***Exploring Trends in the Periodic Table***

***Go to: http://www.lynchburg.net/hhs/chemistry/trends/***

***Objective:*** To discover the periodic trends of certain physical properties of elements related to their position on the Periodic Table of Elements.

***Background:*** The Periodic Table is arranged according to the Periodic Law. The Periodic Law states that when elements are arranged in order of increasing atomic number, their physical and chemical properties show a periodic pattern. Students can discover these patterns by examining the changes in properties of elements on the Periodic Table. The properties that will be examined in this lesson are: atomic radius, first ionization energy, and electro-negativity.

1. ***Atomic radius*** distance from the center of an atom's nucleus to its outer most electron
2. ***First ionization energy*** the amount of energy needed to remove one (the outermost) electron from an atom
3. ***Electro-negativity*** measure of an atoms attraction for electrons in a chemical bond

***Lesson:*** In this exercise you will look at a few physical properties of elements and how those properties are related to their position on the Periodic Table. Analyze the data found on the Periodic Table sites to answer the questions listed below.

***Activity - INQUIRY***

Scroll down the activity page and click on this link: [Cool Periodic Table link](http://the-tech.mit.edu/chemicool) (http://www.chemicool.com/)

1. For each of the first three elements in rows 2 and 3 ([Li](http://the-tech.mit.edu/chemicool/elements/lithium.html), [Be](http://the-tech.mit.edu/chemicool/elements/beryllium.html), [B](http://the-tech.mit.edu/chemicool/elements/boron.html), then [Na](http://the-tech.mit.edu/chemicool/elements/sodium.html), [Mg](http://the-tech.mit.edu/chemicool/elements/magnesium.html), [Al](http://the-tech.mit.edu/chemicool/elements/aluminum.html)) find the Atomic Radius (click on the element symbol).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Element 🡪** | **Li** | **Be** | **B** | **/** | **C** | **N** |
| **Atomic Radius** |  |  |  | /  /  / |  |  |
| **Element 🡪** | **Na** | **Mg** | **Al** | **/** | **Si** | **P** |
| **Atomic Radius** |  |  |  | /  /  / |  |  |

* 1. What appears to be the trend in atomic radius as you move from left to right in a row?
     + Does it: increase ? decrease? stay the same?
  2. What appears to be the trend in atomic radius as you move down a column?
     + Does it: increase ? decrease? stay the same?
  3. Predict the change in atomic radius of the next elements in a row ([C](http://the-tech.mit.edu/chemicool/elements/carbon.html), [Si](http://the-tech.mit.edu/chemicool/elements/silicon.html)), then check those properties.
     1. Predictions for C = \_\_\_\_\_\_\_\_\_\_\_ Si = \_\_\_\_\_\_\_\_\_\_\_
     2. Do they match your predictions?
  4. Check the atomic radius of the next elements in the series ([N](http://the-tech.mit.edu/chemicool/elements/nitrogen.html),[P](http://the-tech.mit.edu/chemicool/elements/phosphorus.html)).
     1. Atomic radii of N = \_\_\_\_\_\_\_\_\_\_\_ P = \_\_\_\_\_\_\_\_\_\_\_\_
     2. How do they fit the predicted pattern?
     3. Is the pattern of atomic radius always true OR generally true?

1. **Repeat the same steps and questions, but look at the property of First Ionization Energy**.

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| --- | --- | --- | --- | --- | --- | --- |
| **Element 🡪** | **Li** | **Be** | **B** | **/** | **C** | **N** |
| *First Ionization Energy* |  |  |  | /  /  / |  |  |
| **Element 🡪** | **Na** | **Mg** | **Al** | **/** | **Si** | **P** |
| *First Ionization Energy* |  |  |  | /  /  / |  |  |

* 1. What appears to be the trend in first ionization energy as you move from left to right in a row?
     + 1. Does it: increase ? decrease? stay the same?
  2. What appears to be the trend in first ionization energy as you move down a column?
     1. Does it: increase ? decrease? stay the same?
  3. Predict the change in first ionization energy of the next elements in a row ([C](http://the-tech.mit.edu/chemicool/elements/carbon.html), [Si](http://the-tech.mit.edu/chemicool/elements/silicon.html)), then check those properties.
     1. Predictions for C = \_\_\_\_\_\_\_\_\_\_\_ Si = \_\_\_\_\_\_\_\_\_\_\_
     2. Do they match your predictions?
  4. Check the first ionization energy of the next elements in the series ([N](http://the-tech.mit.edu/chemicool/elements/nitrogen.html),[P](http://the-tech.mit.edu/chemicool/elements/phosphorus.html)).
     1. First ionization energy of N = \_\_\_\_\_\_\_\_\_\_\_ P = \_\_\_\_\_\_\_\_\_\_\_\_
     2. How do they fit the predicted pattern?
     3. Is the pattern of first ionization energy always true OR generally true?

