} - 20.00^\circ\text{C} = 5.00^\circ\text{C}$$

$$Q = (50.0\text{g})\left(4.18\frac{\text{J}}{\text{g}^\circ\text{C}}\right)(5.00^\circ\text{C}) = 1050\text{J}$$

Answer the questions below based on the procedure in the example above.

- How many joules are needed to change the temperature of 100 g of water from 20°C to 40°C?
- How many joules are needed to change the temperature of 15 g of water from 65°C to 95°C?
- How many joules are needed to change the temperature of 40 g of water from 33°C to 23°C?
- How many joules are needed to change the temperature of 25 g of water from 40°C to 100°C?
- How many joules are needed to change the temperature of 22 g of water from 18°C to 33°C?
- What is the final temperature of a 5.0 g sample of water at 25°C if 832 J of heat are added?