Lab #: A TALE OF A PERIODIC TABLE

PURPOSE: The purpose of this lab is to organize a set of fictitious elements utilizing the data available in a manner similar to the Periodic Table of the Elements developed by Mendeleev.

INTRODUCTION: In this exercise, the physical and chemical properties of a set of fictitious elements will be used to organize these elements into a chart. This is similar to the process used by Mendeleev to organize the known elements of his time. Mendeleev left blanks in his Periodic Table for yet to be discovered elements. From his organization of the known elements, Mendeleev was able to predict the properties of these undiscovered elements. In a similar manner, the properties of a missing fictitious element will be predicted using the data and the chart of these elements. .... You are part of a team of science officers aboard a spacecraft sent to explore the universe outside our solar system. Because of the compactness and efficiency of the ship, the amount of laboratory equipment you can use is limited. You have the following equipment:

1) A science kit with four testing chemicals labeled C1, C2, C3 and C4.
2) A mass spectrometer to measure the atomic mass of the element.
3) A melting point apparatus for determining the melting point of a solid.
4) A device for determining the density of a substance in zero gravity. After a long journey, the spacecraft arrive at a large planet. Your team searches the planet and brings backs rock and mineral samples for analysis to the spacecraft. Your team determines that there are only twelve different elements on the planet, and they are all different from those found on earth. (Remember, this is fiction!) After more laboratory work, eleven of the twelve elements were isolated and their properties were determined. The atomic mass, the melting point, density and the reaction with the testing chemicals, C1, C2, C3 and C4, were determined for the eleven elements. Your team, also, tried to produce oxides of the eleven elements by burning these elements in the presence of oxygen. Not all the elements produced oxides. For the elements, which produced oxides, the formula of the oxide was determined. The eleven elements were assigned names and symbols based on the signs of the zodiac. The data for each element was recorded on a card. Your job is to organize the known elements into a chart in a similar manor to the our periodic table and predict the properties of the missing element.

MATERIALS: handouts, scissors, graph paper (1/2 piece per graph), plain paper, ruler, glue

PROCEDURE: **Check off each step as you complete the step** ___1) For the properties listed for each element, code the **physical properties** with a **P** and the **chemical properties** with a **C** on EACH element's card in the little boxes provided. Cut the cards apart and organize the elements into groups (piles) with **similar chemical properties.**

___2) Arrange the elements into a chart form in order of increasing atomic mass. **Place an element in a particular vertical column ONLY if the element has the same chemical properties as the other elements in the group.** Leave ONE space blank where necessary for the missing element. After the teacher has checked your order, glue the cards down on a piece of plain paper.

___3) Starting in the upper left hand corner of the chart and in the same fashion as the Periodic Table, assign the atomic numbers 1 through 12 to the elements including the blank spot for the missing element. Write the atomic numbers on the cards and record the missing element's atomic number on the report sheet.

___4) Determine the missing zodiac sign and use this sign for the missing element's name. Using the rules for writing an element's symbol, give the missing element a symbol based on its name. Record this information on the report sheet.

5) To determine the atomic mass, the melting point and the density of the missing element, three line graphs will be prepared. Use a **half a sheet** of graph paper for each graph. Remember to follow the proper format for graphs. **Use "connect the dot format"** for drawing the lines on the graph and mark the predicted value by dashing in straight lines from the x and y axes to the plotted line.

_____a) To predict the atomic mass, plot atomic number on the x axis and the atomic mass on the y axis. Connect the data points and using interpolation, determine the atomic mass for the missing element. Record this value on the report sheet.

_____b) To predict the melting point, plot atomic number on the x axis and the melting point on the y axis. Connect the data points and using interpolation determine the melting point for the missing element. Record this value on the report sheet.

_____c) To predict the density, plot atomic number on the x axis and the density on the y axis. Connect the data points and using interpolation determine the density for the missing element. Record this value on the report sheet.

_____5. Use the chemical properties of the other elements in the same vertical group as the missing element, to predict the formula of the oxide and reactions with the chemicals C1, C2, C3 and C4 of the missing element. If no reaction is recorded with C1, C2, C3 or C4, then write NONE. In addition, use the trends from the other groups to predict the color of the missing element. Record your predictions on the report sheet.

Adapted from an activity submitted by D. Brown, Mohonasen Sr. High School, Schenectady, NY.

Name: _____ Report Sheet on the Missing Element

Report should include:

1.) This sheet
2.) Three Graphs
3.) Answer to questions below on loose leaf paper
4.) Periodic Chart of the Fictitious Elements

Name	
Symbol	
Atomic Number	
Atomic Mass	
Density	
Melting Point	
Formula of Oxide	
Reacts with:	
Appearance (Color of solid)	
Why this color?	

Questions:

1.) Give two examples how the organization of the fictitious elements is similar to the arrangement of the elements in the modern periodic table.

2.) Give an example of a physical property of the fictitious elements and explain why it is a physical property.

3.) Give an example of a chemical property of the fictitious elements and explain why it is a chemical property.

4.) What is the definition of the Modern Periodic Law (look it up)?

5.) a) In creating the graphs, which variable was always the independent variable?
b) How does the use of this variable as the independent variable illustrate the Modern Periodic Law?

6.) The vertical groups are also called families because the elements in the group have similar chemical properties. How did you use this fact to determine the placement of fictitious elements in the mini periodic table?

