NAME: **HONORS CHEMISTRY**

SECTION: MODELING ISOTOPES

Objective: Model an isotope using protons and neutrons.

- Go to the University of Colorado – Boulder PhET website at http://phet.colorado.edu
- Find and click on the HTML5 sim "Isotopes and Atomic Mass"

Exploring Isotopes

1) Toggle on "Symbol" and "Abundance in Nature"
2) What is the central region of the atom called? _____
3) Toggle the "Atomic Mass (amu)" button in the atomic balance. For the hydrogen atom, what is the atomic mass in atomic mass units (amu)? _____
4) The chemical symbol for hydrogen is H. Click on other shaded chemical symbols in the Periodic Table and observe the change in the red number in the lower left-hand corner of the chemical symbol shown. What two pieces of information does the red number convey?

   a.

   b.

5) Return to the hydrogen atom and add a neutron to the atom. Does the red number change? (Yes/No)
6) What two meanings can be given to the black number?

   a.

   b.

7) The hydrogen isotope with only one proton, ${}_{1}^{1}H$, is also represented by the name hydrogen–1. The second isotope, ${}_{1}^{2}H$, is named hydrogen–2, or **deuterium**. What is the atomic mass of hydrogen–2, in amu? _____
8) Which isotope is more abundant in nature, ${}_{1}^{1}H$ or ${}_{1}^{2}H$? _____
9) Write the chemical symbol of a hydrogen atom with two neutrons: _____ Why is this nuclide sometimes referred to as tritium?

   a. Build the atom. Is this atomic nucleus stable? (Yes/No)
   Note: *Unstable nuclei are radioactive; that is, they undergo nuclear change by emitting subatomic particles and radiant energy.*
   b. How is the natural abundance of this isotope in nature described? _____
   c. What other name can be given to this third isotope? _____

10) Add a third neutron to the hydrogen atom.

   a. What is the chemical symbol of this isotope?_____
   b. Is this isotope stable? (Yes/No)
   c. Do you expect this isotope to be radioactive? (Yes/No)
   d. What is the reported natural abundance of this isotope in nature? _____
   e. Add a fourth and fifth neutron to the hydrogen atom. What can you conclude about the stability and abundance of these and other more massive hydrogen atoms?

11) Click on the helium (He) chemical symbol in the Periodic Table. Remove the two neutrons by dragging them to the neutron bin. What can you state about the stability and abundance of $^{2}_{2}He$?

a. Write the chemical symbol of the isotope containing two protons and one neutron: _____
b. Build the atom by dragging a neutron and placing it in the nucleus of the atom.

a) Does the addition of a neutron help stabilize the helium nucleus ? (Yes/No)
b) Do you expect this isotope to be radioactive? (Yes/No)
c) What is the reported natural abundance of this isotope in nature? _____
d) What is the name of this isotope? _____

c. Complete the following data table:

Table 1. Possible helium isotopes

Isotope	Chemical Symbol	(Atomic Number) Number of protons	Number of neutrons	Number of electrons	Mass Number	Radioactive? (Y/N)	Natural Abundance
Helium - 3							
Helium - 4							
Helium - 5							

Identifying stable and natural radioactive nuclei and their relative abundances:

12) Survey the first ten elements. Write the chemical symbol, name and write the natural abundance of all stable isotopes. If you identify a radioactive nuclide with "very small" natural abundance, list its chemical symbol and name.

Table 2: Elements 1-10	Hydrogen	Helium	Lithium	Beryllium	Boron
Chemical Symbols of Stable Isotopes	$^{1}_{1}H$, $^{2}_{1}H$				
Isotope Names and Relative Abundance	hydrogen - 1 (99.9885%) hydrogen – 2 (0.0115%)				
Chemical Symbol and Name of Natural Radioactive Isotopes	$^{3}_{1}H$ hydrogen -3				
	Carbon	Nitrogen	Oxygen	Fluorine	Neon
Chemical Symbols of Stable Isotopes					
Isotope Names and Relative Abundance					
Chemical Symbol and Name of Natural Radioactive Isotopes					

- Close the simulation.