Specific Heat Notes

- Heat (q) is the _____ (energy of motion, kinetic energy), measured in Joules (J) or calories (cal)
  - A food Calorie (Cal) is 1000 cal or 1 kcal
  - 1 cal = 4.184 J (We will use J exclusively)

- Temperature (T) is the *average* kinetic energy of a sample, measured in °C or K

  Temperature is not the same as thermal energy (or heat).
  - Thermal Energy is the sum of the kinetic energies of all of the particles: bathtub @ 40°C has more thermal energy than a cup of tea at 90°C

- Specific Heat (c) is the _____ _____
  - Measures how easy it is to change the temperature of a material by adding/removing energy (heat)
  - Water has one of the highest specific heats: $c = \frac{1\text{ cal}}{\text{g}\cdot°\text{C}} = \frac{4.184\text{ J}}{\text{g}\cdot°\text{C}}$
    - Difficult to change T of H_2O (requires a large amount of heat)
  - Other materials have lower c values
- Calculations involving energy & specific heat
  - During heat transfer, q = (m)(c)(ΔT), where
    q is heat (energy) in J
    m is the mass of the sample, in g
    c is the specific heat
    $\Delta T = T_{final} - T_{initial}$ is the temperature change
  - Ex: 5.00 g of water increases in T by 2.00°C. What is the energy absorbed?
    - $q = (5.00\ \cancel{g})\left(4.184\frac{\text{J}}{\cancel{g}\cdot\cancel{°\text{C}}}\right)(2.00\ \cancel{°\text{C}}) = 41.8\text{ J}$
  - ex: The specific heat of calcium = 0.647 J/g·°C. What is the final temperature if 20.0 g Ca at 21.3°C absorbs 135 J heat?
    - $q = mc\Delta T \Rightarrow \Delta T = \frac{q}{mc} = \frac{135\ \cancel{J}}{(20.0\ \cancel{g})\left(0.647\frac{\cancel{J}}{\cancel{g}\cdot°\text{C}}\right)} = 10.4°\text{C};\ T_{final} = 21.3°\text{C} + 10.4°\text{C} = \boxed{31.7°\text{C}}$

Problems:

1. How much heat is needed to raise the temperature of a 55.0 g sample of aluminum (c = 0.900 J/g·°C) from 22.4°C to 94.6°C?

2. What is the final temperature of a 28.2 g sample of iron (c = 0.450 J/g·°C), originally at 20.0°C, that absorbs 3.50 kJ heat?

Answers: 1) 3570 J; 2) 296°C