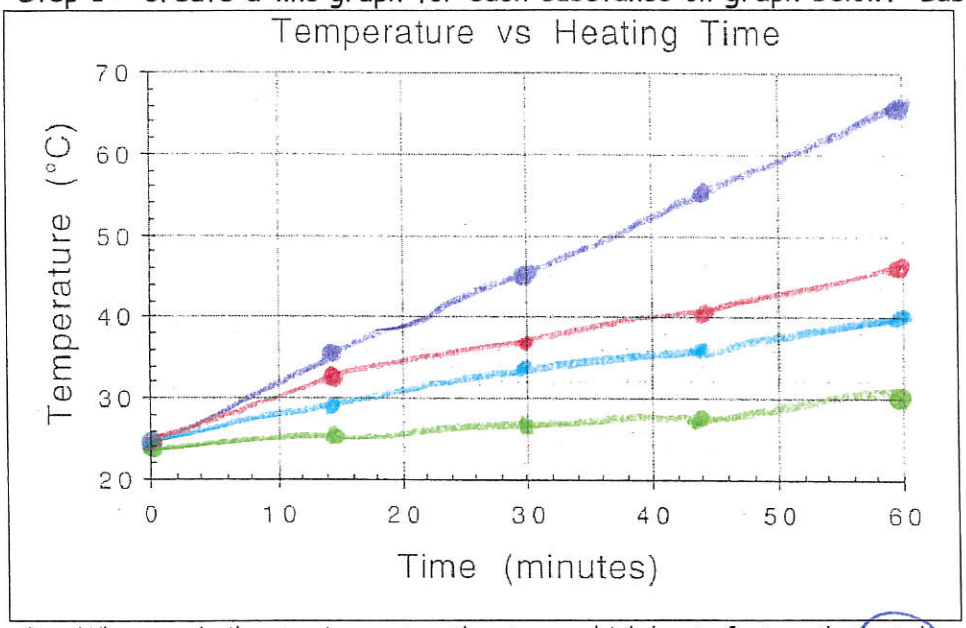
Name:_____ Per:_____

Worksheet- Introduction to Specific Heat Capacities

Heating substances in the sun: The following table shows the temperature after 10.0 g of 4 different substances have been in direct sunlight for up to 60 minutes.

Time (minutes)	Air (° C)	Water (° C)	Sand (° C)	Metal (° C)
0 (initial)	25°C	25°C	25°C	25°C
15.0 min	28.9°C	26.2°C	30°C	35°C
30.0 min	32.5°C	27.5°C	35°C	45°C
45.0 min	36.2°C	28.8°C	40°C	55°C
60.0 min	40°C	30°C	45°C	65°C

Step 1: Create a line graph for each substance on graph below. Label the substances.



Step 2: Answer questions

1. Order the substances based on the time required to heat them from :
   slowest ↓ fastest
   water
   air
   sand
   metal

2. Which do you think will cool the fastest? Explain
   metal - conductors allow easy heat transfer

3. When you boil water in a pot on the stove, which heats faster, the metal or the water? Explain.
   lower specific heat (conductor)

4. Why do you think different substances heat up and cool down at different rates?
   Conductors = diff structures of materials allow it to store / transfer heat differently vs insulators

***Specific heat capacity = the amount of heat needed to raise the temperature of 1 g of a substance by 1 degree. ***

5. Based on the definition above, which of the 4 substances do you think has:
   a) the highest specific heat capacity? water
   b) the lowest heat capacity? metal

6. Here are the heat capacities of the four substances: 4.18 J/g °c, 1.00 J/g °c, 0.80 J/g °c, & 0.60 J/g °c. *Match & then label each substance with its specific heat capacity on the graph.*
   metal 0.60 J/g °c
   water 4.18 J/g °c
   air 1.00 J/g °c
   sand 0.80 J/g °c

7. If something has a **high specific heat capacity** will it take a lot of heat or a little heat to change its temperature? Explain. (careful! Use the definition, your graph, and the data from #6)
   a lot; insulators prevent easy transfer of heat

8. Assuming they both start at the same temperature, which will heat up faster, a swimming pool or a bath tub? Explain your thinking.
   Bath tub because of less mass

EXAMPLE

- How much energy is required to heat 35 grams of gold from 10°C to 50°C?

Looking for	Solution
The heat energy in joules to heat 35 grams of gold by 40°C.	$Q = mc_p(T_2 - T_1)$ $Q = (0.35\text{ kg})\left(129\frac{J}{kg\cdot°C}\right)(50°C - 10°C)$ $Q = (0.35\text{ kg})\left(129\frac{J}{kg\cdot°C}\right)(40°C)$ Q = 1,806 joules 180,600J To produce the necessary change in temperature, 1,806 joules of heat energy need to be put into this sample of gold.
Given Mass = 35 grams = 0.35 kilogram Specific heat of gold = 129 J/g°C T_2 = 50°C and T_1 =10°C	
Relationship $Q = mc_p(T_2 - T_1)$	

We did grams!

1-4 at least one

a. Perform calculations using: ($q = m \cdot c \cdot \Delta T$) b. Determine if it's endothermic or exothermic

1. Gold has a specific heat of 0.129 J/(g×°C). How many joules of heat energy are required to raise the temperature of 15 grams of gold from 22 °C to 85 °C?

$Q = 15g\left(0.129\frac{J}{g°C}\right)(85° - 22°)$

$= 121.9\text{ J}$

Endothermic or exothermic?_____

2. An unknown substance with a mass of 100 grams absorbs 1000 J while undergoing a temperature increase of 15 °C. What is the specific heat of the substance?

$1000\text{J} = 100g(c)(15°)$

$C = 0.67\text{ J/g°C}$

Endothermic or exothermic?_____

3. If the temperature of 34.4 g of ethanol increases from 25 °C to 78.8 °C, how much heat has been absorbed by the ethanol? The specific heat of ethanol is 2.44 J/(g×°C)

$Q = 34.4g(2.44)(78.8° - 25°)$

$= 4516.8\text{ J}$

Endothermic or exothermic?_____

4. Graphite has a specific heat of 0.709 J/(g×°C). If a 25 gram piece of graphite is cooled from 35 °C to 18 °C, how much energy was lost by the graphite?

$Q = 25g(0.709)(18° - 35°)$

$= -301.3\text{ J}$

Endothermic or exothermic?_____

5. Copper has a specific heat of 0.385 J/(g×°C). A piece of copper absorbs 5000 J of energy and undergoes a temperature change from 100 °C to 200 °C. What is the mass of the piece of copper?

$5000\text{J} = m(0.385)(200° - 100°)$

$m = 129.9\text{ g}$

Endothermic or exothermic?_____

6. 45 grams of an unknown substance undergoes a temperature increase of 38 °C after absorbing 4172.4 Joules. What is the specific heat of the substance? Look at the table on page 513 of your book, and identify the substance.

$4,172.4\text{J} = 45g(c)(38°)$

$C = 2.44\text{ J/gC}$ ethanol

Endothermic or exothermic?_____

7. A 40 g sample of water absorbs 500 Joules of energy. How much did the water temperature change? The specific heat of water (liquid) is 4.18 J/(g×°C).

$500\text{ J} = 40g(4.18)(\Delta T)$

$\Delta T = 2.99°C$

Endothermic or exothermic?

8. If 335 g of water at 65.5 °C loses 9750 J of heat, what is the final temperature of the water? Liquid water has a specific heat of 4.18 J/(g×°C).

$9750\text{J} = 335g(4.18)(\Delta T)$

$\Delta T = 6.96$

$T_f = 65.5° - 6.96° = 58.5°C$

Endothermic or exothermic?