

“Build An Atom” Simulation – Build an Ion**Learning Goals:**

1. Draw models that show atomic structure.
2. Use information about the number of protons, neutrons, and electrons to identify an element, its position on the periodic table.
3. Predict how changing the number protons and electrons will change the element and its charge.

Accessing Prior Knowledge:

1. What 2 sub-atomic particles have charges? List the particle *name* and its *charge*.

Protons and electrons are subatomic particles with charges.

Protons: +1 Electrons: -1

2. What does the term “neutral” mean?

A neutral object has no charge, or there are an equal number of positive and negative charges.

3. Describe which particles and how many of each you need to make a neutral beryllium atom. (Round the atomic mass from the periodic table to the nearest whole number to get part of your answer.)

From the periodic table, beryllium has an atomic number of 4 and a mass of almost 9 amu. Therefore, a neutral beryllium atom has 4 protons, 4 electrons, and 5 neutrons (# neutrons = mass # - # protons).

Directions:

- Go to the following website: <<http://phet.colorado.edu/en/simulation/build-an-atom>>
- Click the green “Run Now” button below the large image to start the application.
- Play around with the simulation for a bit to become familiarize with the controls and functions. You can add particles to your atom by dragging them into the atom model. The “Element”, “Mass” and “Net Charge” boxes should be expanded.
- Note that when particles are added to your model you can see if the atom is stable or unstable (labeled in the center), and if it is neutral or an ion (labeled on the outer rings). An ion means there is an overall charge to the atom.
- When you are ready to start the exercise, press the “Reset All” button in the bottom left corner to clear any changes.

Part I: Basic Electron Structure

1. Where are the electrons located inside of the atom? **The electrons orbit around the nucleus.**

Make sure that the simulation is set to the “orbital” model. The model shows two orbits, which we often call energy levels. The first energy level is the one closest to the nucleus, and the second is furthest away.

2. How many electrons can fit in the first energy level?

Only 2 electrons can be in the 1st energy level.

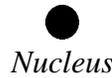
3. Can you ever have more than this number in the first energy level? Can you ever have less?

There cannot be more than 2 electrons in the 1st energy level. Any more are placed in the 2nd energy level. However, you can have 1 or no electrons in the 1st orbit.

4. How many electrons can fit in the second energy level?

We can only put 8 electrons in the 2nd energy level. (I wish we could add more ☹)

5. Build some atoms, and write down three examples that have a *stable nucleus* and *neutral charge*. This time, do not draw individual protons and neutrons, just draw one small dot for the nucleus.



Include a drawing of your atom. The key above is a suggestion for how to draw the parts of your atom.

Be sure to draw the electrons in the correct energy levels.

Answers will vary. The following are examples. Number of neutrons may vary, too.

Picture of Atom

Electrons: <u> 1 </u> Protons: <u> 1 </u> Charge: <u> 0 </u>		Name: Hydrogen Symbol: H
Electrons: <u> 2 </u> Protons: <u> 2 </u> Charge: <u> 0 </u>		Name: Helium Symbol: He
Electrons: <u> 4 </u> Protons: <u> 4 </u> Charge: <u> 0 </u>		Name: Lithium Symbol: Li

Analysis Questions:

1. The *atomic number* on the Periodic Table will tell you how many *protons* are in the nucleus of each atom. From your observations, how can you predict the number of electrons in a neutral atom?

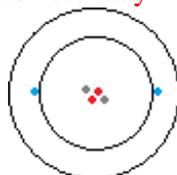
Explain your answer.

The number of electrons and protons should be equal in a neutral atom. Because each electron has a -1 charge, and each proton a +1 charge, the number of each must be the same for the net charge to equal zero.

2. Without using the simulation, draw 2 atoms you have not yet made in the simulation. Pay attention to the electrons, and only pick an element in the first two rows of the periodic table.

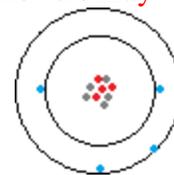
Atom "A"

Answers may vary



Atom "B"

Answers may vary



Part II: Making Ions

Not all atoms are neutral. Many have a charge. Some are more positive and some are more negative. We call the charge on such an atom the “**net charge**”, or “**total charge**”.

1. Make a neutral Beryllium atom. What would you do to make a beryllium atom with a **negative** charge?

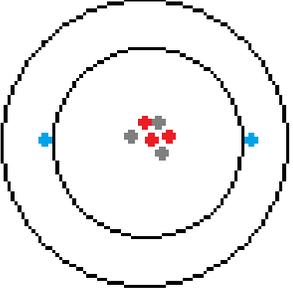
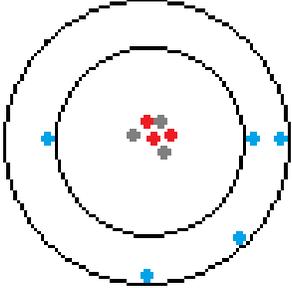
To make a negative beryllium atom, I would add electrons to the orbits.

