

Name(s) : _____

Build An Atom

PART I: Access and explore the simulation.



<http://phet.colorado.edu/en/simulation/build-an-atom>

The simulation has three modes: (A) "Atom", (B) "Symbol", which are both drag and drop, and (C) "Games". They interrelate the number of protons, neutrons, and electrons to:

- a. The identity of an element and its position in the periodic table.*
- b. Whether an atom is neutral or an ion (cation or anion) and its respective charge.*
- c. Orbits versus clouds.*
- d. The total mass of an atom or ion.*
- e. The mass relationship of isotopes and their relative stabilities.*
- f. Representations of names and atomic symbols, which are found in the periodic table.*

Explore the simulation to determine which **particle(s)** is (are) found at the center of an atom, which particle is described by orbits or clouds, and which provide(s) the name of the **element**.

1. What is the periodic table **name** for the following atoms?
 - a) An atom with 3 protons and 4 neutrons: _____
 - b) An atom with 4 protons and 3 neutrons: _____
 - c) An atom with 6 protons and 7 neutrons: _____
 2. Identify the particle associated with an orbit and a cloud, and briefly describe how an orbit and cloud differ.
 3. Using the simulation, discover which particles affect the **charge** of an atom.
 - a) Complete the statements below based on your observations:

Neutral atoms have _____ protons and electrons.

Positive ions have _____ protons than electrons.

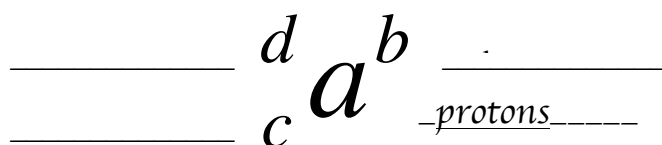
Negative ions have _____ protons than electrons.
 - b) Provide a general mathematical equation that can accurately predict the charge of an atom based on the number and types of the appropriate particles.
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- c) Explore the simulation to discover what affects the **mass** number of an atom or ion. Provide a general mathematical equation to determine the total mass of an atom using the appropriate types of particles and their the numbers.

Using the “Game”, apply your understanding to become efficient at the 1st and 2nd levels of the game.

PART II:

4. Using the “Symbol” facet and the readout box, determine **which particles** apply to each component of the atomic symbol.
- a) In the atomic symbol below, provide the **particle(s) associated with** each labeled letter (*a, b, c, and d*) eg. *a = protons*.



5. Match each of the following terms with the labels (*a, b, c, and d*) from the atomic symbol above.
- Element Symbol:
 - Charge:
 - Atomic Number:
 - Mass Number:
6. What is the complete **atomic symbol** for the following atoms?
- An atom with 13 protons, 14 neutrons, 10 electrons: _____
 - An atom with 12 protons and 14 neutrons, 10 electrons: _____
 - An atom with 14 protons and 13 neutrons, 14 electrons: _____

7. In addition to the atomic symbol, atoms can be represented by name and mass number.
a) Complete the table below:

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

PART III: ISOTOPES

8. Explore the simulation:
a) Which particle(s) affect the stability of the atom? _____
b) Which particle(s) do not affect the stability of the atom? _____
9. Complete the names of two other isotopes of oxygen.
a) Oxygen-16
b) Oxygen-____
c) Oxygen-____
10. The atoms in the previous question are all **isotopes** of each other. What is required for atoms to be isotopes of each other?
11. 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
$^{12}_{6}\text{C}$	$^{13}_{6}\text{C}$	☐ Isotopes ☐ Same Atom, Not Isotopes of Each Other ☐ Different Element
Carbon-12	$^{12}_{6}\text{C}$	☐ Isotopes ☐ Same Atom, Not Isotopes of Each Other ☐ Different Element
Argon-40	Argon-41	☐ Isotopes ☐ Same Atom, Not Isotopes of Each Other ☐ Different Element
$^{11}_{5}\text{B}$	Boron-10	☐ Isotopes ☐ Same Atom, Not Isotopes of Each Other ☐ Different Element
An atom with 13 protons and 13 neutrons	An atom with 14 protons and 13 neutrons	☐ Isotopes ☐ Same Atom, Not Isotopes of Each Other ☐ Different Element

Apply your understanding by playing the 3rd and 4th game levels until you get all the questions correct on the 4th level.

12. The periodic table has a great deal of information about every atom. Using the 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? ____

13. Complete the following table:

Name	Symbol	Atomic number	Mass Number	Number of neutrons	Number of Electrons	Charge
hydrogen-2	² H	1	2	1	1	0
	³ H					
sodium-22	²² Na ⁺				10	
		12	24		12	
		12	25		13	
	⁴⁶ Ti ⁻²					
	¹⁰⁷ Ag					
	¹⁹ F ⁻¹					
carbon-12					6	
carbon-13					6	
carbon-14					6	
carbon-12					7	
carbon-12					5	
	⁴ He					
		8		8	10	
argon-40		18			18	
	⁷⁰ Ga					
	⁷⁰ Ga ⁺³					
		4	9		2	
		7		8	8	

Circle and draw double headed arrows between all related names in the table above that are isotopes of each other. Provide complete symbols below of the ones that have the same letter in their symbols but are **not** isotopes of each other.