Teacher information:

The original lab says use a 96 well microplate instead I bought a pegboard from home depot and got it cut into 8 holes/12 holes small boards. I got 12 small boards for ten bucks. I also asked students not to write anything on the board and put a required size of straws for Hydrogen and Helium first and then for other elements.

Name__________________________Period_____

Plotting Trends

A Periodic Table Activity

Introduction

Most High School chemistry textbooks report a wealth of numerical data to identify periodic trends in the properties of elements. Ionization energies, atomic radii, electronegativity values, and electron affinities—all are dutifully tabulated and graphed. But what do all the numbers mean? Students cannot measure these quantities, they cannot see their relative size, and they cannot feel their relative effects. In this cooperative activity, students use microscale reaction plates and straws of different lengths to construct three-dimensional bar-type charts of the physical properties of the elements. The resulting charts are visually impressive and clearly reveal to students the meaning of periodic trends in the properties of elements.

Purpose

To construct a three dimensional model to discover the following periodic trends: atomic radius, ionization energy, and electronegativity.

Materials

- Calculator, at least 1 per student group
- 4 x 6 notecard, 1 per group
- Microscale reaction plate, 96 well (8 x 12) layout, 1 per group — I used one peg board per group.
- Periodic table (for reference), at least 1 per student group
- Straws, 50 per student group
- Scissors, at least 1 per student group
- Metric rulers, marked in millimeters, at least 1 per student group

Safety Guidelines

Although the materials in this activity are considered nonhazardous, follow all normal laboratory safety guidelines.

Procedure

1. Form a working group with a total of four students
2. Obtain a handout of representative element data, a microscale reaction plate, a metric ruler, scissors, and 50 plastic straws.
3. Find your assigned physical property on the handout of element data for 42 representative (main group) elements. **My Assigned Property is:** ________________
4. Find maximum value of the assigned physical property for the elements listed. *Example*: The maximum value of the density for the elements listed is ~~11.342~~ 11.85 g/cm^3 (for ~~lead~~ Tl). (Thallium)
5. Let the length of the straw minus one cm represent this maximum value. This will be the scale for all of the other measurements of that property. *Example*: For a straw that is 19.5 cm long, a straw length of 18.5 cm would represent a density of 11.342 g/cm^3. The scale is thus 18.5 cm = ~~11.342 g/cm^3~~. 11.85 g/cm³
6. Using the "straw" scale as a ratio, calculate the straw length that is needed to represent the assigned property for each element in the list. *Example*: The density of beryllium is 1.848 g/cm^3. Solving Equation 1 for straw length (sl) shows that a straw length of 3.0 cm would represent beryllium. Round off all straw lengths to 0.1 cm.

18.5 cm = 11.85 g/cm³

$$\frac{1.848\ g/cm^3 \times 18.5\ cm}{11.85\ g/cm^3} = 2.88\ cm + 1 = 3.88\ cm$$

7. Add 1 cm to the calculated straw length for each element and cut a straw to that length. *Example*: Cut a straw 4.0 cm long to represent beryllium.
8. Place the straw in the reaction plate according to its position in the periodic table. Remember, the transition elements and lanthanides and actinides are not included in the list of representative elements. *Example*: Beryllium is placed in row 2, column 2
9. Repeat steps 6-8 with each element on the list.
10. Determine the nature of any periodic relationship or trend that may exist for the assigned property of the elements.
11. Propose an explanation for the observed trend.
12. Create a descriptive card to be displayed with the three-dimensional chart. Include the following information on the descriptive card:
    a. Name of group members
    b. Assigned physical property of the element
    c. Group Trend and Periodic Trend for the property
    d. Proposed explanation for the observed trend

Calculations:

1. Length of Straw minus 1 cm: ______________________________
2. Maximum value of your assigned property: ______________________
   a. What is the element: ______________________________
3. Ratio: Length minus 1 cm / Maximum value of property =
4. Set this value equal to straw length divided assigned value for each element and solve for straw length. Show your work for the first eight elements in the chart: Add one cm to each value calculated.
   a. Hydrogen

Based on the model answer the following questions:

Ionization Energy:

1. What is the periodic trend of the property in a group? Explain why.

2. What is the periodic trend of the property across a period? Explain why.

3. Explain and share your information with other groups for other periodic trends - atomic mass, atomic radius, electronegativity, electron affinity, density, melting point by using the same questions as 1 and 2 above.

