

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## Student Exploration: Element Builder

**Vocabulary:** atom, atomic number, electron, electron dot diagram, element, energy level, ion, isotope, mass number, neutron, nucleus, periodic table, proton, radioactive, valence electrons

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

1. What are some of the different substances that make up a pizza? \_\_\_\_\_  
\_\_\_\_\_
2. What substances make up water? \_\_\_\_\_
3. What substances make up an iron pot? \_\_\_\_\_

**Elements** are pure substances that are made up of one kind of **atom**. Pizza is not an element because it is a mixture of many substances. Water is a pure substance, but it contains two kinds of atom: oxygen and hydrogen. Iron is an element because it is composed of one kind of atom.

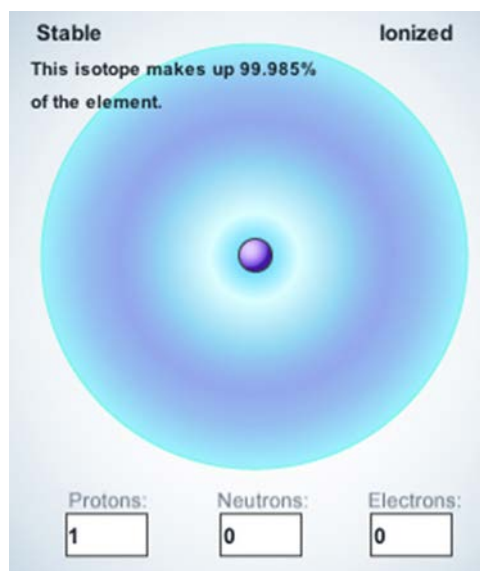
### Gizmo Warm-up

Atoms are tiny particles of matter that are made up of three particles: **protons**, **neutrons**, and **electrons**. The *Element Builder* Gizmo™ shows an atom with a single proton. The proton is located in the center of the atom, called the **nucleus**.

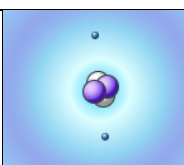
1. Use the arrow buttons (▶) to add protons, neutrons, and electrons to the atom. Press **Play** (▶).

A. Which particles are located in the nucleus?  
\_\_\_\_\_

B. Which particles orbit around the nucleus?  
\_\_\_\_\_

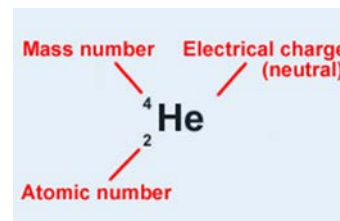


2. Turn on **Show element name**. What causes the element name to change? \_\_\_\_\_  
\_\_\_\_\_

<b>Activity A:</b> <b>Subatomic particles</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Use the arrows to create an atom with two protons, two neutrons, and two electrons.</li> <li>• Turn on <b>Show element name</b>.</li> </ul>	
--	--	---

**Question: What are the properties of protons, neutrons, and electrons?**

1. Observe: Turn on **Show element symbol** and **Element notation**. Three numbers surround the element symbol: the **mass number** (*A*), electrical charge (no number is displayed if the atom is neutral), and the **atomic number** (*Z*).



2. Investigate: Watch how the numbers change as you add or remove particles.

A. Which number is equal to the number of protons in the atom? \_\_\_\_\_

B. How can you calculate the number of neutrons (*N*) in an atom? \_\_\_\_\_

C. Which particle (proton, neutron, or electron) has a positive charge? \_\_\_\_\_

Negative charge? \_\_\_\_\_ No charge at all? \_\_\_\_\_

3. Analyze: An **isotope** is an alternative form of an element. Each isotope of an element has the same number of protons, but a different number of neutrons. The isotope is represented by the atomic symbol and mass number, such as He-4. Some isotopes are stable, while others are **radioactive**, which means the atoms decay over time and emit radiation.

A. What are the stable isotopes of carbon? \_\_\_\_\_

B. What are the stable isotopes of nitrogen? \_\_\_\_\_

C. List two radioactive isotopes of oxygen: \_\_\_\_\_

4. Practice: Use the Gizmo to answer the following questions.


A. How many electrons are in a neutral atom of lithium? \_\_\_\_\_

B. How many neutrons are in an atom of Mg-25? \_\_\_\_\_

C. What is the mass number of an atom with 5 protons and 7 neutrons? \_\_\_\_\_

D. An **ion** is a charged atom. How many electrons are in  $O^{2-}$ ? \_\_\_\_\_

E. How many electrons are in  $Mg^{2+}$ ? \_\_\_\_\_

<b>Activity B:</b> <b>Electron configurations</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"> <li>• Create a neutral hydrogen atom (1 proton, 0 neutrons, 1 electron).</li> </ul>	
--	--	---

**Question: How are electrons arranged around the nucleus of an atom?**

1. Observe: Add electrons to your atom until you have used all the available electrons. How are the electrons arranged? \_\_\_\_\_

2. Analyze: Electrons are arranged in orbits called **energy levels**, shown in the Gizmo.

A. How many electrons can fit in the first energy level? \_\_\_\_\_

B. How many electrons can fit in the second energy level? \_\_\_\_\_

C. How many electrons can fit in the third energy level? \_\_\_\_\_

3. Observe: Click **Reset** (🔄). The electrons in the outermost orbit, called **valence electrons**, help to create chemical bonds. Create a lithium atom (3 protons, 4 neutrons, 3 electrons).

How many *valence* electrons are in a neutral lithium atom? \_\_\_\_\_

4. Diagram: Turn on **Show electron dot diagram**. The valence electrons of an atom are shown in an **electron dot diagram**. Each dot represents a valence electron.

Draw the electron dot diagram for neutral lithium: \_\_\_\_\_

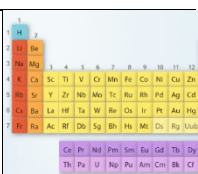
5. Practice: Turn off **Show electron dot diagram**. Use the Gizmo to create a neutral atom of each of the following elements. Draw an electron dot diagram for each. When you are finished, turn on **Show electron dot diagram** and check your answers.

H	He	Li	Be	B	C	N
O	F	Ne	Na	Mg	Al	Si

6. Extend your thinking: Many properties are determined by the number of valence electrons.

Which element probably has similar properties to lithium? \_\_\_\_\_ Beryllium? \_\_\_\_\_

Explain: \_\_\_\_\_

<p><b>Extension:</b> <b>The periodic table</b></p>	<p><u>Get the Gizmo ready:</u></p> <ul style="list-style-type: none"> <li>• Create a neutral hydrogen atom.</li> <li>• If you have access to a periodic table, open it now. (Not required.)</li> </ul>	
--	--	---

**Question:** The 117 or so known elements are arranged in the **periodic table**. Why does the periodic table have the shape it has?

1. Form a hypothesis: Look at the first three rows of the periodic table below.



Why do you think the elements are arranged the way that they are? \_\_\_\_\_

\_\_\_\_\_

2. Draw diagrams: Create an electron dot diagram for each of the elements below. Use the Gizmo to help you do this. To check your work, turn on **Show electron dot diagram**.

H								He
Li	Be	B	C	N	O	F		Ne
Na	Mg	Al	Si	P	S	Cl		Ar

3. Analyze: What do the elements in each *column* of the periodic table have in common?

\_\_\_\_\_

\_\_\_\_\_

4. Draw conclusions: How is the periodic table organized? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_