

“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**.

2. What does the term “neutral” mean?

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.)

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? _____

Make sure that the simulation is set to the “orbital” model and all checked:

Show	
<input checked="" type="checkbox"/>	Element
<input checked="" type="checkbox"/>	Neutral/Ion
<input checked="" type="checkbox"/>	Stable/Unstable

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

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

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.

Picture of Atom

Electrons: _____ Protons: _____ Charge: _____		Name: _____ Symbol: _____
Electrons: _____ Protons: _____ Charge: _____		Name: _____ Symbol: _____
Electrons: _____ Protons: _____ Charge: _____		Name: _____ Symbol: _____

Analysis Questions:

1. From your observations, how can you predict the number of electrons in a neutral atom? Explain your answer.
2. DRAW 1 atom 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.



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? _____
2. Make the neutral Beryllium atom again. What would you do to make a beryllium atom with a **positive** charge? _____
3. Expand the box labeled “Net Charge”. Pick an element, and make two examples 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: _____

Symbol: _____

Example 1	Example 2
Charge: _____	Charge: _____
Electrons: _____	Electrons: _____
Protons: _____	Protons: _____

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

5. 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.

Teacher Signoff! _____

Part III: Making Isotopes!

Not all atoms of the same element have the same mass. Some are lighter or heavier than others. We call atoms of the same element but with different masses, isotopes!

Make two examples OF THE SAME ELEMENT with **DIFFERENT MASSES**:

Name of element: **Hydrogen**

Symbol: ____ ____

Example 1	Example 2
MASS: ____ Electrons: ____	MASS: ____ Electrons: ____
Protons: ____ Neutrons ____	Protons: ____ Neutrons: ____
CHARGE: ____ P + N = ____	CHARGE: ____ P+N = ____

6. What subatomic particle effects the mass of the same element? _____

7. Based on your observations, make a rule or formula to predict the mass of the atom if you are given the number of protons and neutrons.

Teacher Signoff! _____

Put it all together!

CREATE A N-14. Using all of your rules, figure out what changes for each of these actions to an atom or ion. You can test your ideas with the simulation. If you have new ideas, rewrite your rules.

Action	What Changes?	How Does it Change?
Add a Proton	<input type="checkbox"/> Element	
	<input type="checkbox"/> Charge	
	<input type="checkbox"/> Mass	

Action	What Changes?	How Does it Change?
Remove a Neutron	<input type="checkbox"/> Element	
	<input type="checkbox"/> Charge	
	<input type="checkbox"/> Mass	

Action	What Changes?	How Does it Change?
Remove an Electron	<input type="checkbox"/> Element	
	<input type="checkbox"/> Charge	
	<input type="checkbox"/> Mass	

CHALLENGE:

Design a positive ion with a charge of +2:

Particles	Properties
Protons: 6	Element: __
Neutrons: __	Mass: __
Electrons: __	Charge: __
	Stable Nucleus: <input type="checkbox"/> Yes <input type="checkbox"/> No

