

IGNITE ACTIVITY

UP WITH GAS

**STEM²D Topic:
SCIENCE**

**Target Population:
Students, ages 8-14**



Up with Gas is part of the

STEM²D Student Activities Series

developed by FHI 360 as part of Johnson & Johnson's WiSTEM²D initiative (Winning in Science, Technology, Engineering, Math, Manufacturing, and Design). The series features interactive and fun, hands-on activities for youth.



Up with Gas

STEM²D Topic: Science

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ACTIVITY DESCRIPTION

In this Ignite STEM²D activity, students will apply their science knowledge and use critical thinking and observation skills to examine how a chemical reaction inflates a balloon.

ESTIMATED TIME



This activity is intended to be done at a career fair, science fair, exhibit, or other type of “booth” event. It typically takes **5 minutes** to complete

STUDENT DISCOVERIES

Students will:

- Apply their knowledge of science and chemistry to solve a problem.
- Build important STEM²D skills, such as analytical thinking and drawing conclusions.
- Have fun experiencing STEM²D.
- Be inspired to participate in other types of STEM²D experiences.

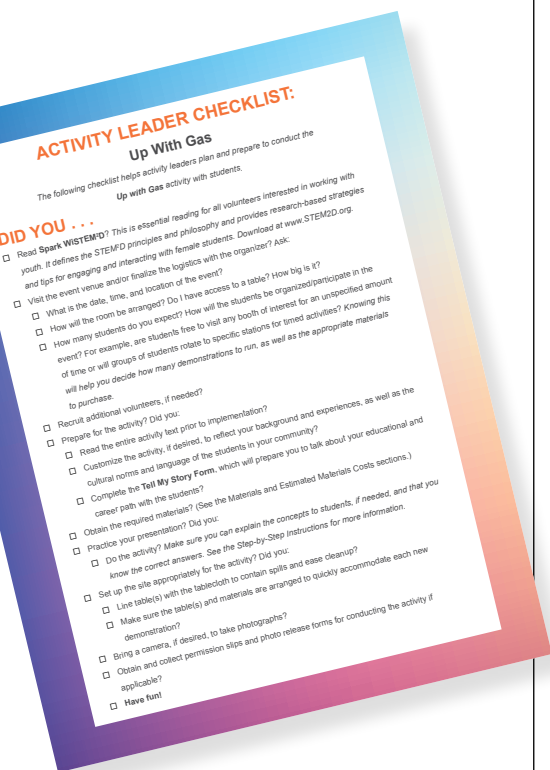
GETTING READY

Materials

- Pre-Activity Checklist
- Tell My Story Form, *optional*
- Hand wipes or paper towels (for cleanup)
- Funnel (a piece of paper rolled into the shape of a funnel will also work)
- Measuring cup
- Tablecloth (number required depends on tables being used)

STEM²D Skills

- Analytical Thinking
- Communication
- Critical Thinking
- Drawing Conclusions
- Observation
- Problem Solving



- Up with Gas materials, *1 set of the following items per demonstration:*
 - 12” balloon
 - 3 teaspoons (15 mL) baking soda
 - 1 cup (250 mL) vinegar
 - 1 plastic bottle with a 28 mm opening (e.g., a 1-liter soft-drink bottle)
- STEM²D brochures, flyers, or other informational materials, *optional*

Estimated Materials Cost:

Activity leaders can expect to incur less than \$15.00 in materials costs when conducting this activity multiple times with student groups.

Activity Leader Preparation

- Read **Spark WiSTEM²D**. This is essential reading for all volunteers interested in working with youth. It defines the STEM²D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students. Download at www.STEM2D.org.
- See the **STEM²D Student Activities Overview** for additional information.
- Review the **Pre-Activity Checklist** (at the end of this document) for details and specific steps for planning, preparing, and implementing this activity.
- Set up the “Up with Gas” learning activity. See the Materials section for required materials and the Pre-Activity Checklist additional instructions.

Step-By-Step Instructions: Up With Gas

1. Welcome & Introductions (1 minute)

- Welcome the students as they arrive at the table/booth.
- Introduce yourself by saying your name, title, and your organization/company.
- Explain that your career is one of many STEM²D careers.

Indicate:

- **STEM²D** refers to: Science, Technology, Engineering, Math, Manufacturing, and Design.

