Atomic Structure and Chemical Bonds (Virtual Lab) **Name:**
**(Glencoe)**

**How can you tell which elements form chemical bonds?**

An **atom** is the smallest particle of an element that has the properties of that element. The atom model we use today is the result of the work of many scientists. It forms the basis of much of our current knowledge about matter and chemistry.

Atoms consist of a positively charged center called the nucleus, surrounded by negatively charged particles called electrons. The two kinds of particles in the nucleus are protons and neutrons.

The **atomic number** of an atom is the number of protons in its nucleus. Every atom of the same element has the same number of protons. Atoms of different elements have different numbers of protons.

The **nucleus** contains most of the mass of an atom. The mass of a proton is about the same as that of a neutron. An atomic mass unit (u) is defined as one-twelfth the mass of a carbon atom containing six protons and six neutrons. Thus, a proton or neutron has a mass of about 1 u.

The **mass number** of an atom is the sum of the number of protons and the number of neutrons in its nucleus:

**mass number = number of protons + number of neutrons**

A **neutron** is neutral, which means it has no charge. Not all the atoms of an element have the same number of neutrons. Atoms of the same element with different numbers of neutrons are called isotopes. Because most elements have more than one isotope, each element is given an average atomic mass. The average atomic mass of an element is the average mass of the mixture of its isotopes.

The **electrons** in an atom make up the electron cloud around the nucleus. The mass of an electron is about 1/2000 the mass of a proton. The electron cloud's mass is so small that it is considered negligible when finding the mass of an atom. Within the electron cloud, electrons remain (or orbit) at various distances from the nucleus. Electrons closest to the nucleus have lower energy. Electrons farther away from the nucleus have higher energy.

You can represent the energy differences of the electrons by picturing the atom as having energy levels. Each **energy level** can hold a maximum number of electrons.

- The **first** and lowest energy level can hold just **2** electrons.
- The **second** energy level can hold **8** electrons.
- The **third** energy level has a maximum of **18** electrons.

- The **fourth** energy level has a maximum of **32** electrons.

The negative electrical charge of an electron is equal to the amount of the positive charge of a proton. Atoms are electrically neutral because the number of protons equals the number of electrons. An atom is chemically stable if its outer energy level is completely filled with electrons. If the outer energy level is not completely filled with electrons, the atom will fill it by forming chemical bonds with other atoms. Losing, gaining, and sharing electrons are the means by which atoms form chemical bonds and become stable.

In this Virtual Lab you will build atomic models of various elements and investigate the structure of atoms to find out which elements can form chemical bonds.

**Objectives:**

Construct models of atoms showing the number of protons, neutrons, and electrons for each element.
For each element, arrange electrons in energy levels around the atomic nucleus.
Predict and determine whether or not elements will form chemical bonds in order to become more stable.

**Procedure:**

1. Click the Video button. Watch the video about chemical bonds.
2. Click the Show Labels button to see labels on the atomic model.
3. Select one of the four elements.
4. Set the number of protons in the nucleus of the atomic model by clicking the up and down arrows.
5. Calculate the number of neutrons in the nucleus. Set the number of neutrons by clicking the up and down arrows.
6. Click the up and down arrows in the Electronic Energy Levels to fill each energy level with the atom's available number of electrons. Start with the lowest energy level, closest to the nucleus.
7. Determine whether the atom is chemically stable or will form chemical bonds with other atoms. Click the Yes or No button.
8. Click the Check button to evaluate your work.
9. Record your data in the Table.
10. Repeat these steps with the three remaining elements.
11. Click the Reset button to investigate four new elements.
12. Complete the Journal questions.

**Journal Questions:** **Name:**

**Atomic Structure and Chemical Bonds**

**How can you tell which elements form chemical bonds?**

Your answers need to be in complete sentences. Make sure to use proper capitalization and punctuation. Answer ALL questions within a question. Answer the highlighted questions, if you choose to answer the other two questions that is up to you.

**Question 1 :**What are electron energy levels? Where are they located?

**Question 2 :**What is the maximum number of electrons that can be held in the first electron energy level of an atom? In the second energy level?

**Question 3 :**Which of the elements you modeled are stable? Why?

**Question 4 :**If two electrons have the same number of protons but different number of neutrons, can they be atoms of the same element?

Table

You are only required to complete 2 of the 4 different elements. If you choose to do the other two elements, that is entirely up to you.

| | Element Name | Atomic Number | Symbol | Atomic Mass | # of protons | # of neutrons | # of electrons | Will atom form chemical bonds with other atoms? | # of energy levels |
|---|---|---|---|---|---|---|---|---|---|
| Element 1 | | | | | | | | | |
| Element 2 | | | | | | | | | |
| Element 3 | | | | | | | | | |
| Element 4 | | | | | | | | | |