2. Make the neutral Beryllium atom again. What would you do to make a beryllium atom with a **positive** charge?

To make a positive beryllium atom, I would take electrons away, out of the orbits.

3. Expand the box labeled “Net Charge”. Pick an element, and make two example of the same element with different charges in the table below. Include what the charge is (sign and number), and how many protons and electrons are in the atom.

Name of element: Lithium Symbol: Li

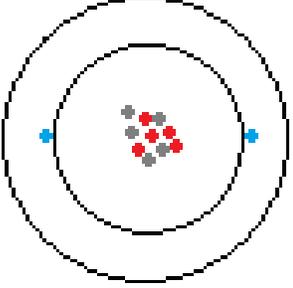
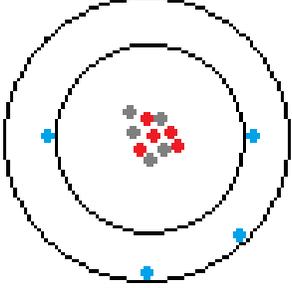
	Example 1		Example 2
Charge: <u>+1</u>		Charge: <u>-2</u>	
Electrons: <u>2</u>		Electrons: <u>5</u>	
Protons: <u>3</u>		Protons: <u>3</u>	

4. What did you do to change “Example 1” to “Example 2”?

I could only change the number of electrons. To make it positive, I took electrons away. To make the atom negative, I added electrons into the atom.

5. Repeat the last process for a *different* element. Make two examples with different charges.

Name of element: Boron Symbol: B

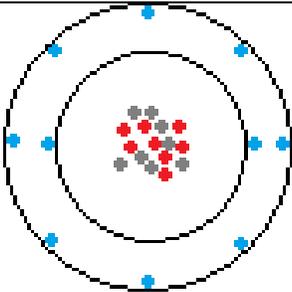
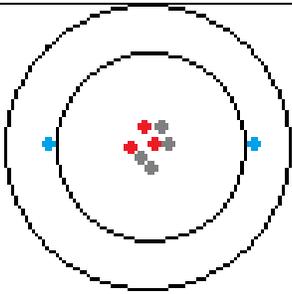
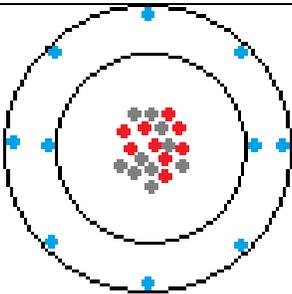
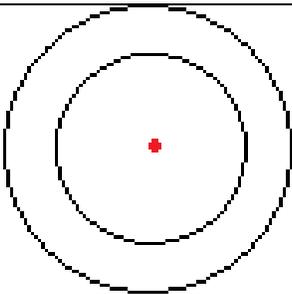
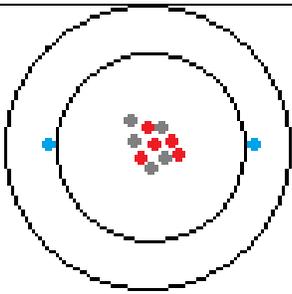
	Example 1		Example 2
Charge: <u>+3</u>		Charge: <u>+1</u>	
Electrons: <u>2</u>		Electrons: <u>4</u>	
Protons: <u>5</u>		Protons: <u>5</u>	

6. Based on your observations, make a rule or formula to predict the charge of the atom if you are given the number of protons and electrons.

$$\text{Net Charge} = (\# \text{ protons}) - (\# \text{ electrons})$$

7. Now you will practice building some specific elements. In the table below, some of the information is filled out about a particular atom. Complete the table below by filling in the blanks and drawing the picture of that atom.

Picture of Atom

Electrons: 10 Protons: <u> 8 </u> Charge: <u> -2 </u>		Name: <i>Oxygen</i> Symbol: O
Electrons: 2 Protons: 3 Charge: <u> +1 </u>		Name: Lithium Symbol: Li
Electrons: <u> 10 </u> Protons: <u> 9 </u> Charge: - 1		Name: <i>Fluorine</i> Symbol: F
Electrons: <u> 0 </u> Protons: 1 Charge: +1		Name: Hydrogen Symbol: H
Electrons: 2 Protons: <u> 5 </u> Charge: <u> +3 </u>		Name: Boron Symbol: B