



## Level A Investigations

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### A-1 The Periodic Table

*What is the periodic table?*

In this Investigation, students will define atom, element, molecule, and compound; build a periodic table using the Periodic Table Tiles, and become familiar with the element names and symbols through the Element Bingo game.

### A-2 Groups of Elements

*How are the elements arranged in the periodic table?*

In this Investigation, students are introduced to atomic structure, ions, and chemical bonds. They will learn to recognize groups in the periodic table, and use the periodic table to predict chemical formulas.

### A-3 Chemical Reactions

*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 Table Tiles.

## Level B Investigations

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### B-1 Chemical Formulas

*Why do atoms combine in certain ratios?*

In this Investigation, students are introduced to energy levels and oxidation numbers. They use oxidation numbers to predict chemical formulas, learn naming conventions for ionic compounds, recognize groups in the periodic table, and play the Molecular Crossword game.

### B-2 A Tour of the Periodic Table

*How is the periodic table organized?*

Students further explore the organization of the periodic table. They build each group of elements with the Periodic Table Tiles while they read about the properties of elements in that group. They practice forming molecules made from elements of two different groups while they read interesting facts about different compounds. They are also introduced to the transition metals, lanthanides, and actinides.

### B-3 Chemical Equations

*How do you balance chemical equations?*

In this Investigation, students learn to identify reactants and products and to write chemical equations. They practice balancing chemical equations using the Periodic Table Tiles.

## Level C Investigations

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### **C-1 Electrons and the Periodic Table**

*What electrons have to do with the periodic table?*

In this Investigation, students learn how electrons are organized in the different energy levels. They build the periodic table out of Periodic Table Tiles and write the electron configurations of all of the elements. They discover that the groups of the periodic table are arranged according to the number of valence electrons. They practice predicting and writing chemical formulas based on an understanding of the octet rule.

### **C-2 Challenging Chemical Equations**

*How do you balance difficult chemical equations?*

In this Investigation, students learn to identify reactants and products and to write chemical equations. They practice balancing challenging chemical equations using the Periodic Table Tiles.

### **C-3 Classifying Reactions**

*How can you predict the products of a chemical reaction?*

In this Investigation, students will learn to identify five common types of reactions, predict the products of a reaction given the reactants, and balance chemical equations given only the reactants.



Question: How do you balance chemical equations?

In this Investigation, you will:

1. Investigate how atoms are conserved in a chemical reaction.
2. Use the Periodic Table Tiles to learn how to balance equations.

A chemical reaction involves changes in substances that react to form new products. This process involves the breaking of chemical bonds and the formation of new ones. A chemical equation shows the chemical formulas of the substances that react, called **reactants**, and the chemical formulas of the substances that are produced, called **products**. The number and type of atoms in the reactants must be exactly equal to the number and type of atoms in the products. How do you write a chemical equation so that the number and type of atoms on the reactant and product sides are balanced?

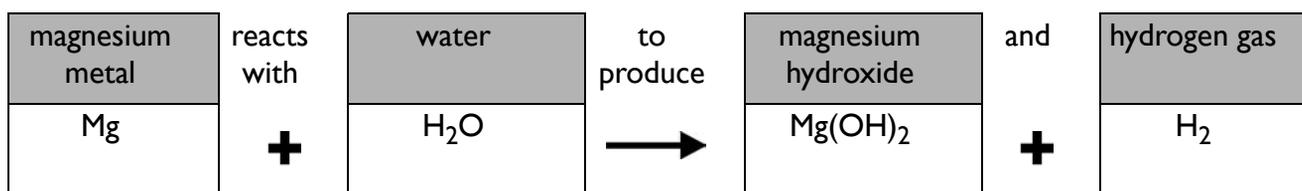
## 1 Writing chemical equations

**Magnesium metal reacts with water to produce magnesium hydroxide and hydrogen gas.**

The statement above is the word form of a chemical reaction. It tells you the names of the reactants and the products. To write it as a chemical equation, you need to determine the chemical formulas of each of the substances in the reaction:

