BUILD AN ATOM

PART I: ATOM SCREEN

Build an Atom simulation (http://phet.colorado.edu/en/simulation/build-an-atom)

1. Explore the ***Build an Atom*** simulation with your group. As you explore, talk about what you find.

2.
   a) List two things your group observed in the simulation.

   b) What particle(s) are found in the center of the atom? **protons, neutrons**

3. Play until you discover which **particle(s)** determine(s) the name of the **element** you build. What did you discover?
   Number of protons determine the element. Number of electrons determine the charge. Number of neutrons determine the isotope.

4. What is the **name** of the following atoms?
   a) An atom with 3 protons and 4 neutrons: **Lithium-7**
   b) An atom with 2 protons and 4 neutrons: **Helium-6**
   c) An atom with 4 protons and 4 neutrons: **Beryllium-8**

5. Play with the simulation to discover which particles affect the **charge** of an atom or ion.
   a) Fill in the blanks below to show your results:

   Neutral atoms have the same number of protons and electrons.

   Positive ions have **more** protons than electrons.

   Negative ions have **less** protons than electrons.

   b) Develop a relationship (in the form of a single sentence or equation) that can predict the charge based on the number and types of particle.
   # Protons > # electrons = + charge **# Protons = # electrons = 0 charge**
   # Protons < # electrons = - charge

6. Play with the simulation to discover what affects the **mass** number of your atom or ion.

   a) What is a rule for determining the mass number of an atom or ion?
   $A = N^0 + P^+$

7. Practice applying your understanding by playing 1st and 2nd levels on the game screen.

PART II: SYMBOL SCREEN

8. Using the *Symbol* readout box, figure out **which particles** affect each component of the atomic symbol.
   a) In the atomic symbol below, label each letter (*a*, *b*, *c*, and *d*) with:
      - the **particle(s)** used to determine the letter, and
      - **how** the value of each letter is determined.

A, atomic mass, $P^+ + N^0$ — $^{d}_{c}a^{b}$ — charge, shows relationship between P^+ and e^-

Z, number of P^+ — symbol

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

   a) Element Symbol **a - a symbol representing the identity of the element**

   b) Charge **b - the overall electric charge**

   c) Atomic Number **c - the number of protons in the element. This determines the identity of the element**

   d) Mass Number **d - the number of protons and neutrons**

10. Practice applying your understanding by playing the 3rd and 4th game levels. Play until you can get all the questions correct on the 4th level.

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

Symbol	Name
$^{12}_{6}C$	Carbon-12
^{11}B	Boron - 11
^{15}N	Nitrogen - 15

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

PART III: ISOTOPES

12. Play with the simulation to determine:
    a) Which particles affect the stability of the atom? **neutrons & protons**
    b) Which particles do not affect the stability of the atom? **electrons**

13. What are the names of the stable forms of oxygen?
    a) Oxygen-16
    b) Oxygen-**17**
    c) Oxygen-**18**
    d) List all of the things that are the same about these atoms (ignore the electrons).
    Number of protons, element identity, stability

    e) List all of the things that are different about these atoms (ignore the electrons).
    Number of neutrons

14. 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.
    Isotopes must have the same number of protons and a different number of neutrons.

15. 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
$^{12}_{6}C$	$^{13}_{6}C$	**a. Isotopes** b. Same Atom, Not Isotopes of Each Other c. Different Element
Carbon-12	$^{12}_{6}C$	a. Isotopes **b. Same Atom, Not Isotopes of Each Other** c. Different Element
Argon-40	Argon-41	**a. Isotopes** b. Same Atom, Not Isotopes of Each Other c. Different Element
$^{11}_{5}B$	Boron-10	**a. Isotopes** b. Same Atom, Not Isotopes of Each Other c. Different Element
An atom with 13 protons and 13 neutrons	An atom with 14 protons and 13 neutrons	a. Isotopes b. Same Atom, Not Isotopes of Each Other **c. Different Element**

EXERCISES

16. The periodic table has a great deal of information about every atom. Using your periodic table, answer the following questions:
    a) What is the atomic number of chlorine (Cl)? **17**
    b) What is the atomic number of tungsten (W)? **74**
    c) How many protons are there in any Cl atom? **17**
    d) How many protons are there in any Te atom? **52**
    e) Can you tell from the periodic table exactly how many neutrons are in an atom? **No, the masses on the table are averages so you can't for any specific atom**
17. 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
hydrogen-3	^{3}H	**1**	**3**	**2**	**1**	**0**
sodium-22	$^{22}Na^{+}$	**11**	**22**	**11**	10	**+1**
magnesium-24	**^{24}Mg**	12	24	**12**	12	**0**
magnesium-25	**$^{25}Mg^{-}$**	12	25	**13**	13	**-1**
titanium-46	$^{46}Ti^{-2}$	**22**	**46**	**24**	**24**	**-2**
silver-107	^{107}Ag	**47**	**107**	**60**	**47**	**0**
fluorine-19	$^{19}F^{-}$	**9**	**19**	**10**	**10**	**-1**
carbon-12	**^{12}C**	**6**	**12**	**6**	6	**0**
carbon-13	**^{13}C**	**6**	**13**	**7**	6	**0**
carbon-14	**^{14}C**	**6**	**14**	**8**	6	**0**
carbon-12	**$^{12}C^{-}$**	**6**	**12**	**6**	7	**-1**
carbon-12	**$^{12}C^{+}$**	**6**	**12**	**6**	5	**1**
helium-4	^{4}He	**2**	**4**	**2**	**2**	**0**
oxygen-16	**$^{16}C^{-2}$**	8	**16**	8	10	**-2**
argon-40	**^{40}Ar**	18	**40**	**22**	18	**0**
gallium-70	^{70}Ga	**31**	**70**	**39**	**31**	**0**
gallium-70	$^{70}Ga^{+3}$	**31**	**70**	**39**	**28**	**+3**
beryllium-9	**$^{9}Be^{+2}$**	4	9	**5**	2	**+2**
nitrogen-15	**$^{15}N^{-}$**	7	**15**	8	8	**-1**

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