Lesson 1
Production of a gas

STUDENT ACTIVITY SHEET

Name: _______________________

Chemistry: Investigating your world
Chemists work on every continent, and their work affects people everywhere. You may think you're just sitting in your classroom. But you're about to take a trip around the world. It is the International Year of Chemistry, after all. So for this activity, we're going global!

Here's the challenge: You are on a team that is racing around the world, meeting scientists and conducting chemistry challenges. When you arrive in each new place, you will meet a scientist. He or she will explain an experiment that you need to do. You'll also find out how the chemistry concepts in the experiment are used to improve people's lives.

At the end of each lesson, you will be asked a question about your chemistry challenge. When you answer the question, you will receive a secret word as a clue. Your final task is to use all four words to fill in the blanks in the following quote about science.

"All the ____________ is a ____________ to the ____________ ____________.

Dr. Martin H. Fischer
Chemist and physician

Are you ready to get started? Then, strap on your seat belt. You are headed first to ... Iceland! While on the plane, read about chemical reactions. The information on the next page will get you up to speed and help you solve the challenges ahead.
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Chemical reactions
As you travel around the world, you will see how different scientists use chemical reactions in their work. Read about chemical reactions here, and get ready to combine chemicals to make something new.

One of the amazing things about chemical reactions is that they create substances that were not there before! When two substances react with each other, atoms or groups of atoms from the substances come apart, rearrange, and then combine in different ways to form different substances.

Another great thing about chemical reactions is that they can be used to make lots of different materials that we need and use every day. Chemical reactions help make the materials that electronic equipment like computers and cell phones are made of. They help make different parts of cars, airplanes, and bicycles. Chemical reactions also help make many of the materials in buildings, sports equipment, medicine, clothing, and food.

Because chemical reactions make something new, you can usually tell when a reaction has happened. You will see something different from what was there to start with. Here are some clues that a chemical reaction may have taken place:

- A gas where there wasn’t one before
- A new color
- A solid where there wasn’t one before
- A change in temperature

Now that you know the clues of chemical change, keep an eye out for them. And get ready for some reaction action!
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Meet the scientist

Country: Republic of Iceland
Scientist: Victor Helguson

Welcome to Iceland! My name is Victor Helguson, and I am a volcanologist. I study volcanoes. I try to predict when the next eruptions will happen. This is an important job in Iceland. We have about 130 volcanic mountains here. And that’s in a country the size of Kentucky!

You may have heard about Eyjafjallajökull. When this volcano erupted in 2010, it spit out so much ash that airports across Europe had to shut down. There was just too much ash in the air for planes to safely fly. To better understand volcanoes, I study the magma inside them and the lava that comes out. I also collect gases that volcanoes emit. Certain changes in these gas emissions can be a sign that a volcano is set to blow.

Carbon dioxide (CO₂) is one of the main gases that seep out of active volcanoes. In the activity below, you will make your own CO₂.

Producing a gas can be very useful, especially if you can control the amount that you make. After the activity, you will see one way that using a chemical reaction to produce a gas can save lives!
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Production of a gas

STUDENT ACTIVITY SHEET

Name: __________________________

Your chemistry challenge
How can you make just the right amount of foam so that it rises all the way to the top of your vial without overflowing?

The rules
Keep the amount of water and detergent the same but try a different amount of citric acid or baking soda or both. A dome of foam at the top of the vial is OK, but the foam shouldn’t drip down the vial. GOOD LUCK!

You will need
- Goggles
- Citric acid
- Sodium bicarbonate
- Detergent solution
- Water
- Small metric measuring cup
- Dropper
- 2 small plastic scoops
- 2 small clear plastic cups
- Clear plastic vial

Procedure
1. Decide on the number of scoops of citric acid and sodium bicarbonate you will combine, and write it in the chart.
2. Measure 5 milliliters (mL) of water and pour it into a small plastic cup.
3. Add the number of scoops of citric acid your group agreed on and swirl.
4. Add 1 drop of detergent solution and swirl.
5. Place the number of scoops of sodium bicarbonate your group agreed on in the plastic vial and stand it up in a cup as shown.
6. Pour the citric acid and detergent solution into the vial so that it mixes well with the baking soda.

<table>
<thead>
<tr>
<th>Make foam rise to the top without overflowing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstration</td>
</tr>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Citric acid</td>
</tr>
<tr>
<td>Detergent</td>
</tr>
<tr>
<td>Baking Soda</td>
</tr>
<tr>
<td>How close did the foam get to the top of the cylinder?</td>
</tr>
</tbody>
</table>

The big chemistry idea
In the chemical reaction in this activity, the citric acid and the sodium bicarbonate are called reactants. The carbon dioxide gas and other substances that are produced by the reaction are called products. The citric acid and sodium bicarbonate are made of atoms. In the chemical reaction between these reactants, certain atoms come apart from one another and rearrange to form the gas and the other substances in the products. When more reacting substances are used, there are more atoms to create more products.
Get a word for the quote
Which of the following statements about chemical reactions is true? Circle the correct answer.

1. The atoms in the reactants rearrange to form the products.
2. The atoms in the products appear out of nowhere.
3. The atoms in the reactants are destroyed, and new atoms are created to make the products.

<table>
<thead>
<tr>
<th>If you answered:</th>
<th>Your word for the quote is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>inquiring</td>
</tr>
<tr>
<td>2</td>
<td>asking</td>
</tr>
<tr>
<td>3</td>
<td>curious</td>
</tr>
</tbody>
</table>

Go to Solve the science quote on page 70 and write down your word in the chart next to the name of this lesson. You will fit it into the quote later.

Goodbye
Congratulations! Your mission here is complete. You will learn more about CO\textsubscript{2} at your next destination. Let me know if you come up with any interesting new ideas about volcanoes. And thanks for coming to Iceland!

Next destination – Fiji!
Lesson 1
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Name: __________________________

Chemical reaction in action!
Your mind may already be halfway to Fiji, but it’s worth reflecting on what you just learned how to do. Chemical reactions that produce gases can make our lives better and safer. One example is the gas that inflates an air bag during a collision. Scientists have figured out a way to make this chemical reaction go super-fast to save lives in a car crash.

Traveling at high speeds, cars are seriously dangerous places to be during an accident. That’s why many vehicles have seat belts and airbags. When two cars collide, passengers are often thrown forward and can become badly injured. Airbags are like large balloons. When they inflate, they prevent people from hitting the hard inside parts of the car. In order for airbags to work, however, they have to be fast. Really fast. That’s where chemistry comes in.

Airbags are connected to a crash sensor, which has a built-in accelerometer that senses a sudden shift in the car’s speed. When the crash sensor detects rapid deceleration, the airbag inflates with nitrogen gas at 200 MPH—faster than the blink of a human eye! In this case, nitrogen forms through a reaction between two chemicals called sodium azide and potassium nitrate. The entire process of airbag deployment takes just $\frac{1}{25}$ of a second. After the airbag inflates, nitrogen gas eventually escapes through very small holes in the airbag material, allowing the passenger to safely exit the vehicle.