3. **Electro-negativity**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Element 🡪** | **Li** | **Be** | **B** | **/** | **C** | **N** |
| *Electro-negativity* |  |  |  | /  /  / |  |  |
| **Element 🡪** | **Na** | **Mg** | **Al** | **/** | **Si** | **P** |
| *Electro-negativity* |  |  |  | /  /  / |  |  |

* 1. What appears to be the trend in electro-negativity as you move from left to right in a row?
     1. Does it: increase ? decrease? stay the same?
  2. What appears to be the trend in electro-negativity as you move down a column?
     1. Does it: increase ? decrease? stay the same?
  3. Predict the change in electro-negativity of the next elements in a row ([C](http://the-tech.mit.edu/chemicool/elements/carbon.html), [Si](http://the-tech.mit.edu/chemicool/elements/silicon.html)), then check those properties.
     1. Predictions for C = \_\_\_\_\_\_\_\_\_\_\_ Si = \_\_\_\_\_\_\_\_\_\_\_
     2. Do they match your predictions?
  4. Check the electro-negativity of the next elements in the series ([N](http://the-tech.mit.edu/chemicool/elements/nitrogen.html),[P](http://the-tech.mit.edu/chemicool/elements/phosphorus.html)).
     1. Electro-negativity of N = \_\_\_\_\_\_\_\_\_\_\_ P = \_\_\_\_\_\_\_\_\_\_\_\_
     2. How do they fit the predicted pattern?
     3. Is the pattern of electro-negativity always true OR generally true?

***Activity - Conclusions***

1. Consider all three of the properties that you have examined.
   1. State the general trend for each property if you move from left to right on the Periodic Table.

Atomic Radii =

First Ionization Energy =

Electro-negativity =

* 1. Now, state the general trend from top to bottom.

Atomic Radii =

First Ionization Energy =

Electro-negativity =

* 1. How do these properties show periodicity (periodic trends)?

5.  Use the links given below to examine the same three properties graphically.

1. View the line graph of [atomic radius](http://www.webelements.com/webelements/properties/text/image-line/covalent-radius.html). (Type in ‘line graph for atomic radius’ in the search engine and scroll down to view graph).
   1. What do the different colors show?
   2. Can you see a pattern in the second period that is repeated in the third period?
   3. How does this graph agree with your observations of atomic radius made earlier?
   4. Why do the fourth and fifth periods have more dots and different patterns?
   5. View the line graph for [1st ionization energy](http://www.webelements.com/webelements/properties/text/image-line/ionization-enthalpy-1.html) (enthalpy)
   6. What do the different colors show?
   7. Can you see a pattern in the second period that is repeated in the third period?
   8. How does this graph agree with your observations of first ionization made earlier?
   9. Why do the fourth and fifth periods have more dots and different patterns?
   10. View the line graph for [electronegativity](http://www.webelements.com/webelements/properties/text/image-line/electroneg-pauling.html).
   11. What do the different colors show?
   12. Can you see a pattern in the second period that is repeated in the third period?
   13. How does this graph agree with your observations of electro-negativity made earlier?

6.Use the color-coded tables, [atomic radius](http://www.webelements.com/webelements/properties/text/image-intensity/covalent-radius.html), [1st ionization energy](http://www.webelements.com/webelements/properties/text/image-intensity/ionization-enthalpy-1.html) and [electronegativity](http://www.webelements.com/webelements/properties/text/image-intensity/electroneg-pauling.html), to answer the questions below.

* 1. How does this show periodic trends of the selected property?
  2. Which method did you find most informative?
  3. Which method was easiest to see the general pattern and not get confused by exceptions in that pattern?