

INVESTIGATE BATTERY BREAKDOWN

Teacher Guide • Pressure Build-Up Simulation

Middle School • Approximately 20–25 minutes

Lesson Purpose

Students observe a chemical reaction in a sealed bag and use their observations to think about gas production, pressure, and why pressure or swelling can be an important safety concern when a lithium-ion battery is damaged or overheats.

Learning Objectives

- Students will accurately record observations from a hands-on investigation.
- Students will identify evidence that a gas was produced during the reaction.
- Students will explain that gas building up in a sealed container can increase pressure.
- Students will connect the model to battery-safety concerns without assuming that the experiment recreates the chemistry inside a lithium-ion battery.

Materials

- 1 sealable quart-size zip-top bag
- 2–3 tablespoons baking soda
- 1/4 cup vinegar
- 1 paper towel
- Safety goggles for each student
- Tray or container to catch spills (optional)
- Student worksheets and pencils

Teacher Preparation

- Review the procedure and prepare one set of materials for each student/group.
- Place the activity on a tray or another easy-to-clean surface.
- Make sure students have safety goggles before beginning.
- Remind students that the bag should not be squeezed, shaken, held near the face, or pointed toward another person.
- Decide in advance how students will dispose of the used materials and clean their workspace.

Safety Notes

The original activity is designed as a pressure-build-up simulation. Because a sealed bag can expand and potentially leak or rupture, students should follow the teacher's directions closely.

- Students should wear safety goggles.
- Keep the sealed bag away from faces and bodies.
- Place the bag on a tray and have students step back after the reaction begins.
- Do not have students squeeze, shake, or intentionally stress the bag.
- Do not open the bag unless directed by the teacher.

Lesson Sequence

- 1. Introduce — 2–3 minutes:** Tell students they are going to investigate what happens when a gas-producing reaction occurs inside a sealed container. Ask: What do you think will happen when gas has nowhere to escape?
- 2. Predict — 2 minutes:** Have students make a quick prediction about how the bag will change after the baking soda and vinegar mix.
- 3. Experiment — 5–7 minutes:** Students complete the procedure on the worksheet while observing the bag from a safe distance.

4. Record — 3–5 minutes: Students document what they see, hear, and notice changing over time.

5. Discuss — 5–8 minutes: Use the observation and thinking questions to connect the model to pressure, swelling, and battery safety.

Expected Observations

Students may observe:

- Fizzing or bubbling when the baking soda and vinegar mix.
- The formation of gas and foam.
- The bag beginning to expand or swell.
- The bag becoming more inflated as the reaction continues.
- A change in the appearance and movement of the materials inside the bag.

Student observations will vary. Encourage students to describe what they actually observed rather than trying to match a single 'correct' description.

Discussion & Suggested Answers

1. What caused the bag to expand?

Suggested response: The baking soda and vinegar reaction produced gas. Because the bag was sealed, the gas collected inside the bag and caused it to expand. Look for students to connect their explanation to evidence such as bubbling, fizzing, or the bag becoming larger.

2. How did the bag change from the beginning to the end?

Suggested response: It began relatively flat or uninflated and became more expanded as the reaction produced gas. Students may also note changes in the contents, such as bubbling or foaming.

3. What might happen if gas continues to build up in a sealed container?

Suggested response: Pressure inside the container can increase. If the pressure becomes greater than the container can safely withstand, the container may leak, rupture, or otherwise fail. Students do not need to calculate pressure for this lesson.

4. How could pressure or heat be a concern if a lithium-ion battery is damaged or overheats?

Suggested response: The experiment gives students a model for thinking about a sealed system that changes as gas builds up. In the context of battery safety, swelling, unusual heat, damage, or other changes can be warning signs that a battery should not be used and should be handled according to appropriate safety guidance.

5. How is this model similar to a battery problem—and how is it different?

Suggested response: Similar: both help students think about what can happen when gas or pressure builds within a confined space. Different: the baking soda and vinegar reaction is not the chemistry inside a lithium-ion battery. The experiment is only a simple model for discussing gas, pressure, and observable changes.

6. What is one safety action people should take if a battery becomes unusually hot, swells, leaks, or is damaged?

Suggested response: Students should recognize these as reasons to stop using the battery/device and tell a responsible adult or follow the manufacturer's or local safety guidance. The key lesson is to avoid continuing to use a battery that shows unusual heat, swelling, leaking, or damage.

Key Teaching Point

Emphasize that the experiment is a MODEL, not a recreation of a lithium-ion battery failure. The purpose is to help students visualize how a sealed container can change when gas is produced and pressure builds.

Common Student Misconceptions

- “The baking soda and vinegar reaction is what happens inside a lithium-ion battery.” — Clarify that this is only a model for discussing gas and pressure.

- “The bag is expanding because the liquid is getting bigger.” — Guide students toward the evidence that a gas is being produced.
- “More pressure is always dangerous.” — Explain that the lesson is about pressure building in a confined space and the importance of recognizing changes or warning signs.
- “If a battery is swollen, I can keep using it carefully.” — Reinforce that swelling or unusual heat is a warning sign and the battery/device should not continue to be used.

Optional Extension Questions

- What evidence would you collect if you wanted to compare two bags?
- What variables could change how quickly the bag expands?
- Why is observation important when investigating a safety problem?
- What other everyday objects contain materials under pressure?

Exit Ticket — 1–2 Minutes

Ask students to answer before leaving:

“What did you observe today that helped you understand why changes in a sealed system can be important for safety?”

Look for: an observation + an explanation connecting gas/pressure to safety.

Teacher Quick Check

- ☐ Students wore safety goggles.
- ☐ Students kept the bag away from faces and bodies.
- ☐ Students observed without squeezing or shaking the bag.
- ☐ Students recorded evidence rather than only writing what they expected.
- ☐ Students understood that the activity is a model, not a recreation of lithium-ion battery chemistry.
- ☐ Students identified a safe response to an unusually hot, swollen, leaking, or damaged battery.