Atomic & Ionic Radius

Unit: Periodicity

MA Curriculum Frameworks (2016): HS-PS1-1

Mastery Objective(s): (Students will be able to…)

- Rank elements according to atomic or ionic radius based on their charge, electron configuration and location on the periodic table.

Success Criteria:

- Rankings account for charge, electron configuration and size.

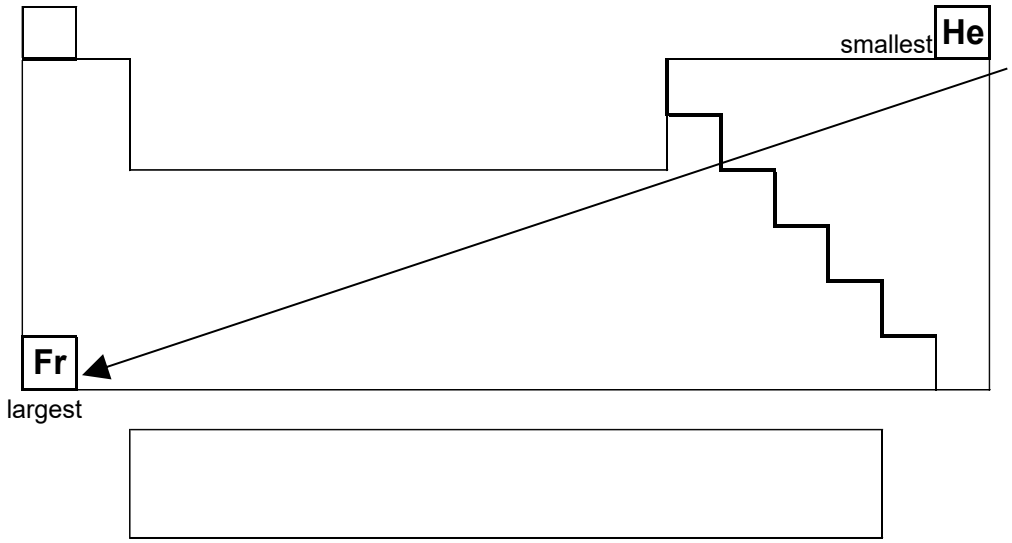
Tier 2 Vocabulary: radius

Language Objectives:

- Explain why atomic and ionic radius decrease as you go up and to the right on the periodic table.

Notes:

atomic radius: the average distance from the nucleus to the outermost electrons in an atom. The atomic radius is a measure of the "size" of the atom.



Use this space for summary and/or additional notes:

shielding: when electrons in the lower energy levels (closer to the nucleus) shield (cancel) some of the nucleus's positive charge. This causes the outer electrons to be held less tightly by the nuclear charge, and the atom gets larger.

- Atoms of elements get larger as you move down a column, because each row adds a new energy level, and each new level is farther out from the nucleus than the previous level. Also, the inner electrons shield some of the charge in the nucleus, which means that the nucleus holds onto the outer electrons less tightly.

- Atoms of elements get smaller as you move to the right within the same row. This is because the amount of unshielded positive charge from the nucleus is greater, which pulls the electrons closer.

Covalent atomic radii for all elements are listed in your Chemistry Reference Tables in "Table Z. Selected Properties of the Elements," which begins on page 516.

Use this space for summary and/or additional notes:

Ionic Radius

Because most of the space that an atom takes up is outside the nucleus (where the electrons are), changing the number of electrons (making an ion) changes the size of the atom.

- If you take away electrons, the ion gets smaller. This means ions with a positive charge are smaller than the neutral atom and also smaller than an atom of the neutral element with the same number of electrons. This is because the positive ions have more unshielded positive charge, which pulls the electrons closer.

- If you add electrons, the ion gets larger. This means ions with a negative charge are larger than the neutral atom and also larger than an atom of the neutral element with the same number of electrons.

Element	Covalent radius (of neutral atom) (Å)	Charge of ion	Radius of ion (Å)
O	0.75	−2	1.4
F	0.73	−1	1.33
Ne	0.72	0	—
Na	1.54	+1	1.02
Mg	1.36	+2	0.72
Al	1.18	+3	0.54

Use this space for summary and/or additional notes:

Homework Problems

For each pair of elements:

- Answer the question about which element has the larger or smaller atomic or ionic radius.
- State the direction(s) on the periodic table (up *vs.* down and/or left *vs.* right) that you based your choice on.
- Explain *why* moving that direction (up *vs.* down and/or left *vs.* right) caused the difference in atomic radius.

1. Which atom is the *smallest*: Be, C, or F ?
   Direction(s):
   Explanation:

2. Which atom is the *smallest*: N, P, or Sb ?
   Direction(s):
   Explanation:

3. Which atom is the *largest*: Ba, Ga, or N ?
   Direction(s):
   Explanation:

4. Which ion is the *largest*: P^{3-}, S^{2-}, or Cl^{-} ?
   Direction(s):
   Explanation:

5. Which ion is the *smallest*: Na^{+}, Mg^{2+}, or Al^{3+} ?
   Direction(s):
   Explanation:

6. Which of the following is the *smallest*: O^{2-}, Ne, or Mg^{2+} ?
   Direction(s):
   Explanation:

Use this space for summary and/or additional notes: