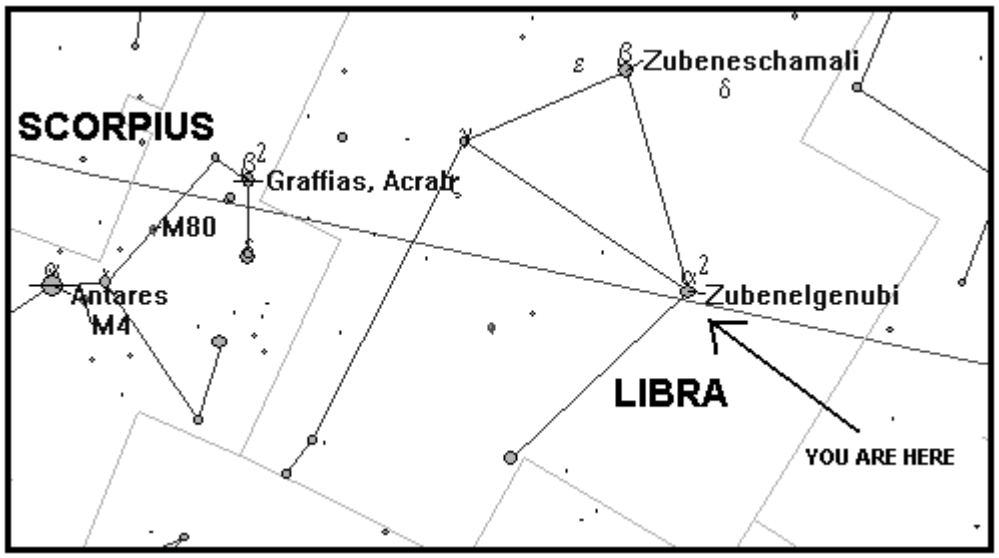
DIY Periodic Table – Make Mendeleev Proud!

Objective: to predict the properties of an unknown element based on the Modern Periodic Lab.

Background: "Welcome to the Starship ChemQuest! You are part of a team of science officers charged with investigating the universe outside our solar system.



After a long journey, you find and land on a large planet circling the star Zubenelgenubi. You and the science team gather samples from the landing site and take them back into the ship to investigate them. After subjecting them to all the tests you can, you make the most amazing discovery! The planet seems to be home to twelve elements. None of these elements have ever been seen before, at least not on Earth! Excited, you decide to follow in Dmitri Mendeleev's footsteps and create a new periodic table for these elements. You isolate and purify 11 of the elements. The 12th remains stubborn and you can not isolate it from the compound it is a part of with the equipment you have on board.

Based on the principles of the modern periodic law, you decide to find out as many properties of these elements as you can. You measure the melting point, density and atomic mass. You react each of the elements with reagents A, B, C and D to see what will happen. You also use up a little of your precious oxygen to see what kind of oxide compound you will get from each element when reacted with the oxygen. You then name the elements for the twelve constellations of the Zodiac (Zubenelgenubi is the brightest star in the constellation Libra).

You can create your own periodic table by obeying the Modern Periodic Law. This law clearly states that the properties of the elements are periodic functions of their atomic numbers. In English? OK, then! This states that, when lined up in order of increasing atomic number, the properties of the elements repeat themselves every so often (periodically). The elements with similar properties are placed into groups (vertical columns) on the Periodic Table. Of course, you don't know the atomic numbers of your elements, so you will have to use the next best thing, atomic mass. Works fairly well on Earth's Periodic Table too…only a few flip flops along the way. Now that you know the Modern Periodic Law, make sure you follow it! Ignorance of the Modern Periodic Law is no defense! Remember that when you are hauled in front of the judge in Chem Court!!!

Adapted from P. Iacovella's adaptation of D. Brown's (Mohonasen Sr. High School, Schenectady, NY) work

Equipment & Materials

scissors	glue	ruler	graph paper

Experimental Procedure

1) On Page 5 (Missing Element Fact Sheet), identify each property that will be investigated as being either a PHYSICAL or CHEMICAL property.

2) Cut out the boxes and place them on the provided blank periodic tables , in order of increasing atomic mass, using the Modern Periodic Law. Make sure that elements in the same group have similar chemical properties! 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.

3) Determine which sign of the Zodiac is unaccounted for out of the eleven isolated elements and assign that name to the missing element. Come up with a symbol for it that follows the rules of proper element symbology**. Write the name and symbol of the missing element in the blank space on your Periodic Table.**

4) When finished, write the atomic number in the small box on the upper right side of each element box (to the right side of the element name and symbol) including the box with the missing element. Start at "1" for the first element then go up by one as you go from left to right. Then move on to the next column and continue. You need these to do the graphs.

5) *Do the graphs (See analysis) and use the information to complete the Missing Element Factsheet (p. 5)

6) *Follow Analysis (2) to identify the chemical properties of the missing element and add to Factsheet (p. 5)

7) Return your scissors and glue to the teacher.

8) Complete questions on page 4 per instructions.

9) Submit all work as directed for GROUP GRADE.

