

What is an Atom?

Name _____

1. Go to the web address www.phet.colorado.edu then type Build an Atom in the search box. Click the link for Build an Atom then click run now.
2. Click the green plus sign next to Symbol, Mass Number, and Net Charge so that all boxes are maximized.
3. Drag one proton in the center of the diagram where you see the X. Drag one electron toward the center.
4. Draw your diagram in the first box provided below. Use the following legend for drawing protons, electrons and neutrons for the entire activity.

Legend:

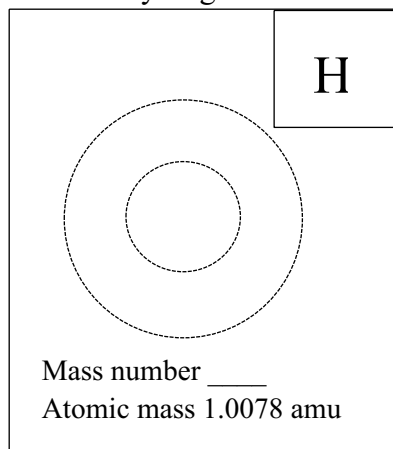
● A dark circle for an electron (-)

○ An open circle for a proton (+)

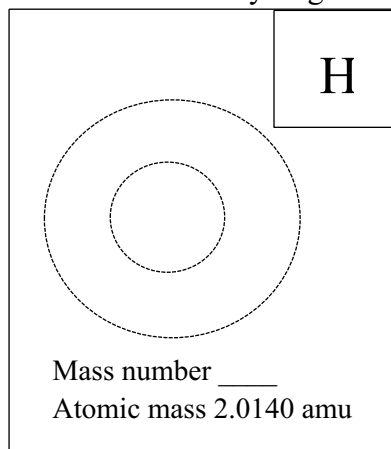
○ A lightly shaded circle for a neutron (no charge)

5. In the upper right corner of the box, write the symbol found in the symbol box.
6. Below the diagram, write the mass number found in the mass number box.
7. Drag one neutron towards the center.
8. Draw your diagram in the second box including symbol and mass number.
9. Drag your neutron back to the container. Drag one more electron towards the center.
10. Draw your diagram in the third box including symbol and mass number.

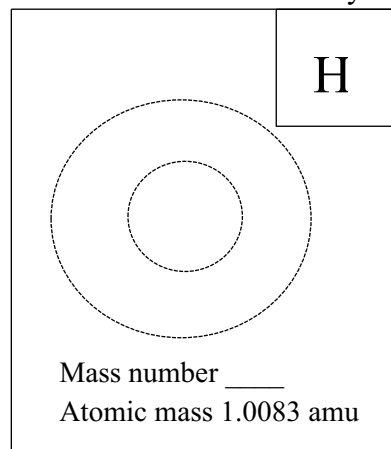
Hydrogen



Hydrogen



Hydrogen

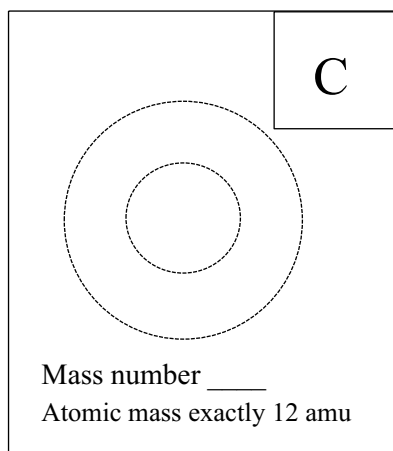


11. For the fourth diagram, drag a total of 6 protons, 6 neutrons, and 6 electrons towards the center. Draw and label everything as you have in the previous boxes.

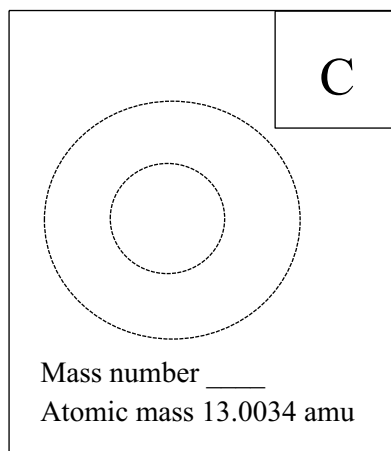
12. For the fifth diagram, add one more neutron for a total of 6 protons, 7 neutrons, and 6 electrons.

