



Part 1: Build an Atom

1. Go to the website: phet.colorado.edu/en/simulations/build-an-atom.
2. Explore the *Build an Atom* simulation with your group. As you explore, talk about what you find. List two things your group observed in the simulation.
 - a.
 - b.
3. Click on the + sign for each of the boxes (element name, net charge and mass number) to view changes as you change the number of particles in the atom.
4. What particle(s) are found in the center of the atom? _____
5. Play until you discover which particle(s) determine(s) the name of the element you build.

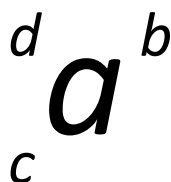
6. What is the name of the following atoms?
 - a. An atom with 3 protons and 4 neutrons: _____
 - b. An atom with 2 protons and 4 neutrons: _____
 - c. An atom with 4 protons and 4 neutrons: _____
7. Play with the simulation to discover which particles affect the charge of an atom or ion.

8. Fill in the blanks below to show your results:
 - a. Neutral atoms have _____ protons and electrons.
 - b. Positive ions have _____ protons then electrons.
 - c. Negative ions have _____ protons and electrons.
9. Develop a relationship (in the form of a single sentence or equation) that can predict the charge based on the number and types of particles.
10. Play with the simulation to discover what affects the mass number of an atom or ion?

 - a. What is a rule for determining the mass number of an atom or ion?
11. Practice applying your understanding by playing the 1st and 2nd games on the game screen. 1

Part I1: Symbol Screen

- Using the *Symbol* readout box, figure out which particles affect each component of the atomic symbol and how the value of the numbers is determined.



Position in symbol box	Term to describe this information	Particle used to determine this	How the value is determined
a	Element symbol	Protons	# of protons will identify the element
b			Protons + Electrons
c	Atomic number		
d		Protons, neutrons	

- Create a definition (using a complete sentence) for each of these items based on your labels from the atomic symbol above.

- Element Symbol

- Charge

- Atomic Number

- Mass Number

- Practice applying your understanding by playing the 3rd game on the game screen. Play until you can get all the questions correct on the 4th level. Fill in the information here for your last screen of the 4th game level.

Protons: _____
 Neutrons: _____
 Electrons: _____

4. In addition to atomic symbol, we can represent atoms by name and mass number. Complete the table below:

Symbol	Name
$^{12}_{6}\text{C}^{+1}$	<i>Carbon-12</i>
$^{18}_{9}\text{F}$	
$^{11}_{5}\text{B}$	

5. Each representation (*Symbol* and *Name*) in the table above provides information about the atom. Describe the similarities and differences between *Symbol* and *Name* representation.

Part II1: Isotopes

- Play with the simulation to determine:
 - Which particles affect the stability of the atom? _____
 - Which particles do not affect the stability of the atom? _____
- What are the names of the stable forms of Oxygen?
 - Oxygen-16
 - Oxygen-_____
 - Oxygen-_____
- List all of the things that are the same about these atoms (ignore the electrons).
- List all of the things that are the different about these atoms (ignore the electrons).
- The atoms in the previous question are isotopes of each other. Based on this information, list the requirements for two atoms to be isotopes of each other.

6. Test your understanding of isotopes by examining the relationships between the pairs of atoms listed below:

Atom 1	Atom 2	Relationship between atom 1 and atom 2
$^{12}_{06}\text{C}$	$^{13}_{06}\text{C}$	<input type="checkbox"/> Isotopes <input type="checkbox"/> Same Atom, Not Isotopes of Each Other <input type="checkbox"/> Different Element
Carbon-12	$^{12}_{06}\text{C}$	<input type="checkbox"/> Isotopes <input type="checkbox"/> Same Atom, Not Isotopes of Each Other <input type="checkbox"/> Different Element
Argon-40	Argon-41	<input type="checkbox"/> Isotopes <input type="checkbox"/> Same Atom, Not Isotopes of Each Other <input type="checkbox"/> Different Element
$^{11}_{05}\text{B}$	Boron-10	<input type="checkbox"/> Isotopes <input type="checkbox"/> Same Atom, Not Isotopes of Each Other <input type="checkbox"/> Different Element
An atom with 13 protons and 13 neutrons	An atom with 14 protons and 13 neutrons	<input type="checkbox"/> Isotopes <input type="checkbox"/> Same Atom, Not Isotopes of Each Other <input type="checkbox"/> Different Element

Part IV: Review Exercises

- The periodic table has a great deal of information about every atom. Using your periodic table, answer the following questions:
 - What is the atomic number of chlorine (Cl)? _____
 - What is the atomic number of tungsten (W)? _____
 - How many protons are there in any Cl atom? _____
 - How many protons are there in any Te atom? _____
- Can you tell from your own periodic table exactly how many neutrons are in an atom? Explain your answer.
- How will you use your periodic table to find the number of neutrons?

4. What do an atom, ion, and isotope of an element have in common?

5. How are they different?

6. Complete the following table:

Name	Symbol	Atomic Number	Mass Number	Number of Neutrons	Number of Electrons	Charge
Hydrogen-2	^2H	1	2	1	1	0
	^3H					
Sodium-22	$^{22}\text{Na}^+$				10	
		12	24		12	
		12	25		10	+2
	$^{46}\text{Tl}^{-2}$					
	^{107}Ag					
	$^{19}\text{F}^{-1}$					
Carbon-12					6	
Carbon-13					6	
Carbon-14					6	
Carbon-12					7	
Carbon-12					5	
	^4He					
		8		8	10	-2
Argon-40		18			18	
	^{70}Ga					
	$^{70}\text{Ga}^{+3}$					
		4	9		2	
		7		8	8	

7. To test your knowledge of isotopes, draw arrows between all pairs of atoms in the table above that are isotopes of each other.