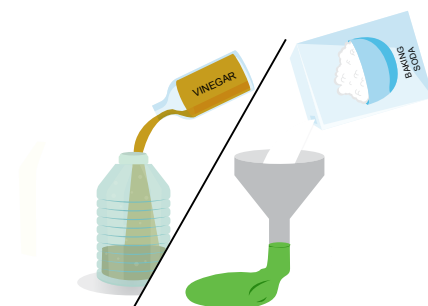
- Individuals with an interest or degree in these areas are in demand.
- The STEM²D sector is expected to experience high growth over the next ten years.
- Share a few Johnson & Johnson job titles and careers that might align with this activity.

2. Learning Activity: Up with Gas (3-4 minutes)

- Start the activity. Verbally tell students what you are doing while they observe the actions outlined in each of the steps below; do not indicate the specific ingredients that you are using. Initiate the demonstration:
 - **Step 1:** Using the measuring cup, pour 1 cup (250 mL) vinegar into a 2-liter plastic bottle. If using a smaller-sized bottle, fill approximately 1/4 of the bottle with vinegar. Caution! Only use bottles with 28 mm or smaller openings! Bottles with wider openings may result in the balloon disengaging during the reaction.
 - **Step 2:** Attach the balloon to the small end of the funnel.
 - **Step 3:** Pour 3 teaspoons (15 mL) baking soda into the funnel (and subsequently into the balloon). To ease this process, have a volunteer (or student) hold the funnel with the attached balloon while you add the baking soda.
 - **Step 4:** Detach the balloon from the funnel and attach it to the mouth of the plastic bottle filled with vinegar. Be sure the balloon completely covers the opening of the bottle. DO NOT tip or spill the contents of the balloon into the bottle.
- Ask the students:
 - What do you think will happen when I raise the balloon and add its contents to the liquid in the bottle?
 - Why will this happen?
- Lift the balloon, tipping the baking soda into the plastic bottle filled with vinegar.
- Have students observe the reaction (i.e., the balloon will self-inflate).
- Invite students to explain what occurred. Pose open-ended questions that will encourage students to share their ideas:
 - Why do you think the balloon is inflated?

KEY WORD

- Chemical Reaction
- Limiting Reagent (or limiting reactant)
- Excess Reactant
- STEM²D





- How is chemistry involved?
 - What is a chemical reaction?
 - What household substances can be combined to create such a reaction?
 - If students cannot tell you how the balloon was inflated or the role of a chemical reaction, offer some brief background information:
 - A **chemical reaction** is a process in which the structure of atoms or molecules that make up a substance are changed.
 - Chemical reactions can be seen in our everyday world, such as the rusting of iron (e.g., a rusty nail), the burning of wood, the cooking of an egg, the baking of a cake, the lighting of fireworks, or a banana rotting.
 - Encourage students to reflect on the key points presented and talk about why objects react or how. Say:
 - With these examples in mind, can you guess how this reaction worked?
 - If we added more baking soda or more vinegar, what would occur?
 - Guide students' thinking. If necessary, offer the following prompts to encourage responses:
 - The substance that reacts completely is known as the limiting reagent. The amount of this substance determines how much product is created and the reaction cannot continue if it runs out.
 - The substance that is not completely reacted is known as the one in excess. Usually a chemical reaction does not yield a 100% result, which is why there is product in the bottle that is left over and visible.
- 3. Student Reflection (1-2 Minutes)**
- Ask students to reflect on the activity. Have them spend a few minutes thinking about the following questions:
 - What did you learn about chemical reactions?
 - How do you think this might be relevant for someone in a STEM²D profession?
 - Can you see yourself as a future STEM²D professional? Why or why not?
 - How do chemical reactions relate to broader fields of science?

- Build on student responses. Consider:
 - The application of chemistry has an enormous range—from pharmaceuticals and petrochemicals to paints, explosives, cosmetics, and food.
- Thank students for joining you today and encourage them to continue exploring STEM²D.

Key Words

Limiting reagent (or limiting reactant): The substance that is totally consumed when the chemical reaction is complete. The amount of product formed is limited by this reagent, since the reaction cannot continue without it.

Excess reactant: The reactant in a chemical reaction in a greater amount than necessary to react completely with the limiting reactant. It is the reactant(s) that remain after a chemical reaction has reached equilibrium.