13. For the sixth diagram, add one more electron for a total of 6 protons, 7 neutrons, and 7 electrons.

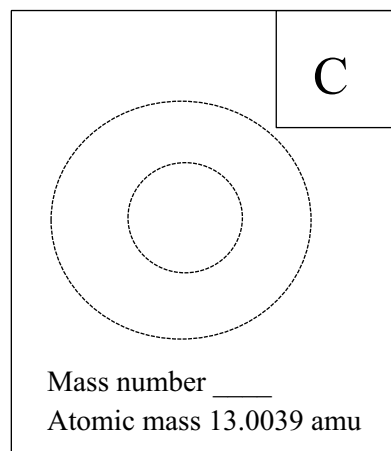
Carbon



Carbon

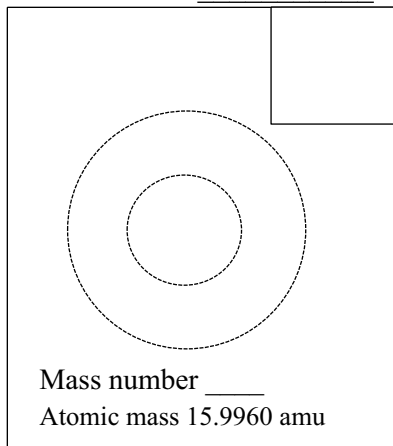


Carbon



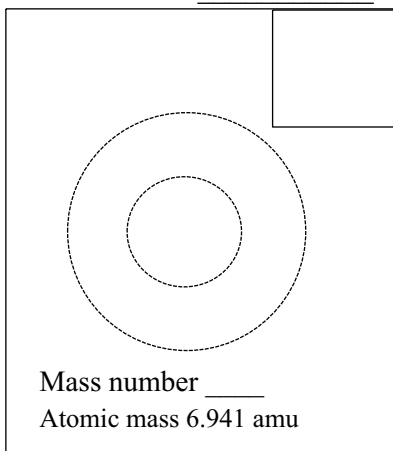
14. For the next diagram, add a total of 8 protons, 8 neutrons, and 10 electrons. Fill in all the missing information in the diagram below.

Element name _____



15. For the next diagram, add a total of 3 protons, 4 neutrons, and 2 electrons. Fill in all the missing information in the diagram below.

Element name _____



^1H and ^2H are **isotopes** of hydrogen. ^{12}C and ^{13}C are **isotopes** of carbon.

Critical Thinking Questions

1. How many protons are found in ^{12}C ? ^{13}C ? $^{13}\text{C}^-$?
2. How many neutrons are found in ^{12}C ? ^{13}C ? $^{13}\text{C}^-$?
3. How many electrons are found in ^{12}C ? ^{13}C ? $^{13}\text{C}^-$?
4. Based on your answers to questions 1-3, what do all carbon atoms (and ions) have in common?

5. Based on your diagrams, what do all hydrogen atoms (and ions) have in common?
6. Based on your answers to questions 4 and 5, what is the significance of the atomic number, Z , above each atomic symbol in the periodic table?
7. Based on your answer to question 6, what do all nickel (Ni) atoms have in common?
8. In terms of the numbers of protons, neutrons, and electrons:
 - a) Why does the notation $^{13}\text{C}^-$ have a negative sign in the upper right hand corner?
 - b) What feature distinguishes a neutral atom from an ion?
 - c) Provide an expression for calculating the charge on an ion.
9. Determine the number of protons, neutrons, and electrons in one $^1\text{H}^+$ ion. Explain how you found your answer.
10. What structural feature is different in isotopes of a particular element?
11. How is the mass number, A , (left-hand superscript next to the atomic symbol as shown in your diagrams) determined (from the structure of the atom)?
12. Show that the mass number and charge given for $^{16}\text{O}^{2-}$ and $^7\text{Li}^+$ are correct.
13. Based on your diagrams, where is most of the mass of an atom, within the nucleus or outside of the nucleus? Explain your reasoning using grammatically correct English sentences.

Exercises

1. Complete the following table.

ISOTOPE	ATOMIC NUMBER Z	MASS NUMBER A	NUMBER OF ELECTRONS
^{31}P	15		
^{18}O			8
	19	39	18
$^{58}\text{Ni}^{2+}$		58	

2. Define mass number.

3. Define atomic number.

4. Indicate whether the following statement is true or false and explain your reasoning.

An ^{18}O atom contains the same number of protons, neutrons, and electrons.

5. How many electrons, protons, and neutrons are found in each of the following?

^{24}Mg $^{23}\text{Na}^{+}$ ^{35}Cl $^{35}\text{Cl}^{-}$ $^{56}\text{Fe}^{3+}$ ^{15}N $^{16}\text{O}^{2-}$ $^{27}\text{Al}^{3+}$

6. Complete the following table.

ISOTOPE	ATOMIC NUMBER Z	MASS NUMBER A	NUMBER OF ELECTRONS
	27	59	25
^{14}N			
	3	7	3
	3	6	3
$^{58}\text{Zn}^{2+}$			
$^{19}\text{F}^{-}$			

7. Using grammatically correct English sentences, describe what the isotopes of an element have in common and how are they different.