



# Chemistry and the Periodic Table

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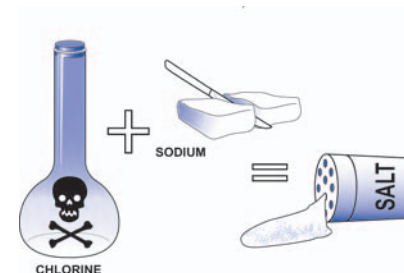
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## A-3 Chemical Reactions

*Key Question: What is a chemical reaction?*

In this Investigation, students learn to identify reactants and products in a chemical reaction and practice balancing simple chemical equations using the periodic puzzle blocks.



### Preparation

In order to complete this activity, students should be familiar with atoms and elements, and ions. They should also be familiar with how to write chemical formulas. Students should complete *Investigation A-2 Groups of Elements* before this Investigation.

### Setup and Materials

Students work in groups of four at tables.

Each group should have:

- One set of periodic puzzle blocks.

Each student should have:

- One photocopy of the periodic table that came with the blocks.

Each classroom should have:

- A wall chart of the periodic table (optional, but useful for you and students to refer to during class).

### The Investigation

**Time**  One class period

- Leading Questions**
- What is a chemical reaction?
  - How do you balance a chemical equation?

- Learning Goals**
- In this Investigation, students will:
- Identify reactants and products in a chemical reaction.
  - Write and balance chemical equations.

**Key Vocabulary** chemical reaction, reactants, products, diatomic molecule, chemical equation

**1**

1a. The reactants are sodium and chlorine.

1b. The product is sodium chloride, or salt.

**2**

2a. The reactants are octane and oxygen.

2b. The products are carbon dioxide and water.

A-3

## Chemical Reactions



**Question:** What is a chemical reaction?

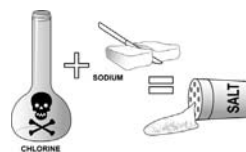
In this Investigation, you will:

1. Define reactant, product, and chemical reaction.
2. Learn to balance chemical equations.

In the previous Investigation, you learned that atoms combine to form molecules. Now we will investigate how those combinations take place through **chemical reactions**.

**1**

What is a chemical reaction?



Sodium and chlorine combine to form sodium chloride, or table salt. We call this process a **chemical reaction** because the atoms that we start with rearrange themselves and form new bonds with other atoms. It is important to remember that the numbers and kinds of atoms don't change; instead they are just rearranged.

We call the ingredients that go into the reaction the **reactants**. The material or materials that we end up with are called the **products**.

- a. What are the reactants in the chemical reaction above?
- b. What are the products?

**2**

Identifying reactants and products of chemical reactions



- a. Octane is a major component of gasoline. When octane is burned in the presence of oxygen, carbon dioxide and water are formed. What are the reactants in this chemical reaction?
- b. What are the products of the octane-burning reaction?

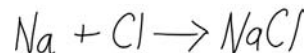
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## Writing chemical equations

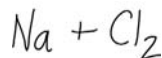


We can show what happens during a chemical reaction by writing a **chemical equation**. Writing chemical equations is a lot like writing mathematical equations. To write a chemical equation, we use the symbols for the elements and compounds involved in the reaction. The reactants are shown on the left side of the equation, followed by an arrow, and then the products on the right side.

Remember that sodium reacts with chlorine to form sodium chloride, or table salt. We *might* write the chemical reaction for table salt like this:



to show that we started with sodium (Na) and chlorine (Cl) and ended up with salt (NaCl). The only problem with this equation is that chlorine is not available in the atomic state. Pure chlorine exists in pairs of atoms that we call **diatomic molecules**. The formula for diatomic chlorine is  $\text{Cl}_2$ . Therefore we write the left side of the chemical equation like this:



Take three periodic puzzle blocks to represent the reactants above: One sodium block and two chlorines joined together to represent a molecule. Rearrange them to make salt. What is the happens?



The rule for chemical equations is that you have to use all the atoms you start with, and you cannot add extras or have leftovers at the end. In other words, chemical equations must always *balance*.

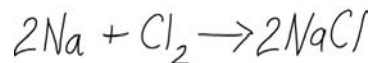
Since chlorine comes in molecules containing two atoms, we need to have two sodium atoms to match up with the two chlorine atoms in the diatomic molecule.

Now add another sodium block to the three blocks you already have. Let the chemicals react! Does your equation balance now?



- How many sodium atoms do you need to complete the equation?
- How many molecules of sodium chloride are formed in the equation?

