Periodic trends: Atomic radius answers.

Name _____

1. What is the atomic number?

   The number of protons found in an element.

2. What is the atomic radius? How do you think chemists measure it?

   The radius of an atom, or its size. Normally represented as covalent radii—chemists determine this by measuring the distance between one element and another when bonded.

3. Make a prediction about the following trends you expect to see in atomic radius:
   a. As you move across a period? Why?

      Decrease because of the increasing positive charge on the electrons exerted by the increasing number of protons.

   b. As you move down a group? Why?

      Increase due to shielding of outer electrons by inner electrons.

Go to the Periodic Table Live! at *www.chemeddl.org/resources/ptl*. Click on the "Graph/Table" button in the upper right corner. Use this graphing feature to answer the questions below.

Start by clicking the "Deselect All" button above the miniature periodic table. You want to be able to choose which *elements, groups,* and *periods* will be graphed to answer this worksheet.

Select any main-group elements *period* (excluding 1, 6, and 7) by clicking on the *period number*. On the graph to the right of your screen, go to the drop-down menus below *x* and *y* (this is where you can choose the value for your *x*- and *y*-axis). For *x,* under atomic properties, choose *atomic number.* For *y,* under atomic properties, choose *atomic radius.*

4. Why do you place the atomic number on the *x*-axis instead of the *y*-axis?

   The atomic radius is dependent on the number of protons found in an element. So the atomic number is the independent variable that is placed on the x-*axis by convention.*

5. Do you notice a *general trend* (don't worry about a few outliers—look for the overall trend) in the atomic radius across the period? Describe the trend.

It trends downward so the atomic radius gets smaller across a period. There are some outliers (not addressed in this worksheet).

6. Choose a couple more periods (excluding 1, 6, and 7). Does the same trend hold true? Is this the trend you predicted?

   Yes. Yes.

7. Explain why you see this trend as you move across a period.

   Electrons are attracted to the positive charge in the nucleus. There are more protons as you move across a period, thus the attraction for the electrons increases—drawing them closer to the nucleus and making the radius smaller.

8. Next, deselect all and choose any one *group* in the periodic table, keeping atomic number as the *x*-axis and atomic radius as the *y*-axis. Look at a few more groups, making sure you look at some groups outside the transition metals (i.e., groups 3–12). Do you see a trend in the atomic radius down a group? Is it consistent between groups?

   It increases down a group. It also seems to reach a maximum (not addressed in this worksheet).

9. Explain why you see this trend and why it is not a contradiction to your explanation for question 7.

   As you move down, it is true that the number of protons increases and thus the charge pulling the electrons increases, but the number of electrons also increase and you find that the inner electrons effectively shield the charge from the outer electrons—allowing them to "roam" more freely. So instead of getting smaller, the atomic radius gets bigger.

For a more thorough exploration of atomic radius, download the following articles:

Craft, J., and J.S. Miller. 2007. Unlocking the atom. *The Science Teacher* 74 (2): 24–29.

McInerny, W. 1999. Probability and atomic radius in the H atom. *Journal of Chemical Education* 76 (3): 443–444.

Ping, M., L. Xiubin, and W. Yuankai. 1990. A formula for calculating atomic radii in metals. *Journal of Chemical Education* 67 (3): 218–219.

Smithenry, D. 2009. Teaching with crystal structures. *The Science Teacher* 76 (6): 52–57.