


# Cycling Through the Periodic Table

## Constructing the Model:

1. Given a set of cards, how many different ways can your group arrange them?
2. What properties can your group use to arrange the cards in different ways?
3. Group the cards by color.
4. Arrange each color set by decreasing circle size.  

5. What are all the patterns within a color set?
6. Are these patterns repeated from one color set to the next?
7. Form a “calendar” grid with the cards, making each horizontal row a different color.
  - a. How many vertical columns are there?
  - b. How many horizontal rows are there?
8. What are the patterns for each vertical column?
9. Are these patterns the same from one vertical column to the next?

The model your group has assembled represents a portion of the periodic table. The horizontal rows are **periods**, associated with electron energy levels within the atom. The vertical columns represent **groups**, which are elements that have chemical similarities. The circle represents the size of the **electron cloud**. The dots on the circle represent the outermost electrons of each atom. The number in the center of the circle represents the **nuclear charge**.

## Critical Thinking Questions:

1. Is the **nuclear charge** positive or negative?
2. What particles are responsible for the **nuclear charge**?
3. Are there electrons on each card which are not pictured? Explain your reasoning.
4. As a group, discuss **why** the size of the electron cloud changes within each vertical **group**. Summarize your answer with one grammatically complete sentence. Be ready to share your answer with the class.

## Class Discussion/Consensus

5. Is the **nuclear charge** increasing or decreasing moving from left to right in a **period**?
6. Is the size of the electron cloud increasing or decreasing moving from left to right in a **period**?
7. Which element within the second **period** generates the greatest force of attraction between its nucleus and electron cloud? Explain your answer.

8. As a group, discuss **why** the size of the electron cloud changes within each **period**. Summarize your hypothesis with one grammatically complete sentence. Be ready to share your hypothesis with the class.

### Class Discussion/Consensus

The **atomic radius** is a measure of the size of the electron cloud. The term **valence electrons** is more properly used than "outermost electrons."

9. As a group, finish this sentence in your own words:  
"The **atomic radius** is the distance between..."
10. Is the following statement true or false?  
"Elements with fewer **valence electrons** are always larger than elements with more **valence electrons**."  
Give examples of elements that illustrate your claim.
11. Why would elements in each **group** (vertical column) have similar chemical properties? (Hint: What is the same about each **group**?)

Flip all the cards over while maintaining the same card arrangement. **First Ionization Energy** is the energy required to remove the most loosely bound valence electron. **Electronegativity** is the tendency of an atom to attract electrons to itself when bonded to another atom.

12. What is the atomic number of the element with the largest **atomic radius** in your set of cards?
13. Using the trend discovered above, what is the name of the element on the complete periodic table that has the largest **atomic radius**?
14. What is the name of the element that has the smallest **atomic radius**?
15. Using a grammatically complete sentence, restate the trend in **atomic radius** going from left to right across a **period**. What was the reason for this trend? (CTQ 8)
16. Using a grammatically complete sentence, restate the trend in **atomic radius** going from top to bottom in a **group**. What was the reason for this trend? (CTQ 4)
17. What is the general trend in **first ionization energy** in going from left to right across a **period**?
18. Using a grammatically complete sentence, state the reason for this trend in **first ionization energy** by relating it to **nuclear charge** and attraction to the electron cloud.
19. What is the general trend in **first ionization energy** in going from top to bottom in a **group**?
20. Using a grammatically complete sentence, state the reason for this trend in **first ionization energy** by relating it to **atomic radius**, number of electrons, or changing energy levels.

21. What is the name of the element with the highest **electronegativity**?
22. What is the name of the **group** that has no **electronegativity** values? Explain why this is so.
23. What is the general trend in **electronegativity** in going from left to right across a **period**?
24. Using a grammatically complete sentence, state the reason for this trend in **electronegativity** by relating it to **nuclear charge** and attraction to the electron cloud.
25. What is the general trend in **electronegativity** in going from top to bottom in a **group**?
26. Using a grammatically complete sentence, state the reason for this trend in **electronegativity** by relating it to **atomic radius**, number of electrons, or changing energy levels.

**Exercises:**

1. Identify the larger element of each pair and explain why it is larger.
  - a. oxygen or sulfur
  - b. calcium or potassium
  - c. nitrogen or oxygen
  - d. copper or gold
2. Identify the element in each pair with the larger **first ionization energy** and explain why for each.
  - a. Ba or Cs
  - b. Br or Kr
  - c. S or Se
  - d. Si or C
3. Select the atom in each pair with the greater **electronegativity** and explain why.
  - a. S or Cl
  - b. Cl or Br
  - c. C or O
  - d. S or Se