Name _____ Date _____

A4 Valence Electrons

Materials:

- ✔ 2 Atom Building Games
- ✔ Periodic table

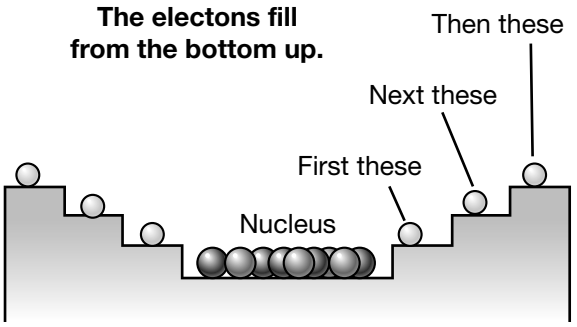
What are valence electrons and how are they related to the structure of the periodic table?

Valence electrons are **electrons** in the outermost energy level of an atom. The region of an energy level that holds the valence electrons is called the **outermost shell**. These electrons participate in the formation of **chemical bonds**. A chemical bond is a bond formed between atoms that involves sharing or transferring electrons. You can think of valence electrons as the outer "skin" of an atom. In this investigation, you will look at valence electrons and discover how they are related to the structure of the periodic table.

❶ Reviewing atomic structure

Here are some important things to remember about atomic structure.

- A neutral atom has the same number of electrons and protons.
- The electrons occupy **energy levels** surrounding the nucleus.
- Since electrons are attracted to the nucleus, they fill the lower energy levels first..
- Once a level is full, electrons start filling the next level.



❷ How many electrons are in the outermost level?

Using the Atom Building Game, build each element in Table 1. For each element, record the number of electrons in the outermost level and the number of unoccupied spaces in the outermost level.

Table 1: Element data

Element	Atomic number	Electrons in outermost level	Unoccupied spaces in outermost level
hydrogen			
helium			
lithium			
fluorine			
neon			
sodium			
chlorine			
argon			
potassium			

❸ What are valence electrons?

In the atoms you built, the number of valence electrons is equal to the number of electrons in the outermost level of the model. Examine the table you just completed, and record the answers to the following questions.

✓ **a.** For the atoms you built, how many valence electrons does it take to completely fill the outermost level of each atom?

b. What do lithium, sodium, and potassium have in common?

c. What do fluorine and chlorine have in common?

d. Neon and Argon are in the group of elements known as **noble gases**. What do neon and argon have in common?

❹ Valence electrons and the periodic table

You will need your periodic table to answer the following questions.

a. You can find the information for the second column of Table 2 in Table 1. Use your periodic table to find the column in which each element is located. For this activity, use only the eight tallest columns on the periodic table.

Table 2: Periodic table data

Element	Electrons in outermost level	Column on the periodic table in which each element is located
hydrogen		
helium		
lithium		
fluorine		
neon		
sodium		
chlorine		
argon		
potassium		

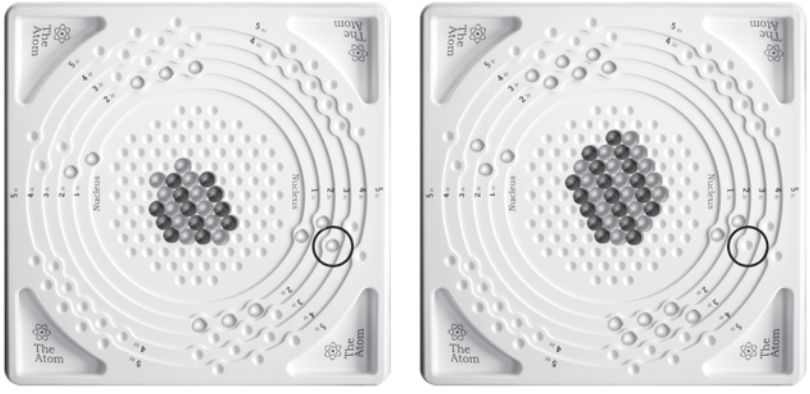
✓ **b.** For the atoms you built, what relationship do you see between the numbers of electrons in an element's outermost level and the column in which it appears on the periodic table?

c. How do you think this influenced the arrangement of the periodic table?

d. There is a whole section of elements in the periodic table we didn't account for. These are called the transition metals. Use your textbook to find out about the transition metals, and write a short paragraph explaining their properties.

❺ Modeling a chemical bond

Atoms that have a complete set of valence electrons are stable. If there are empty holes, an atom will either gain, lose, or share electrons with another atom in order to complete its outermost shell and become stable. When atoms gain, lose, or share electrons with another atom, they form chemical bonds.



Using two Atom Building Games, build a sodium atom and a chlorine atom. Put them next to each other, and answer the questions below.

a. In order to complete its outermost shell, do you think sodium will tend to lose its only valence electron, or gain seven? Explain your answer.

b. In order to complete its outermost shell, do you think chlorine will tend to lose all seven of its valence electrons or gain one electron? Explain your answer.

c. Why do you think these two atoms bond together to form a compound? In your answer, describe what you think happens to the electrons when sodium and chlorine form a chemical bond.