



# STUDENT GUIDE

## The Atom

### Part I: Modeling Atoms

Everything on Earth is made of matter. All of this matter is made from tiny particles that we cannot see with the naked eye – or even with the most powerful optical microscope. These tiny particles are called **atoms**. Everything on this planet – including you – is made from unique combinations of atoms.



So, what exactly is an atom? What makes up an atom? How much mass does an individual atom have? What makes one atom different from another atom? To answer these questions we will first look at the overall structure of an atom and then build some model atoms to look for clues in the patterns that appear.

#### Procedure:

1. Cut out one ( $p^+$ ) circle from the strip given to you by your teacher. It represents a subatomic particle called a proton. Color it yellow and glue it in the nucleus of the hydrogen atom found in Part I of your *Student Journal*.
2. Draw one VERY small, red dot between the nucleus and outer edge of the electron cloud in the hydrogen atom. Just a dot will do. This dot represents a subatomic particle called an electron ( $e^-$ ).
3. Cut out two more ( $p^+$ ) circles from the strip given to you by your teacher. Color them yellow and glue them in the nucleus of the helium atom found in Part I of your *Student Journal*.
4. Cut out two ( $n^0$ ) circles from the strip given out by your teacher. They represent subatomic particles called neutrons. Color them blue and glue them in the nucleus of the helium atom. Overlapping is fine such that you still see parts of all four circles.
5. Draw two VERY small, red dots ( $e^-$ ) between the nucleus and outer edge of the electron cloud in the helium atom.
6. Use your colors to make a color key for the protons, neutrons, and electrons.

As you built the models of a hydrogen and helium atom, you should have noticed some differences between the protons, neutrons, and electrons, or subatomic particles. Subatomic particles are the particles that are smaller than an atom. You should have noticed that there were two regions in the atom, the nucleus and the electron cloud. The protons and neutrons are located in the nucleus and the electrons are located in the electron cloud.

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## Part I: Modeling Atoms, continued

The mass of atoms and their subatomic particles is measured in Atomic Mass Units, or amu. A proton and a neutron each have a mass of 1 amu. An electron is much smaller with a mass of  $1/2000$  amu. Because the mass of an electron is so small, their mass is not counted when determining the total mass of an atom.

You probably noticed that you used different symbols to represent each of the subatomic particles. The proton was represented by  $(p^+)$ . The + sign represent the positive electrical charge of a proton. The electron was represented by  $(e^-)$ . The – sign represents the negative electrical charge of an electron. The neutron was represented by  $(n^0)$ . The 0 sign represents the neutral electrical charge of a neutron.

Complete the “Properties of Subatomic Particles” table in your *Student Journal* and then answer the Part I questions.

## Part II: Atom Patterns

We are well on our way to understanding atoms, the building blocks of our universe. We learned the following:

- Protons and neutrons make up the mass of an atom and are found in the nucleus.
- Electrons do not contribute significant mass to an atom but do make up the volume of an atom since they are found in the electron cloud.
- The overall charge of the nucleus is positive because of the positive protons ( $p^+$ ) and neutral neutrons ( $n^0$ ).
- The charge of the electron cloud is negative because of the negative electrons ( $e^-$ ).
- Protons, neutrons, and electrons are subatomic particles. Atoms are different from each other because the numbers of their subatomic particles are different.

Let's look closer at the mass and electrical charge of an atom.

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## Part II: Atom Patterns, continued

**Mass:** Units for the mass of an atom are amu, Atomic Mass Units. We learned in Part I that each proton contributes 1 amu, each neutron contributes 1 amu, and electrons are so small that they do not contribute to the mass of an atom. One way to determine the mass of an atom is to simply count the total number of protons and neutrons of the atom. The diagram of the hydrogen atom that you built had one proton in the nucleus so the mass of this hydrogen atom is 1 amu. The diagram of the helium atom that you built had two protons and two neutrons in the nucleus so the mass of this helium atom is 4 amu.

**Electrical charge of an atom:** To determine the electrical charge of an atom simply count the number of positive protons and the number of negative electrons, then add these two numbers together. The hydrogen and helium atoms that you built in the diagrams did not have a charge. For example: the hydrogen atom had one positive proton and one negative electron, resulting in  $(+1) + (-1) = 0$ . The helium atom had two positive protons and two negative electrons, resulting in  $(+2) + (-2) = 0$ . As long as the number of protons and electrons are equal, the atom is without charge or neutral.

Use the information in the table below to make a model of a lithium atom and a model of a beryllium atom in your *Student Journal*. Use the ( $p^+$ ) circles, colored yellow, to represent protons; the ( $n^0$ ) circles, colored blue, to represent neutrons; and small red dots to represent electrons ( $e^-$ ) for each model in your *Student Journal*.

Subatomic Particles Found in One Atom of the Elements Lithium and Beryllium			
Element	Number of Protons	Number of Neutrons	Number of Electrons
Lithium	3	4	3
Beryllium	4	5	4

After you build the models of a lithium and beryllium atom, complete the charts and questions in Part II of your *Student Journal* to explore the properties of the subatomic particles.

Complete all questions in the *Student Journal*.