Student Sheet Name_____

Title: Periodic Trends of Chemical Reactivity

Objective:

- Be able to identify trends in reactivity of metals on the periodic table using experimental observations.

Pre-Demo Questions:

1. In this demonstration, you will observe chemical changes. Recall from your study of physical and chemical changes that there are five signs that a chemical reaction has occurred. What are they?

2. Why are elements placed in families (groups) on the periodic table?

3. What are valence electrons and why are they important?

4. When metals react, they lose electrons to become positively charged ions. Which metal (Sodium, Magnesium or Aluminum) do you predict will most readily lose electrons? Explain your answer using your knowledge of electronic structure.

5. One common property of the alkali metals is that they react with water, but they do not all react with the same intensity. Which alkali metal do you expect to be the most reactive? Explain your answer using your knowledge of electronic structure.

Procedure:

1. Observe the diagramed data table below. Notice how it is set up in a similar fashion to where the metals reside on the periodic table. This will assist you in identifying trends of reactivity as you move down a group or across a period.
2. The demonstrator will obtain samples of each metal used in the experiment. (Rubidium and Cesium will be observed on video as they are too dangerous to demonstrate.)
3. Each metal sample will be added to a beaker of water containing universal indicator. The indicator will change color as the solution becomes more acidic or basic during the chemical reaction.
4. Your job is to observe the reaction and note the relative reactivity of each metal. Reactivity is how fast and violently the reaction occurs, not necessarily how much product is made in the end. Record your observations of the reactions. If no reaction occurs, write NR in the data table.
5. For each metal that did not react with water, acid will be added to the beaker. Again, record your observations of the reactions. Be specific about whether the metal was reacting with water or acid.

Data Table:

Li			
Na	Mg	—	Al
K	Ca		
Rb			
Cs			

Summing Up:

1. Which of the alkali metals did you observe in this demonstration?

2. Based on your observations, rank the alkali metals from least reactive to most reactive with water.

3. When alkali metals react with water, they lose an electron. The energy required to remove an electron from an atom is called ionization energy. If an atom has a low ionization energy it can lose electrons more easily than an atom with a high ionization energy. Based on your experimental observations, what is the trend for ionization energy as you go down a group on the periodic table (does it increase or decrease)? What experimental evidence supports your conclusion?

4. Electrostatic attraction is strongest when two charges are closer together and weaker when the charges are far apart. Using your knowledge of the size of atomic orbitals, explain why the ionization energy follows the observed trend.

5. Now we will examine the trend in ionization energy moving across a period from left to right. Note that acids facilitate the loss of electrons from metals. Considering your experimental observations, rank sodium, magnesium and aluminum from least reactive to most reactive.

6. Based on your experimental observations, what is the trend for ionization energy as you go across a period from left to right on the periodic table (does it increase or decrease)? What experimental evidence supports your conclusion?

7. Electrostatic attraction is strongest when the magnitude of the charges is larger (i.e. more protons in the nucleus) and weaker when the magnitude of the charges is smaller. Within the same principal energy level (i.e. period on the periodic table), why does the ionization energy follow the observed trend?

8. As you go down a column on the periodic table, the atomic number increases, meaning there are more protons and a larger charge in the nucleus. According to your reasoning in question 7, ionization energy should increase as you move down a group. Hypothesize why this is NOT the observed trend.