1. Magnesium metal is an element and exists as an atom. Its chemical formula is Mg.
2. The chemical formula for water is H<sub>2</sub>O.
3. Magnesium hydroxide is an ionic compound. To write its chemical formula, you need to find out the charges of each of its ions. The magnesium ion is Mg<sup>2+</sup>. The hydroxide ion is OH<sup>-</sup>. You need 1 Mg<sup>2+</sup> and 2 OH<sup>-</sup> to make a neutral compound, so the formula is Mg(OH)<sub>2</sub>.
4. Pure hydrogen gas always exists as a diatomic molecule, so its chemical formula is H<sub>2</sub>.

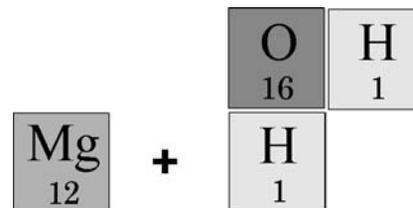
The chemical equation is written as:



## 2 Trying out the reaction with Periodic Table Tiles

Use the Periodic Table Tiles to make the reactants above.

Rearrange the reactants to make the products. Is there any problem? What are you missing?



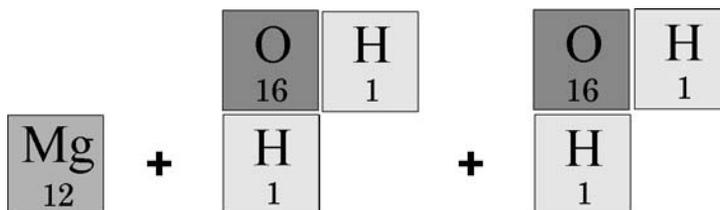

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### 3 Balancing the reaction

Chemical equations must always balance. This means that you must use all of the atoms you start with and you cannot have any leftover atoms when you are finished. If you need more atoms to make the products, you can only add them in the form of the actual reactants.



You cannot simply add the extra atoms that you need, unless the chemical formula is a single atom—like Mg. Which atoms did you need more of for the reaction you tried? Since you needed more oxygen and hydrogen atoms, you can only add them in the form of another water molecule.

Try adding another water molecule to the reactants and rearrange them to form the products again. Did the reaction work this time?

### 4 Writing balanced chemical equations

To balance the equation for this reaction, you needed to add another water molecule to the reactants side. You ended up with the correct amount of products. Since one magnesium atom reacted with two water molecules to form one magnesium hydroxide molecule and one hydrogen gas molecule, the proper way to write the balanced chemical equation is:

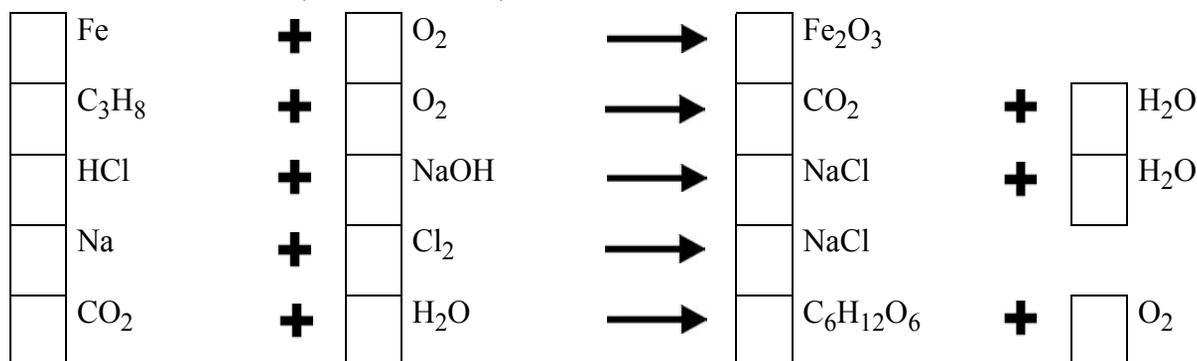


The 2 in front of water is called a **coefficient**. This number tells you how many water molecules are needed in the reaction. The rest of the reactants and products show no coefficients. This is because when the coefficient is 1, there is no need to write it.

### 5 Try balancing these chemical equations

The following chemical equations have the proper reactants and products. Try to balance each using the following steps:

- Assemble the reactants out of the appropriate tiles.
- Rearrange the reactants to form the products.
- Figure out the number of each reactant and product required to make the equation balance and write the numbers (the coefficients) in the boxes.



## B-3

## Chemical Equations



Question: How do you balance chemical equations?

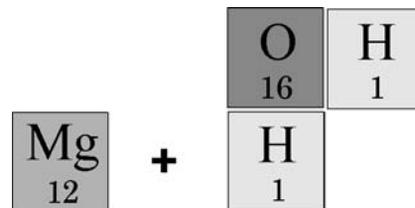
### 1 Writing chemical equations

There are no questions to answer in part 1.

### 2 Trying out the reaction with Periodic Table Tiles

Use the Periodic Table Tiles to make the reactants.

Rearrange the reactants to make the products. Is there any problem? What are you missing?




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### 3 Balancing the reaction

Try adding another water molecule to the reactants and rearrange them to form the products again. Did the reaction work this time?

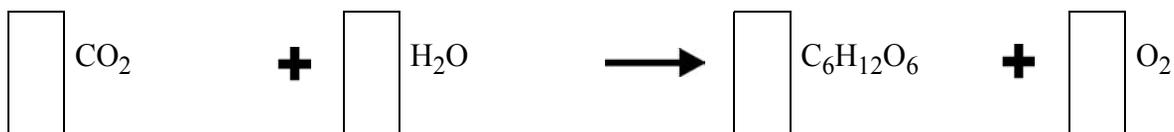
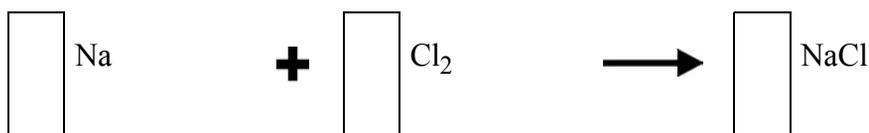
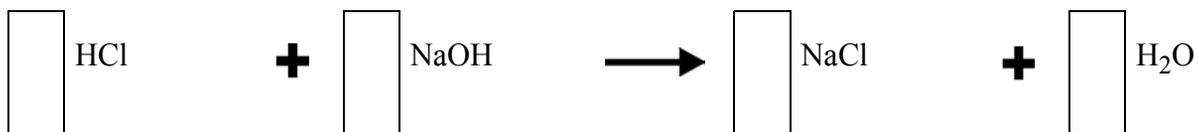
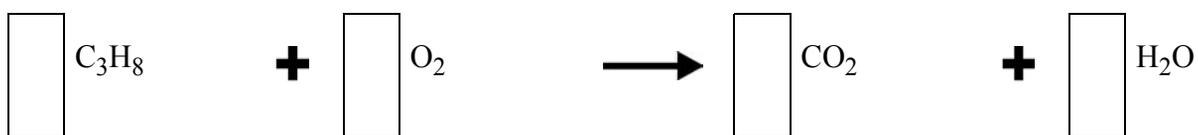
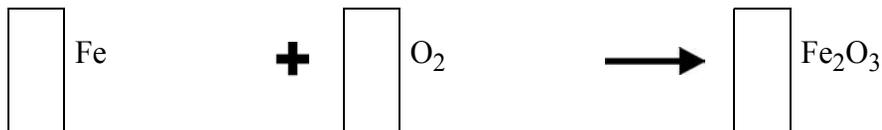
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### 4 Writing balanced chemical equations

There are no student responses required in this section.

The following chemical equations have the proper reactants and products. Try to balance each using the following steps:

1. Assemble the reactants out of the appropriate tiles.
2. Rearrange the reactants to form the products.
3. Figure out the number of each reactant and product required to make the equation balance and write the numbers (the coefficients) in the boxes.



