CST

Chem 3a
7a, b, d

Hot Cement

ChemCatalyst:

- What difference do you notice about the data?
- What could account for the differences in avg. temperature?

Notes:

- What is Specific heat capacity?

- Specific heat: amount of heat needed to raise the temperature of 1 gram of a substance by 1°C
- it takes more heat to change the temperature of water vs. a metal pan
  - because water has a higher heat capacity
    - it takes more heat energy to change the temperature
  - metal has low heat capacity
    - it takes less heat energy to change its temperature

Hot Cement

Name: _____

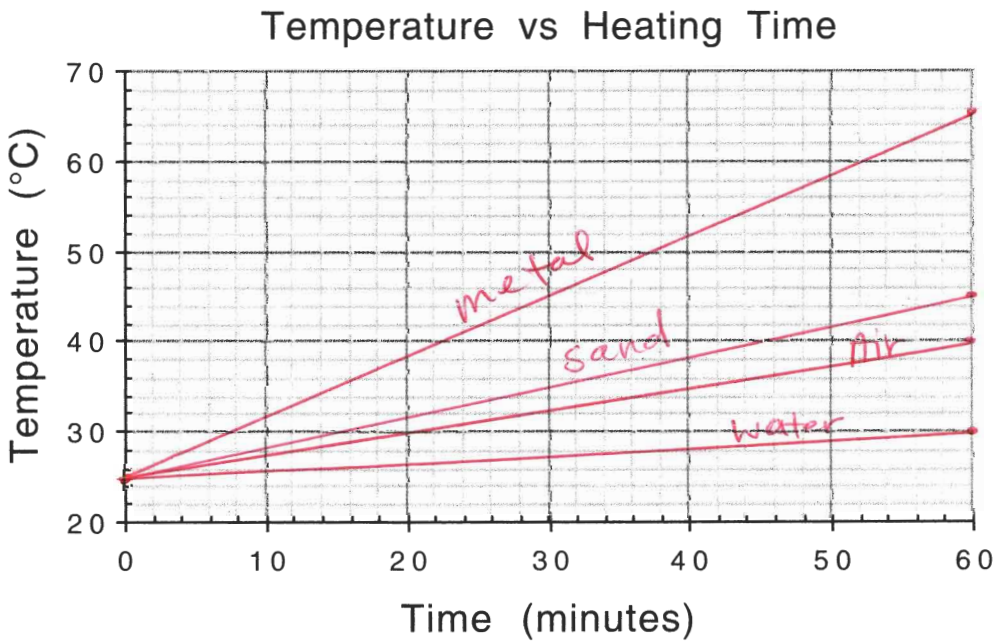
Date: _____Period: _____

Purpose: This activity allows you to compare the specific heat capacities of various substances.

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

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

Graph the data.



Answer the following questions:

1. Put the substances in order of the time required to heat them from slowest to fastest. water, air, sand, metal
2. Which do you think will cool the fastest? Explain your reasoning.

metal, steepest rate of change

3. When you boil water in a pot on the stove, which heats faster, the metal or the water? metal
4. If you place 10 g of hot metal at 100°C into water at 25°C, what will happen to the temperature of each? Will the metal cool by a little or a lot? Will the water warm by a little or a lot? metal will cool a lot
   water will warm a little

Specific heat capacity is the amount of heat required to raise the temperature of 1 g of a substance by 1 degree.

5. Which substance has the highest specific heat capacity? water
6. Here are the heat capacities of the four substances: 0.10 cal/ g °C, 0.25 cal/ g °C, 1.0 cal/ g °C , and 0.2 cal/ g °C. Match each substance with its specific heat capacity. water ↑ metal, ↗ air, ↘ sand
7. Which substance has the lowest heat capacity? metal
8. If something has a high specific heat capacity will it take a lot of heat or a little heat to change its temperature? a lot
9. Which will heat faster, a swimming pool or the ocean? Explain your thinking.

10. If you have more grams of a substance, will it take more time or less time to heat the substance? more
11. Use the data in the table to determine how hot 20.0 g of water will be after 60 minutes. 27.5°C
12. How do you think specific heat capacity affects the weather?

13. In the late afternoon after the sun has been shining, what do you think happens to the temperature of the air as it moves from the ocean to the land? Explain your reasoning. heated

14. Why is the range of temperature small over the ocean? Why is the range in temperature so large in the center of the United States?
    water has ↑ heat capacity
15. What difference in temperature do you predict for the soil and water samples? Explain your reasoning.

Making sense question:
Use specific heat capacity to explain why some regions have very mild climates and other regions have severe climates with a wide range of temperatures.

If you finish early…
The winds blow from west to east across the United States. Use this fact to explain why the West Coast city of San Francisco is warmer in the winter and cooler in the summer than the East Coast city of Washington, D.C. Both are at the same latitude.

Making Sense Notes:

- Why do some substances have high specific heat capacity & others low?

- different substances require different amounts of heat in order to raise their temperature
  - substances w/ high specific heat capacity require more heat to raise their temp.
    - takes more energy to move the molecules faster due to strong intermolecular forces
    - ex: water
    - also cool down more slowly
  - substances w/ low specific heat capacity require less heat to raise their temp.
    - takes less energy to move the molecules
    - also cool down quickly
    - ex: metal pot

- How do you calculate the specific heat (q) of a substance?

- specific heat is symbolized w/ a "q"
- $\boxed{q = c \times m \times \Delta T}$
  - q = in J (Joules) units
  - c = specific heat capacity for the substance
  - m = mass in grams
  - ΔT = change in T (in °C)
- ex: A 20.0g sample of water is heated from 25.0°C to 35.0°C. How much heat is required? ($c_{water} = 4.180\ J/g°C$)

$$q = 4.180\ J/g°C \times 20.0g \times (35.0°C - 25.0°C)$$
$$= \boxed{836\ J}$$