STEM²D: The acronym used for the disciplines of science, technology, engineering, math, manufacturing, and design.

Resources and References

Activity concepts and real-life connections adapted from:

Carpi, Anthony, and Adrian Dingle. “Chemical Reactions | Chemistry.” Visionlearning, Visionlearning, Inc., 12 Feb. 2017.

www.visionlearning.com/en/library/Chemistry/1/Chemical-Reactions/54

“Excess and Limiting Reagents.” Ideal Gas.

www.science.uwaterloo.ca/~cchieh/cact/c120/limitn.html

Helmenstine, Anne Marie. “Know the Equation for the Baking Soda and Vinegar Reaction.” ThoughtCo, ThoughtCo, 30 Apr. 2018.

www.thoughtco.com/equation-for-the-reaction-of-baking-soda-and-vinegar-604043

Skluzacek, Joanna M. “Quick and Simple STEM Activities for 4-H Clubs and Afterschool Groups.”

www.extension.iastate.edu/clayton/sites/www.extension.iastate.edu/files/clayton/QuickandcheapSTEMactivities.pdf

Tips About STEM²D Careers

Share with students that there are many different kinds of careers related to STEM²D. Some STEM²D careers related to this activity are:

- Chemist
- Chemical Engineer
- Chemical Health & Safety
- Chemical Technology
- Formulation Chemistry
- Organic Chemist
- Quality Assurance/Quality Control
- Technical Sales and Marketing

ACTIVITY LEADER CHECKLIST:

Up With Gas

The following checklist helps activity leaders plan and prepare to conduct the

Up with Gas activity with students.

DID YOU . . .

- Read **Spark WiSTEM²D**? *This is essential reading for all volunteers interested in working with youth. It defines the STEM²D principles and philosophy and provides research-based strategies and tips for engaging and interacting with students. Download at www.STEM2D.org.*
- Visit the event venue and/or finalize the logistics with the organizer? Ask:
 - What is the date, time, and location of the event?
 - How will the room be arranged? Do I have access to a table? How big is it?
 - How many students do you expect? How will the students be organized/participate in the event? For example, are students free to visit any booth of interest for an unspecified amount of time or will groups of students rotate to specific stations for timed activities? *Knowing this will help you decide how many demonstrations to run, as well as the appropriate materials to purchase.*
- Recruit additional volunteers, if needed?
- Prepare for the activity? Did you:
 - Read the entire activity text prior to implementation?
 - Customize the activity, if desired, to reflect your background and experiences, as well as the cultural norms and language of the students in your community?
 - Complete the **Tell My Story Form**, which will prepare you to talk about your educational and career path with the students?
- Obtain the required materials? *See the Materials and Estimated Materials Costs sections.*
- Practice your presentation? Did you:
 - Do the activity? *Make sure you can explain the concepts to students, if needed, and that you know the correct answers. See the Step-by-Step Instructions for more information.*
- Set up the site appropriately for the activity? Did you:
 - Line table(s) with the tablecloth to contain spills and ease cleanup?
 - Make sure the table(s) and materials are arranged to quickly accommodate each new demonstration?
- Bring a camera, if desired, to take photographs?
- Obtain and collect permission slips and photo release forms for conducting the activity if applicable?
- Have fun!**

Tell My Story Form

This form will help activity leaders and other volunteers prepare to talk about their STEM²D interests, education, and career path.

ABOUT YOU

Name: _____

Job Title: _____

Company: _____

When/Why did you become interested in STEM²D? _____

What do you hope young people will get out of this activity? _____

FUN FACT:

Share a little about your background. Ideas:

- Share a memory from childhood when you first had your “spark” or “interest” in STEM.
- Detail your journey, highlighting what you have tried, what you learned, steps to success, etc.
- Failures or set backs are also great to talk about—difficulties, and/or challenges, and how you overcame them.

EDUCATION AND CAREER PATH

What classes/courses did you take in secondary school and in college that helped or interested you most? _____

How did you know you wanted to pursue a STEM²D career? _____

What was your postsecondary path, including the institution you attended and your degree? *If you switched disciplines, make sure you explain why.* _____

What your current position entails. *Be sure to include how you use STEM²D during a typical work day.* _____

This activity was written by Johnson & Johnson's Bridge to Employment (BTE)
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