

## Activity 5.5

# Production of a gas—Controlling a chemical reaction

### How can you control the amount of gas produced in a baking soda and vinegar reaction?

In this investigation, students have seen a few reactions that produce a gas. In this activity, they will adjust the amount of baking soda and vinegar to control the *amount* of gas produced in the reaction. Since the bubbles of carbon dioxide gas normally disappear quickly, students will add a little detergent to make a longer-lasting foam. They will then evaluate the amount of gas produced based on the height the foam rises in a graduated cylinder.

#### Materials needed for each group

Baking soda	$\frac{1}{2}$ , $\frac{1}{4}$ , and $\frac{1}{8}$ Teaspoons
Vinegar	1 Dropper
Water	2 Small cups
Liquid dish detergent	2 Waste containers
Graduated cylinder, 50 ml	Paper towels

#### Notes about the materials

- **Be sure you and the students wear properly fitting goggles.**
- You may reuse the source cups of vinegar and baking soda left over from *Activity 5.4*.
- Use a 50 ml graduated cylinder if possible. If you have a different size, you will need to adjust the amount of baking soda and vinegar used so that the resulting foam overflows in the demonstration portion of the activity, p. 278.
- Students will need to rinse out the graduated cylinders during the activity. Using a squirt bottle and waste container is one easy way to do this if you do not have sinks at tables.
- Only one waste container is needed per group if sinks are readily available.

#### Preparing materials

- If you are not using cups from *Activity 5.4*, label 2 small cups **vinegar** and **baking soda**.
- Place about 3 tablespoons of vinegar and about 1 tablespoon of baking soda in their labeled cups.
- Label one small cup **detergent** for each group.
- Make enough solution for the class by adding 1 teaspoon of liquid dish detergent to 2 tablespoons of water. Stir gently until well-mixed.
- Place 1 teaspoon of the detergent solution you made into each labeled cup.

#### Activity sheet



Copy *Activity sheet 5.5—Production of a gas: Controlling a chemical reaction*, p. 280, and distribute one per student when specified in the activity.

#### Assessment

An assessment rubric for evaluating student progress during this activity is on pp. 305–307. For this formative assessment, check a box beside each aspect of the activity to indicate the level of student progress. Evaluate overall progress for the activity by circling either “Good”, “Satisfactory”, or “Needs Improvement”.

## Activity 5.5

### Production of a gas—Controlling a chemical reaction

#### Question to investigate

### How can you control the amount of gas produced in a baking soda and vinegar reaction?

#### 1. Introduce the activity.

Students know that baking soda and vinegar produce a gas. Explain that in chemical reactions, the change resulting from the reaction can be controlled by the amount of each substance used. Tell students that they will investigate how the amount of baking soda and vinegar used in a reaction influences the amount of gas produced.

#### Demonstration

#### 2. As a demonstration, combine vinegar, detergent, and baking soda in a graduated cylinder so that the foam overflows.

#### *Procedure*

1. Use a graduated cylinder to measure 10 ml of vinegar. (Refer to *Activity sheet 5.4*, p. 276 if necessary.)
2. Pour the vinegar in a small cup and add 1 drop of detergent. Swirl gently to mix.
3. Add  $\frac{1}{2}$  teaspoon of baking soda to the empty graduated cylinder.
4. Stand the graduated cylinder in the center of a plastic waste container.
5. Pour the vinegar and detergent from the cup into the graduated cylinder. Have students observe the level of foam in the graduated cylinder.
6. Rinse the graduated cylinder over a sink, bucket, or separate waste container.



***Expected results:*** A white foam will rise up and overflow from the graduated cylinder.

#### 3. Discuss with students what they might change to create a foam that rises to the top of the graduated cylinder without overflowing.

Ask students what they could change to create a foam that does not overflow.

Students might mention variables such as:

- The amount of vinegar, detergent, or baking soda.
- The order in which the substances are added to the graduated cylinder.

Explain that the amount of detergent is not varied in this activity because it is used as an indicator to help *measure* the amount of gas produced in the baking soda and vinegar reaction.

#### 4. Have a class discussion to help groups plan their testing strategies.

Remind students that 10 ml of vinegar and  $\frac{1}{2}$  teaspoon of baking soda caused a reaction that flowed over the top of the graduated cylinder. Students should consider these amounts as they plan how much of each reactant they will use as they start their trials.

- Every test should be conducted the same way. For example, in the demonstration baking soda was placed in the graduated cylinder before the vinegar and detergent were added. This method mixes the baking soda and vinegar better. All new trials should be conducted this same way.
- Discuss with students the importance of thoroughly rinsing the graduated cylinder between trials.
- Ask students how they will remember the amounts of vinegar and baking soda they used in each trial. Point out the necessity of making and recording accurate measurements since they may need to reproduce their results. It is easy to forget how much of each reactant was used for each test and how high the foam rose.

#### 5. Have students conduct their trials.



Distribute *Activity sheet 5.5—Production of a gas*. Tell students that they should try to get the foam to go as high up in the graduated cylinder as possible without overflowing. It is fine for the foam to rise above the rim in a dome as long as it does not drip down the outside. You may choose to limit students to a maximum of three tries or let them experiment further if time and supplies allow.

##### *Procedure*

Students should follow the same procedure as in the demonstration but with different amounts of baking soda and vinegar. They should use 1 drop of detergent in each trial.

On the activity sheet, students will describe the level of foam either by the number of milliliters it reaches or using words such as *almost to the top, a little overflow, etc.*



***Expected results:*** Using  $\frac{1}{8}$  teaspoon of baking soda, 5 ml of vinegar, and 1 drop of detergent will cause foam to rise to the top of the cylinder without overflowing. Results may vary.

#### 6. Have students report on their trials.

Have groups share their findings about the amounts of baking soda and vinegar that came closest to reaching the top of the cylinder. Did each group use similar amounts of baking soda and vinegar? Ask students if the amount of baking soda and vinegar used affects the amount of carbon dioxide gas produced. They should agree that it does.