

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

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

## Student Exploration: Grade 9 Chemistry Review

**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**.

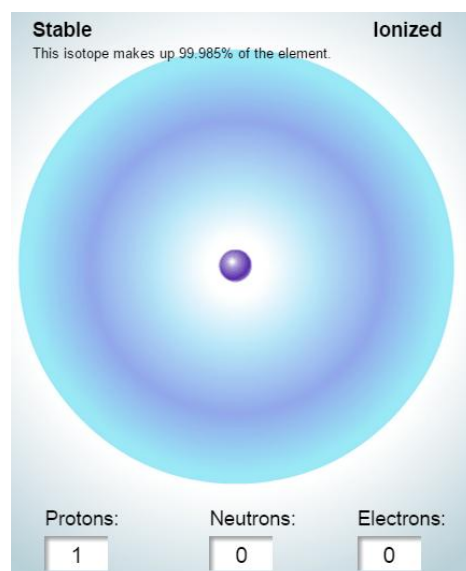
1. Use the arrow buttons (▶) to add protons, neutrons, and electrons to the atom. Press **Play** (▶).

A. Which particles are located in the nucleus?

\_\_\_\_\_

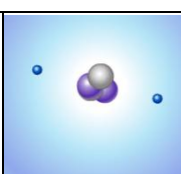
B. Which particles orbit around the nucleus?

\_\_\_\_\_



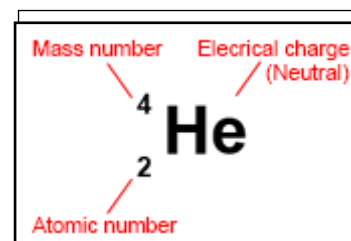
2. Turn on **Show element name**. What causes the element name to change? \_\_\_\_\_

\_\_\_\_\_

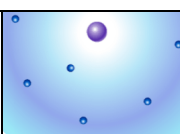
<b>Activity A:</b> <b>Subatomic particles</b>	<u>Get the Gizmo ready:</u> <ul style="list-style-type: none"><li>• Use the arrows to create an atom with two protons, two neutrons, and two electrons.</li><li>• Turn on <b>Show element name</b>.</li></ul>	
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**Question: 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. When an atom is charged, it is called an **ion**. How many electrons are in  $O^{2-}$ ? \_\_\_\_\_
- E. How many electrons are in  $Mg^{2+}$ ? \_\_\_\_\_

<b>Activity B:</b>  <b>Electron arrangements</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>	
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**Question: How are electrons arranged around the nucleus of an atom?**

1. **Observe:** Add electrons to the atom until you have used all the available electrons. How are the electrons arranged? \_\_\_\_\_  
\_\_\_\_\_
2. **Analyze:** Electrons are arranged in orbits called **energy levels**. The Gizmo shows all of the first two energy levels but only part of the third energy level.



- 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 fit in the part of the third energy level shown? \_\_\_\_\_

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.

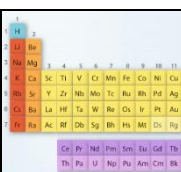
H	He	Li	Be	B	C	N
O	F	Ne	Na	Mg	Al	Si

6. **Extend your thinking:** Many chemical properties are determined by the number of valence electrons. Elements with the same number of valence electrons will have similar properties.

Which element 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>	
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**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.



1	H	2											13	B	14	C	15	N	16	O	17	F	18	He
2	Li	Be											13	B	14	C	15	N	16	O	17	F	18	Ne
3	Na	Mg	3	4	5	6	7	8	9	10	11	12	13	Al	14	Si	15	P	16	S	17	Cl	18	Ar

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?

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

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