

Chemistry Activity Bag

Chemical Bonds: Student Activity Guide

You may have heard people say things like H_2O when talking about water, or $NaCl$ when talking about salt. Those combinations of letters and numbers refer to elements and numbers of atoms in a particular substance. But, what do we mean by a particular number of atoms? In this activity, we are going to explore how elements bond together in exact proportions to become new things. This bonding process is called a chemical reaction. Chemists have figured out which elements are involved in chemical reactions and how many atoms of each element combine.

These directions will get you started. Your teacher will be in contact to guide you and provide information.

Materials From The Bag

- Element Cards

Part 1: Compounds

H_2O is the chemical formula for water. Let's explore this chemical formula. The electrons are the active part of the atoms of each element. They create chemical bonds.

1. Cut out all 15 element cards. What do you notice about the cards?
2. Find an oxygen card. What do you notice about the electrons for oxygen?
3. Find two hydrogen cards. What do you notice about the electrons for hydrogen?
4. Place them all together. You just created a compound. In our compound, how many oxygen cards do you have? How many hydrogen cards do you have?
5. Each card represents one atom of the element. How many atoms of oxygen and hydrogen are present in H_2O ? What do you notice about the total number of electrons?

What's happening...

A compound is formed when two or more elements form chemical bonds with their electrons. In water one oxygen accepts two electrons (-2) and two hydrogens each give up an electron (+2). Therefore the electrons in the water molecule add up to zero ($-2+2=0$) and are balanced. When a compound is formed the electrons must balance in this way.

6. Use the element cards to create as many compounds as you can with two or more different elements. Each card represents one atom of that element. Remember, the electrons in each compound must balance.
7. Record each compound you have made. Keep track of how many atoms of each element are in the compound. You indicate this by writing the number as a subscript, the smaller number, to the right of the element ($H_2 = 2$ Hydrogen atoms). If there is no subscript it means that there is only one atom ($O = 1$ oxygen atom).

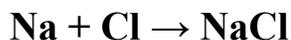
Explain if the molecule $NaHCO_3$ could exist based on the balance of electrons.

Part 2: Chemical Reaction

In this part, we will explore how different atoms of elements rearrange themselves during a chemical reaction.

1. Find one sodium card and one chlorine card.

2. When one sodium atom bonds with one chlorine atom it forms sodium chloride (NaCl). Sodium chloride is also known as salt. The chemical reaction is below.



Explain how NaCl can exist based on what you learned in Part 1.

3. Looking at the reaction: $\text{Na} + \text{Cl} \rightarrow \text{NaCl}$

What do you notice about the number of Na atoms on the left side of the arrow and the number of Na atoms on the right side of the arrow? What do you notice about the number of Cl atoms on the left side of the arrow and the number of Cl atoms on the right side of the arrow?

What's happening...

In a chemical reaction, atoms cannot be created or destroyed. They can only be rearranged. The number of atoms for each element must be the same before and after the reaction. This is called the Law of Conservation of Matter.

4. Find one sodium card, one chlorine card, two hydrogen cards, and one oxygen card.
5. Let's look at when HCl and NaOH are combined together. Build the compounds HCl and NaOH with your element cards.

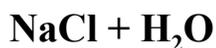
Based on what we know about electrons, can these two compounds exist?

6. Look at the formula below and write down the total number of atoms for each element.

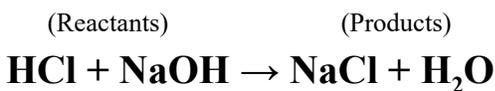


7. Now let's look at when HCl and NaOH react together. They are called **reactants**. When HCl and NaOH combine they react and create new compounds NaCl and H₂O. NaCl and H₂O are called **products**.

Using the same element cards, build these compounds. We have previously determined that NaCl and H₂O can exist. Write down the total number of atoms for each element.

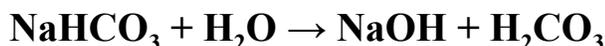


8. The chemical equation for the complete reaction is below. The reactants are on the left side of the arrow and the products are on the right side of the arrow.



Explain how the equation supports the Law of Conservation of Matter. The Law of Conservation of Matter states that the number of atoms for each element must be the same before and after the reaction.

9. Using what you know let's look at the following equation.



Based on what we know about electrons explain how each compound (NaHCO₃, H₂O, NaOH, H₂CO₃) can exist, and provide evidence that this equation supports the Law of Conservation of Matter.