To write the complete, balanced equation for this reaction, we place numbers in front of the reactants and products to show how many of each are required. These numbers are called coefficients. If the number of reactants or products is one, we do not use a coefficient (or write the 1). The complete, balanced equation for the formation of sodium chloride is:



2

3

When students rearrange the periodic puzzle blocks to try and make a salt molecule, they have one sodium block left over. This does not work because there should be no stray atoms left over. Only the product, NaCl should be formed.

- Two sodium atoms are needed to complete the equation.
- Two molecules of sodium chloride are formed in the equation.

4

The balanced equation for making methane from hydrogen gas and carbon is:

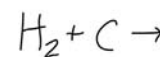


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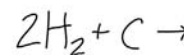
## Balancing chemical equations



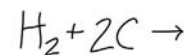
Let's try another reaction. Combine hydrogen gas (which is also a diatomic molecule,  $\text{H}_2$ ) with carbon (C) to make methane ( $\text{CH}_4$ ). First pick out some hydrogen and carbon blocks, and then try setting up the reactants. Remember that you must be able to rearrange all the reactant atoms to get complete products. Which of these reactant combinations works?



or



or



Write the balanced chemical equation for making methane from hydrogen gas and carbon.

3

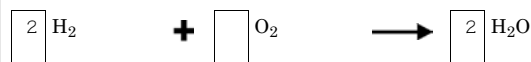
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## More equations to balance

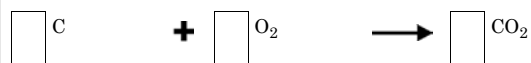


Let's balance some other chemical equations. The following equations have the proper reactants and products. First assemble the reactants out of blocks, then rearrange them to make products. Figure out the right number of each reactant and product to make the chemical equation balance. Fill in the numbers in the boxes below. If there is only one reactant or product required, do not write the 1. The first one is done for you.

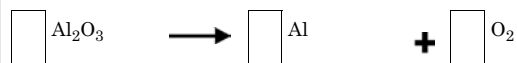
**Hydrogen reacts with oxygen to produce water:**



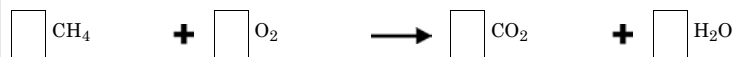
**Carbon reacts with oxygen to produce carbon dioxide:**



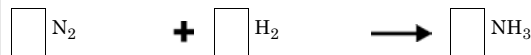
**Aluminum ore is heated to produce aluminum metal and oxygen gas:**



**Methane (natural gas) burns in oxygen to produce carbon dioxide and water:**



**Nitrogen gas reacts with hydrogen gas to produce ammonia:**



**Carbonic acid in soda pop breaks down to produce water and carbon dioxide (the bubbles in your soda!):**



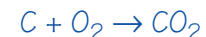
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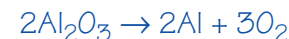
**Hydrogen reacts with oxygen to produce water:**



**Carbon reacts with oxygen to produce carbon dioxide:**



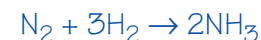
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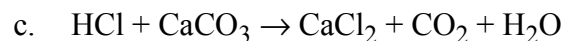
**Carbonic acid in soda pop breaks down to produce water and carbon dioxide (the bubbles in your soda!)**



1. Answers are:

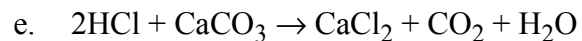
a. The reactants are hydrochloric acid and calcium carbonate. The products are calcium chloride, carbon dioxide, and water.

b. Hydrochloric acid reacts with calcium carbonate to produce calcium chloride, carbon dioxide, and water.

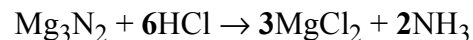
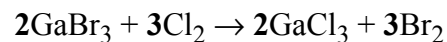
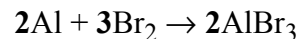
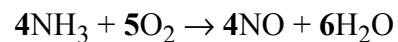
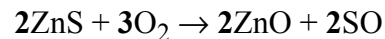
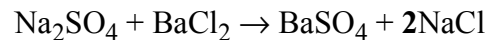


d.

atom	reactants	products
<b>H</b>	1	2
<b>Cl</b>	1	2
<b>Ca</b>	1	1
<b>C</b>	1	1
<b>O</b>	3	3



2. Answers are:



## Curriculum Resource Guide: Periodic Puzzle

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