

# What's New, CO<sub>2</sub>?

GET TO KNOW A CHEMICAL REACTION



## STUDENT LAB GUIDE

Name \_\_\_\_\_

# What's New, CO<sub>2</sub>?

## GET TO KNOW A CHEMICAL REACTION

Have you ever seen scientist characters in cartoons? They mix liquids together in a lab, only to have everything suddenly explode. Real chemists in real labs mix chemicals together but rarely have explosions. Instead they combine chemicals to make useful substances.

Chemistry is the science that studies what everything is made of down to its tiniest parts. It also is the science that makes new things. Medicines, fabrics, art supplies, shampoos, and foods are just a few examples of the many things made with chemistry.

Today you will start with two common chemicals, combine them, and then watch as they change into different chemicals. One of the chemicals can be a challenge to observe because it is invisible! But with a few clever science tricks, you will be able to observe and investigate it. Today you will do chemistry!



When your visiting scientist combined citric acid and baking soda, a *chemical reaction* occurred. This means that the chemicals broke apart into their smallest parts and then rearranged themselves to become different chemicals.



What is the name of the gas that caused the rubber stopper to fly out of the test tube?



Your visiting scientist did not add this chemical to the test tube. Where did it come from?

# Foam Dome

In each of the activities you will do today, you will use the very same chemicals your visiting scientist used in the demonstration—citric acid, baking soda, and water. And like the scientist, you will use carbon dioxide gas to do something interesting and exciting. In this activity, you will use carbon dioxide gas to make foam.

## GET READY FOR THE ACTIVITY

Take the following items out of your bag:

- Citric acid
- Baking soda
- Beaker
- Dropper
- 2 small scoops
- 1 small clear plastic cup labeled “citric acid solution”
- 3 small clear plastic cups
- Paper towel

Leave the other items in the bag, seal the bag, and place it out of your way. Your presenter will give you a cup of detergent solution.

Your challenge is to create just the right amount of foam that rises to the top of the cup without spilling over. See if you can do it in just three tries. Listen to your presenter and talk with your group to figure out what you will do.



## RISE TO THE CHALLENGE

Put on your goggles now and anytime you see this picture. You must wear your goggles during this activity. Do not remove your goggles until you have finished cleaning up from the activity and your teacher or the scientist says it is okay.



The procedure below is just like the one your visiting scientist demonstrated. But this time, you decide how much citric acid and baking soda to use.

1. Place the number of scoops of citric acid your group agreed on in the cup labeled “citric acid solution”.



2. Use a beaker to measure 10 mL of water. Add this water to the citric acid.

3. Use a dropper to add 1 drop of detergent solution. Swirl gently until the citric acid dissolves. Be sure to keep the bottom of the cup on the table as you swirl.



4. Place the number of scoops of baking soda your group agreed on in a small clean plastic cup. Then place this cup on a paper towel.



5. Add the citric acid and detergent solution to the baking soda. Do not swirl or stir. Try to get the foam to rise in a dome shape over the cup without spilling over.

6. Talk with your group about the number of scoops of citric acid and baking soda you will use on your next try.



	First Try	Second Try	Third Try
How many scoops of citric acid did you use?			
Remember to use the same amount of water and detergent solution each time.	10 mL of water	10 mL of water	10 mL of water
	1 drop of detergent	1 drop of detergent	1 drop of detergent
How many scoops of baking soda did you use?			
How high did the foam rise?			

## CLEAN-UP



Wear your goggles as you clean up from this activity.

- Rinse the citric acid cup and save it for the next activity.
- Empty the foamy liquids into your waste container.
- Place these empty plastic cups, the dropper, and the wet paper towel out of your way.
- Leave the scoops, citric acid, baking soda, beaker, cup labeled “citric acid solution,” and water out for the next activity.



## WHAT DO YOU KNOW?

What is your best recipe for foam that rises to the top of the cup and does not spill over?

What does the amount of foam tell you about the amount of carbon dioxide gas produced in the chemical reaction?

What would you do if you wanted to make even more carbon dioxide gas than you did in this activity?



# The Invisible Blue Buster

In the last activity, you used detergent solution to help you see the invisible carbon dioxide gas produced when citric acid and baking soda react with each other. In this activity, you will use a special blue liquid called bromthymol blue indicator to help you see the invisible gas in a different way.

## GET READY FOR THE ACTIVITY

You will need the following items:

*From the previous activity*

- Citric acid
- Baking soda
- 2 small scoops
- Beaker
- Small cup labeled “citric acid solution”
- Water

*From the materials bag*

- Bromthymol blue indicator
- 1 tall clear plastic cup
- 1 small clear plastic cup
- 2 wide clear plastic cups

## DO THE ACTIVITY

*Prepare the indicator solution*

1. Add 10 mL of water to a small clear plastic cup.
2. Add 10 drops of bromthymol blue indicator and swirl gently to mix.



### *Make a citric acid solution*

3. Place 3 scoops of citric acid in its labeled cup.
4. Use a beaker to measure 10 mL of water. Add this water to the citric acid and swirl to mix.