7.) The formula for sodium chloride is NaCl and for sodium oxide is Na_2O. What would you predict the formula to be for potassium chloride and potassium oxide based on the fact that sodium and potassium are in the same vertical group?

8.) Which group on the real periodic table is the last vertical group on the right side of the fictitious periodic table most similar to and why?

1) In which list are the elements arranged in order of increasing atomic mass?

A) Te, I, Xe
B) Ne, F, Na
C) Fe, Co, Ni
D) Cl, K, Ar

2) Which list of elements contains a metal, a metalloid, and a nonmetal?

A) Zn, Ga, Ge
B) Si, Ge, Sn
C) F, Cl, Br
D) Cd, Sb, I

3) In which group of the Periodic Table do most of the elements exhibit *both* positive and negative oxidation states?

A) 7
B) 2
C) 17
D) 12

4) Which is a property of *most* nonmetallic solids?

A) brittleness
B) high thermal conductivity
C) malleability
D) high electrical conductivity

5) In Period 3, from left to right in order, each successive element will

A) increase in metallic character
B) increase in number of protons
C) decrease in electronegativity
D) decrease in atomic mass

6) On the present *Periodic Table of the Elements*, the elements are arranged according to increasing

A) atomic number
B) number of oxidation states
C) number of neutrons
D) atomic mass

7) The element in Group 14, Period 3 on the Periodic Table is classified as a

A) metal
B) noble gas
C) metalloid
D) nonmetal

8) The element in Period 4 and Group 1 of the Periodic Table would be classified as a

A) nonmetal
B) metalloid
C) metal
D) noble gas

9) Which list of elements contains two metalloids?

A) Si, P, S, Cl
B) Po, Sb, I, Xe
C) As, Bi, Br, Kr
D) Si, Ge, Po, Pb

10) Element *X* is a solid that is brittle, lacks luster, and has six valence electrons. In which group on the Periodic Table would element *X* be found?

A) 1
B) 2
C) 15
D) 16

11) Which list consists of elements that have the *most* similar chemical properties?

A) K, Ca, and Ga
B) K, Al, and Ni
C) Mg, Al, and Si
D) Mg, Ca, and Ba

12) The elements located in the lower left corner of the Periodic Table are classified as

A) nonmetals
B) noble gases
C) metals
D) metalloids

13) Which element has chemical properties that are *most* similar to the chemical properties of sodium?

A) Se
B) K
C) Cl
D) Mg

14) Which element is a noble gas?

A) chlorine
B) antimony
C) krypton
D) manganese

The Eleven Elements

1) Using the small boxes to the right side of each property, write a P if the property is PHYSICAL and a C if the property is CHEMICAL.

2) Cut out the boxes and place them on the provided blank periodic tables using Modern Periodic Lab. Leave one space blank for the missing element. Ask the teacher to check your table before gluing it down. Once you have gotten the all-clear, use the glue to affix the boxes to your new Periodic Table

Aquarius - Aq	
Atomic Mass: 9.4 u	
Density: 3.1 g/cm^3	
Appearance: Yellow Solid	
Melting Point: 250°C	
Oxide Formula: Aq_2O_3	
Reacts With: C to form orange solution	

Aries - Ai	
Atomic Mass: 11.8 u	
Density: 4.0 g/cm^3	
Appearance: Black Solid	
Melting Point: 290°C	
Oxide Formula: none	
Reacts With: no reactions	

Cancer - Cn	
Atomic Mass: 32.3 u	
Density: 6.1 g/cm^3	
Appearance: Silver Solid	
Melting Point: 400°C	
Oxide Formula: none	
Reacts With: no reactions	

Capricorn - Cp	
Atomic Mass: 3.1 u	
Density: 2.5 g/cm^3	
Appearance: White Solid	
Melting Point: 100°C	
Oxide Formula: Cp_2O	
Reacts With: A and B to form white precipitate	

Gemini - Gm	
Atomic Mass: 16.5 u	
Density: 3.5 g/cm^3	
Appearance: Turquoise Solid	
Melting Point: 250°C	
Oxide Formula: GmO	
Reacts With: B and D to form colored solution	

Leo - Le	
Atomic Mass: 29.1 u	
Density: 5.0 g/cm^3	
Appearance: Red Solid	
Melting Point: 380°C	
Oxide Formula: Le_2O_3	
Reacts With: C to form orange solution	

Libra - Li	
Atomic Mass: 27.2 u	
Density: 4.5 g/cm^3	
Appearance: Green Solid	
Melting Point: 320°C	
Oxide Formula: LbO	
Reacts With: B and D to form colored solution	

Pisces - Pi	
Atomic Mass: 6.2 u	
Density: 2.7 g/cm^3	
Appearance: Blue Solid	
Melting Point: 200°C	
Oxide Formula: PiO	
Reacts With: B and D to form colored solution	

Saggitarius - Sa	
Atomic Mass: 25.1 u	
Density: 4.1 g/cm^3	
Appearance: Silver Solid	
Melting Point: 250°C	
Oxide Formula: Sa_2O	
Reacts With: A and B to form white precipitate	

Scorpio - So	
Atomic Mass: 14.1 u	
Density: 3.0 g/cm^3	
Appearance: Gray Solid	
Melting Point: 180°C	
Oxide Formula: So_2O	
Reacts With: A and B to form white precipitate	

Taurus - Tu	
Atomic Mass: 20.9 u	
Density: 5.0 g/cm^3	
Appearance: Gray Solid	
Melting Point: 330°C	
Oxide Formula: none	
Reacts With: no reactions	