## Questions

1. Hydrochloric acid (HCl) is a substance produced by your stomach to help break down food. Sometimes, if you eat spicy foods or worry too much about your upcoming science test, your stomach produces too much hydrochloric acid and you get heartburn. Many people take antacids to relieve this painful condition. Antacids commonly contain calcium carbonate ( $\text{CaCO}_3$ ) which neutralizes the hydrochloric acid. The products formed are calcium chloride ( $\text{CaCl}_2$ ), carbon dioxide ( $\text{CO}_2$ ), and water ( $\text{H}_2\text{O}$ ).

a. What are the reactants in this chemical reaction? What are the products?

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b. Write the chemical equation for the heartburn reaction in words.

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c. Now write the equation again, using the chemical symbols for each molecule in the reaction. Use an arrow to represent the words “to produce.”

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d. Fill out the table below to determine the number of each type of atom on the reactant and on the product side. Hydrogen is done for you.

atom	reactants	products
H	1	2
Cl		
Ca		
C		
O		

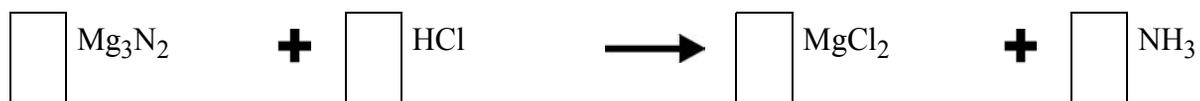
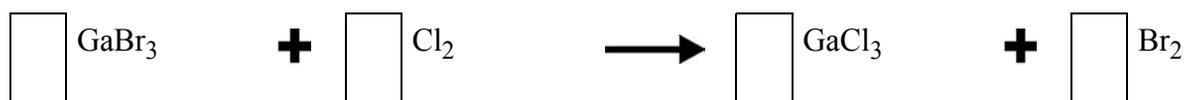
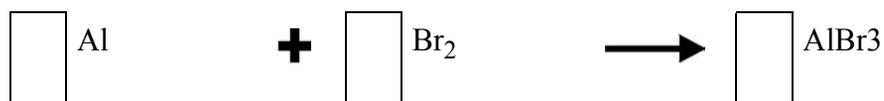
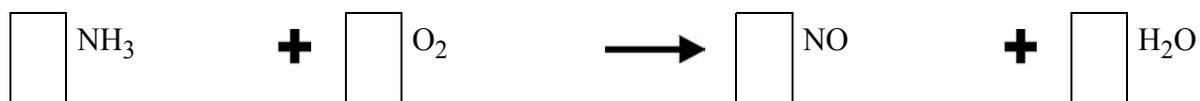
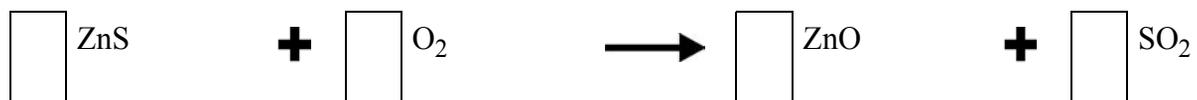
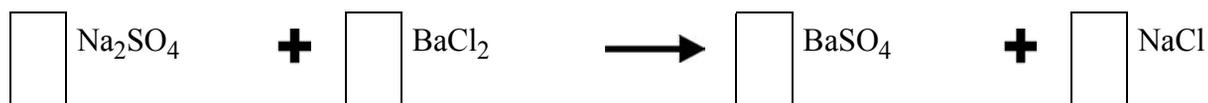
e. Use the chart above to help you balance the equation. Remember, you can change the coefficients in front of a molecule, but you can't change the subscripts. Write the balanced equation for the heartburn reaction.

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2. Balance the following equations. Make your own charts like the one in step 1e to help you.



## Curriculum Resource Guide: Periodic Table Tiles

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