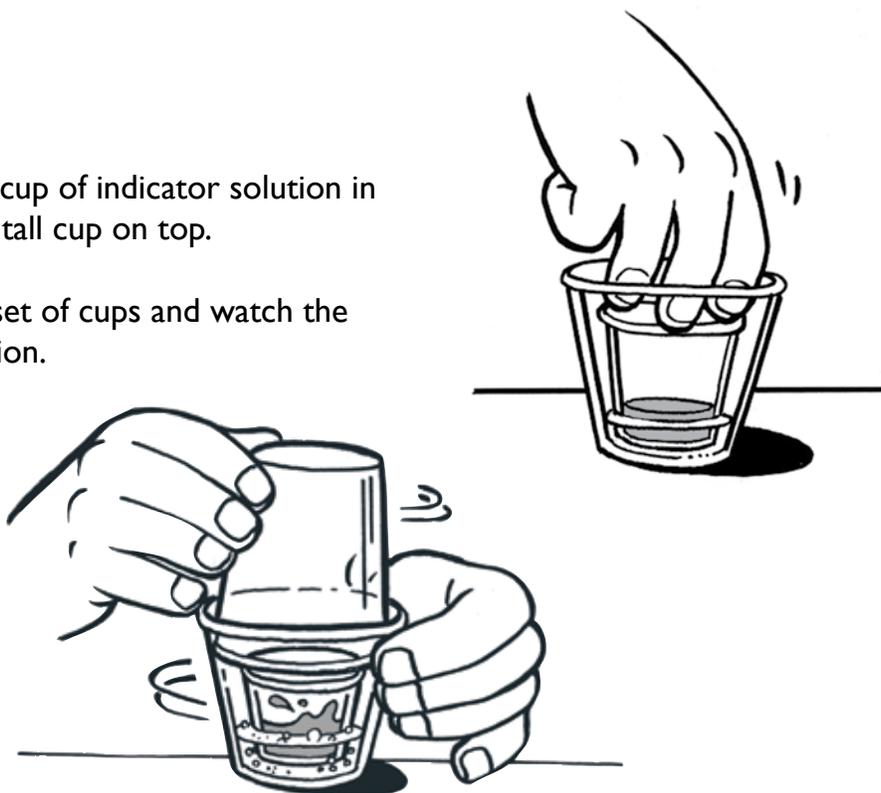
### *Start the chemical reaction*

5. Place 3 scoops of baking soda in a wide clear plastic cup.
6. Add the citric acid solution to the baking soda.



### *Trap carbon dioxide gas*

7. Quickly stand the small cup of indicator solution in the wide cup and place the tall cup on top.
8. Gently swirl the entire set of cups and watch the color of the indicator solution.





## WHAT DO YOU KNOW?

Carbon dioxide gas is invisible. How did you know when it moved into the bromthymol blue indicator solution?

Do you think carbon dioxide gas from any source would change the color of bromthymol blue indicator solution to green?

Why?

The scientific abbreviation for carbon dioxide gas is  $\text{CO}_2$ . Why do you think the title of your Student Lab Guide is *What's New,  $\text{CO}_2$ ?*

## CLEAN-UP

Place the following items back in the materials bag:

- Citric acid
- Baking soda
- Bromthymol blue indicator solution
- 2 small scoops
- Beaker



Empty the liquids into your waste container. Stack up the cups and put them aside so that your presenter can easily collect them.

# The Grand Finale

Carbon dioxide gas is everywhere! It's in your breath, soda pop, fire extinguishers, and it's in the self-inflating balloons you will explore in this activity. If you think about what you've learned about chemical reactions and carbon dioxide gas, you can figure out how self-inflating balloons work.

*Note: You do not need to wear goggles for this activity because all chemicals are contained inside the self-inflating balloons.*

1. Place your shiny self-inflating balloon on the table. Gently feel the balloon.
2. Place your see-through balloon next to the shiny balloon.
3. When your visiting scientist or teacher says it's time, select two students from your group to place each balloon on the floor and step on it.



4. Have the other students in your group shake the balloons and hold them.
5. Take turns holding and shaking until the balloons fully inflate.



## WHAT DO YOU KNOW?

What is the powder in a self-inflating balloon?

What is the liquid inside the little bag in a self-inflating balloon?

How do self-inflating balloons work?



# What did you learn?

Carbon dioxide gas is invisible. Name three ways you observed it in the activities you did with the presenter.



You can make carbon dioxide gas at home by combining vinegar and baking soda. What color would you expect bromthymol blue indicator to turn if you did the *Invisible Blue Buster* activity with vinegar and baking soda?

What would you mix together if you wanted to fill a sandwich-sized zip-closing plastic bag with carbon dioxide gas?

What is  $\text{CO}_2$  an abbreviation for?

What is a chemical reaction?



Visit [www.acs.org/kids](http://www.acs.org/kids) for more science activities you can do at home.