** For steps 5 & 6, recommend each group member a different task within the analysis.*

Analysis

1) In order to determine the properties for the missing element, three graphs must be made. These graphs will involve "connecting the dots", so no best fit lines, please!

Use the graphing templates provided.

GRAPH 1:

Plot atomic number on the X axis and melting point on the Y axis. Connect the dots on either side of the missing element and interpolate to determine the missing element's melting point. Record this number on the Missing Element Factsheet.

GRAPH 2:

Plot atomic number on the X axis and atomic mass on the Y axis. Connect the dots on either side of the missing element and interpolate to determine the missing element's atomic mass. Record this number on the Missing Element Factsheet.

GRAPH 3:

Plot atomic number on the X axis and density on the Y axis. Connect the dots on either side of the missing element and interpolate to determine the missing element's density. Record this number on the Missing Element Factsheet.

2) 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 reagents A, B, C and D. In addition, use the trends from the other groups to predict the color of the missing element. Record your predictions on the report sheet.

DIY Periodic Table – Make Mendeleev Proud!

Names:	Period:	Group:	Grade:

Objective: to predict the properties of an unknown element based on the Modern Periodic Lab.

This page will be turned in with your completed questions on the back. The rest of the lab you will keep as notes.

Your completed lab report will include the following, in this order:

1) This page
2) Your Periodic Table
3) Your graphs
4) The answers to the questions below, in complete sentences.

Conclusion: Answer the following on a separate sheet of paper, except #7, below.

1) Give two examples of how the organization of the fictitious elements is similar to how the elements on the modern Periodic Table are organized.

2) Give an example of a physical property of the fictitious elements explain why the property is considered to be a physical property.

3) Give an example of a chemical property of the fictitious elements explain why the property is considered to be a chemical property.

4) What is the Modern Periodic Law and how did you use it to predict the chemical property for your unknown element you detailed in question 3, above?

5) 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 located in the same vertical group on the Periodic Table?

6) On another mission, another new element is isolated and it is given the name Jovium.

   a) Create a symbol for this new element.
   b) The symbol of Jovium Oxide is (Your Symbol Here)$_2O_3$. Which group on your Periodic Table should this element be placed?

7) Comparing your Periodic Table to the one we have here on Earth (Answer in the chart, below):

Group on Earth's Table	**Properties of Elements in that Group**	**Which, if any, group on your table shares these properties?**
1	Highly reactive, have 1 valence electron, form an ion charge of +1, so the ionic formula of the oxide is X_2O, only found in compounds in nature	
2	Very reactive, have 2 valence electrons, form an ion charge of +2, so the ionic formula of the oxide is XO, only found in compounds in nature	
13	Fairly nonreactive, have 3 valence electrons, form an ion charge of +3, so the ionic formula of the oxide is X_2O_3	
17	Highly reactive, have 7 valence electrons, form an ion charge of -1, form covalent bonds with oxygen with many possible formulas.	
18	Completely nonreactive, have 8 valence electrons, so they do not form either ion charges or oxide compounds.	

8) If you had the opportunity to travel to another planet, which planet would you choose and why?

Adapted from P. Iacovella's adaptation of D. Brown's (Mohonasen Sr. High School, Schenectady, NY) work

Analysis: Complete the following chart by using interpolation from your three graphs and using periodic trends of the surrounding elements to make your predictions. Get checked by the teacher.

Missing Element Factsheet

Property	Value	Physical Or Chemical Property
Name		
Symbol		
Atomic Number		
Atomic Mass		
Density		
Appearance		
Why that color?		
Melting Point		
Formula of Oxide		
Reaction with A		
Reaction with B		
Reaction with C		
Reaction with D		

If no reaction or oxide formula is predicted, place "none" in the appropriate space.

Question: What was the sticking point that prevented you from getting this solved right away and what was the clue that helped you to get unstuck so you could solve it?

How could the process of getting unstuck here in this lab help you down the road if you get stuck on something else?

Zubenelgenubi Three's Eleven Isolatable Elements

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^{o}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^{o}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^{o}C
Oxide Formula: none
Reacts With: no reactions

Capricorn - Ci
Atomic Mass: 3.1 u
Density: 2.5 g/cm^3
Appearance: White Solid
Melting Point: 100^{o}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^{o}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^{o}C
Oxide Formula: Le_2O_3
Reacts With: C to form orange solution

Libra – Lb
Atomic Mass: 27.2 u
Density: 4.5 g/cm^3
Appearance: Green Solid
Melting Point: 320^{o}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^{o}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^{o}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^{o}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^{o}C
Oxide Formula: none
Reacts With: no reactions

Adapted from P. Iacovella's adaptation of D. Brown's (Mohonasen Sr. High School, Schenectady, NY) work

Teacher Check	

Groups

1	2	3	4

When finished, write the atomic number in the small box on the upper right side of <u>each</u> element box (to the right side of the element name and symbol), including the box with the missing element. Start at "1" for the first element, then go up by one as you go from left to right. Then move on to the next row and continue. You need these to do the graphs.

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