4. Show calculations for the first ten elements.

5. Fill out the chart with straw lengths for your property. If your chart is not filled out, you will not be allowed into the lab.

Symbol	Atomic Number	Straw Length in cm (rounded to .1)
H	1	
He	2	
Li	3	
Be	4	
B	5	
C	6	
N	7	
O	8	
F	9	
Ne	10	
Na	11	
Mg	12	
Al	13	
Si	14	
P	15	
S	16	
Cl	17	
Ar	18	
K	19	
Ca	20	
*3d elements omitted		
Ga	31	
Ge	32	
As	33	
Se	34	
Br	35	
Kr	36	
Rb	37	
Sr	38	
*4d elements omitted		
In	49	
Sn	50	
Sb	51	
Te	52	
I	53	
Xe	54	
Cs	55	
Ba	56	
*5d elements omitted		
*4f elements omitted		
Tl	81	
Pb	82	
Bi	83	
Po	84	
At	85	
Rn	86	

Representative Element Data

Symbol	Atomic Number	Atomic Mass (amu)	Density (g/cm³)	Ionization Energy (kJ/mol)	Electron Affinity (kJ/mol)	Electro-Negativity	Atomic Radius (pm)	Melting Point (K)
H	1	1.008	0.0001	1312	72.8	2.2	32	13.4
He	2	4.003	0.0002	2372	−21		31	0.95
Li	3	6.941	0.534	520	59.6	0.98	152	454
Be	4	9.012	1.848	899	−241	1.57	112	1560
B	5	10.81	2.35	801	26.7	2.04	85	2349
C	6	12.011	2.266	1086	121.9	2.55	77	4188
N	7	14.007	0.0012	1402	0	3.04	70	63
O	8	15.999	0.0014	1314	141	3.44	73	55
F	9	18.998	0.0017	1681	328	3.98	72	54
Ne	10	20.18	0.0009	2081	−29		71	24
Na	11	22.99	0.968	496	52.9	0.93	186	371
Mg	12	24.305	1.738	738	−230	1.31	160	923
Al	13	26.981	2.699	578	42.5	1.61	143	934
Si	14	28.086	2.336	786	133.6	1.9	118	1685
P	15	30.974	1.823	1012	72	2.19	110	317
S	16	32.07	2.069	1000	200.4	2.58	103	380
Cl	17	35.453	0.0032	1251	349	3.16	100	172
Ar	18	39.948	0.0018	1521	−34		98	84
K	19	39.1	0.856	419	48.4	0.82	227	336
Ca	20	40.08	1.55	590	−156	1	197	1115
* 3d elements omitted								
Ga	31	69.72	5.904	579	28.9	1.81	135	303
Ge	32	72.61	5.323	762	119	2.01	122	1211
As	33	74.92	5.778	947	78.2	2.18	120	1090
Se	34	78.96	4.285	941	195	2.55	119	450
Br	35	79.9	3.1	1140	324.7	2.96	114	266
Kr	36	83.8	0.0037	1351	−39	3	112	116
Rb	37	85.47	1.532	403	46.9	0.82	248	312
Sr	38	87.62	2.63	550	−167	0.95	215	1030
* 4d elements omitted								
In	49	114.82	7.31	558	28.9	1.78	167	430
Sn	50	118.71	7.265	709	107.3	1.88	141	505
Sb	51	121.75	6.697	834	103.2	2.05	140	904
Te	52	127.6	6.25	869	190.2	2.1	142	723
I	53	126.91	4.94	1008	295.2	2.66	133	387
Xe	54	131.29	0.0059	1170	−40	2.6	131	161
Cs	55	132.91	1.9	376	45.5	0.79	265	302
Ba	56	137.33	3.62	503	−52	0.89	222	1000
* 5d elements omitted								
* 4f elements omitted								
Tl	81	204.38	11.85	589	19.3	1.83	170	577
Pb	82	207.2	11.342	716	35.1	2.1	146	601
Bi	83	208.98	9.808	703	91.3	2.02	150	545
Po	84	210	9.142	812	183.3	2	168	527
At	85	210		890	270.2	2.2		302
Rn	86	222	0.0097	1037	−41			202

*Transition metals and inner transition elements are not included in this table.