**Exploring Thermochemistry** Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Each group of 4-5 is work cooperatively and discuss observations and opinions related to acids and bases, and then present one section of the activity on one large sheet of butcher paper.

The group will assign the following task managers:

* Lab Technicians (2-3) to conduct the experimentation for the group.
* Recorder to compile the findings of the group on their individual worksheets and submit them to the teacher for the collective group
* Director who keeps the group on task, makes certain that the various questions are being answered, progress is being made, and tasks completed.

**Learning Goal:**

TSW explore the important properties of thermochemistry.

TSW apply thermochemistry concepts and laws to real life.

TSW formulate the basic understandings of heat, temperature, and enthalpy.

**Pre-Activity Questions:**

What do you know about Heat, that is what is heat?

How could you define temperature?

How are temperature and heat related?

Why do some things get hotter faster than others?

Describe what happens with energy related to bond breaking and forming.

How is energy transferred with changes in state?

**Part 1: Specific Heat Capacity**

Make a prediction about the following –

Which of the four metals (Al, Zn, Cu, Pb) is the heaviest?

Which of the four metals (Al, Zn, Cu, Pb) is the most dense?

Which of the four metals (Al, Zn, Cu, Pb) will transfer the most heat to another object?

**Activity:**

On a ring stand, heat 500ml of water to a boil. Record the temp of the boiling water. Add the four metals to the boiling water. After 3-5 minutes remove the metals one at a time and place into a Styrofoam cup containing 100ml of water. Record the temperature of the water in the cup before and after the metal is added.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Density | Mass | Temp Before | Temp After | Temp Change |
| Al | 2.69 |  |  |  |  |
| Fe | 7.87 |  |  |  |  |
| Zn | 7.13 |  |  |  |  |
| Cu | 8.96 |  |  |  |  |
| Pb | 11.4 |  |  |  |  |

Answer the following after exploring the four metals –

What observations can you make about the change in temperature?

Identify some of the differences between the four metals.

What impact did density have on the temperature change?

What impact did mass have on the temperature change?

**Part 2: Heat Transfer of Aluminum**

Make a prediction about the following –

What will happen to the water when heated aluminum metal is added?

What effect will the amount of water have on the temperature change?

What effect will the amount of time heated have on the temperature change?

**Activity:**

Carefully heat a piece of aluminum metal in a Bunsen burner flame for a set amount of time and then add the metal to a Styrofoam cup. Record the temperature of the water in the cup before and after the metal is added. You may also choose to modify the amount of time heated or the starting temperatures.

Observe.

|  |  |  |  |
| --- | --- | --- | --- |
| Volume | Temp Before | Temp After | Temp Change |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Time Heated | Temp Before | Temp After | Temp Change |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Starting Temp | Temp Before | Temp After | Temp Change |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

Answer the following after exploring the heating Aluminum–

What effect did the volume have on the temperature change?

What about the time heated or starting temperature?

**Part 3: Temperature Mixing**

What is the difference between hot and cold water?

What do you think will happen when you mix water at two different temperatures?

Why do you think this?

**Activity:**

Obtain 3 Styrofoam cups. Place 100 ml of hot water in one, 100ml of cold in another. Record their temperatures. Pour them together into a third cup and record the temperature of the third cup. Vary the temperatures using ice to cool and a water bath to heat.

Observe.

|  |  |  |
| --- | --- | --- |
| Temp Hot | Temp Cold | Combined |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Did the temperature change as you expected?

What was the trend in the temperature change?

Why do you think this was the case?

**Part 4: Heats of Various Reactions**

In most every chemistry lab we did this year we used aqueous solutions. Now you will mix two solids and then add a small amount of water to the mixture while recording the temperature.

What will happen to the temperature of the mixture before water is added?

What will happen to the temperature of the mixture after water is added?

What role does water play in the reaction?

Do you think that heat generated in the aqueous reactions too? If so, why? And what happens to the heat?

**Activity:**

Obtain a 150ml beaker. Add 2-3g of Mg to 20ml of HCl. Stir, observe, record temp. Repeat with 3g Citric Acid and 3g Baking soda. Stir, observe record temp. Add a few drops of water. Stir, observe record temp. Add 50 ml H2O. Stir, observe, record temp.

|  |  |
| --- | --- |
| Mg and HCl | Temp |
|  |  |
|  |  |
|  |  |

|  |  |  |
| --- | --- | --- |
| Citric Acid & Baking soda | H2O | Temp |
|  |  |  |
|  |  |  |
|  |  |  |

You may also choose to change the mass of the compounds, but do not exceed 3 g of either, and keep the amount of water constant.

|  |  |  |
| --- | --- | --- |
|  |  | Temp |
|  |  |  |
|  |  |  |
|  |  |  |

Explain what you observed.

Did the temperature change with the compounds as you expected?

What effect to the amount of water have on the temp?

What about changing the mass ratios?

**Part 5: Why is this Warm?**

Why do certain objects seem warmer or cooler than others when sitting in the same room at the same temperature?

Is your perception of hot or cold the same as other peoples? Explain.

**Activity:**

Obtain a beaker of vegetable oil and on of water. Place one of your index fingers in each at the same time. Which feels warmer? Check their temperatures. Are they the same?

Compare how the temperature feels with the two black squares. Do they feel like the same temperature? Check with a thermometer.

If an ice cube is placed on each square, which one will cause it to melt fastest? Why?

Do it. Were you right?

Explain what happened and why it happened.

**Conclusion:**

Using your text book or the Internet, answer the following.

What is heat?

How could you define temperature?

How are temperature and heat related?

Why do some things get hotter faster than others?

Describe what happens with energy related to bond breaking and forming.

How is energy transferred with changes in state?

What did you learn from this activity?

What more would you like to explore or learn about with het?