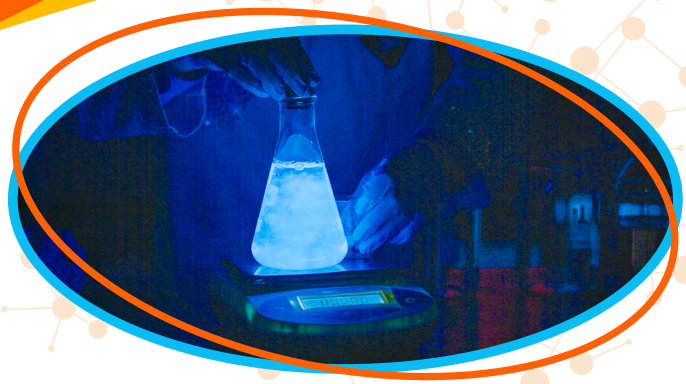
GENERATIONGENIUS
ALWAYS QUESTION. ALWAYS WONDER.



LESSON PLAN

CHEMICAL REACTIONS
GRADES 6-8

SUMMARY

Students will analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. Students will also model the rearrangement of atoms to demonstrate matter is neither created nor destroyed. The atoms rearrange themselves to form different substances.

NEXT GENERATION SCIENCE STANDARDS CORRELATION

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

Science & Engineering Practices	Connections to Classroom Activity
Analyzing and Interpreting Data	• Students conduct an investigation to determine the identity of the gas produced when a bath bomb chemically reacts with water using a glowing splint test.

Disciplinary Core Ideas	Connections to Classroom Activity
PS1.B: Chemical Reactions Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. The total number of each type of atom is conserved, thus the mass does not change.	• Students conduct an investigation to determine whether the same number of atoms are present before and after a chemical reaction (matter is conserved) and to identify one of the products of the reaction.

Cross Cutting Concepts	Connections to Classroom Activity
Energy and Matter: Flows, Cycles, and Conservation	• Students conduct an investigation to determine whether the same number of atoms are present before and after a chemical reaction (matter is conserved).

DURATION

Two 45-minute class periods

MATERIALS

- Bath bombs (1 for demonstration, 3 more to be broken up for the class)
- Plastic bottle (12–20 oz) with cap (1 per group)
- Matches or lighter (teacher use only)
- Wood splints or dry spaghetti
- Graduated cylinders (25 ml)
- Electronic balances (preferably measuring to 0.01 g)
- Paper or dry erase boards

ENGAGE

Tell students you have an interesting phenomenon you want to share with them. Have students create a t-chart. Write *Notice* on one heading and *Wonder* on the second. Tell students to record observations in the notice column and questions in the wonder column. Place the bath bomb in a bowl of room temperature water, and ask students to record observations every 30 seconds for 3 minutes. Students may wonder things such as, “What is the gas in the bubbles?”, “Why does it dissolve?”, or “Where does the bath bomb go?” At the end of 3 minutes, ask students to share their observations with a partner.

Next, ask students to share observations and questions with the class. Record the observations on a display board for the class (e.g., projection screen, white board, dry erase board, chalkboard).

Say, “Most of us are wondering about the gas produced.” Discuss investigations to figure out the gas produced. Students might say they could light the gas on fire or see if the gas puts out the fire. They may also have experience with dry ice and say they would test to see if the gas from dry ice is heavier than the air (gas we breathe). How could you tell?

EXPLORE

Tell students that bath bombs have two main ingredients: baking soda and citric acid. Placing the bath bomb in water causes a chemical reaction.

$NaHCO_3$ (baking soda) + $C_6H_8O_7$ (citric acid) + H_2O = **?**

We want students to figure out what this chemical reaction produces. Review with students the difference between physical changes and chemical reactions from elementary school. Students should recall that physical changes do not result in new substances being formed, whereas chemical reactions create new substances that have different properties compared with the substances you started with.

Tell students that based on the starting substances (reactants), the likely gasses are oxygen, hydrogen, and carbon dioxide. We will use a glowing splint test to determine which of the three gasses is produced when the bath bomb reacts with water.

Conducting the Investigation

This investigation will allow students to test the Law of Conservation of Mass while simultaneously figuring out what gas is produced in the bath bomb reaction.

Ask students to create a data table, or project a data table and have students copy it into their notebooks or on to piece of paper.

Distribute pieces of the bath bomb to students, and then share the following directions:

1. Measure and record the mass of bath bomb piece.
2. Measure and record the mass of the plastic bottle and cap.
3. Measure 25 ml of tap water. Remind students water has a mass of 1g/ml so 25 ml of water has a mass of 25 g.
4. Calculate the total initial mass.

Tell students to place their empty bottle on the mass balance. Have them pour the 25 ml of water into the plastic bottle. Then tell them to place the bath bomb in the bottle and cap it immediately. When the bath bomb is completely reacted, ask students to record the final mass. Students will discover the mass before and after the chemical reaction is the same. Ask students to explain to a shoulder partner why the mass did not change. Then ask one or two students to share their ideas with the class. **Because the total initial mass before and after the chemical reaction are the same, the same amount of matter exists before and after a chemical reaction.**

Remind students we have still not figured out what gas is produced in the chemical reaction. If necessary, re-direct them to their initial questions about the gas they observed. Explain that to determine the gas produced, we will test the property of flammability. Students will know from previous grade levels that oxygen helps fire to continue burning, whereas carbon dioxide extinguishes fire. They may not have previous experience with hydrogen.

Project the Using Glowing Splint Test to Identify Gasses table. Give students an opportunity to read the table. Ask students to restate what they will look for to determine if the gas is hydrogen, carbon dioxide, or oxygen.

Show students how to perform a glowing splint test using an empty bottle. Use a student volunteer to assist you. Use a match or lighter to set the end of the glowing splint (or spaghetti) on fire. Tilt the bottle sideways, and ask the student to remove the lid. Very quickly insert the splint in the bottle.
Tell students that some groups will use a smoldering splint (to test for oxygen) and some a glowing splint (to test for hydrogen and carbon dioxide). Have each group report its observations.

Say to students, “We’ve figured out one product of the chemical reaction, but figuring out the products will require additional investigations.”

$NaHCO_3$ (baking soda) + $C_6H_8O_7$ (citric acid) + H_2O = $\mathbf{CO_2}$ **+ ?**

End of Day 1

EXPLAIN

WATCH THE GENERATION GENIUS CHEMICAL REACTIONS VIDEO AS A GROUP

ELABORATE

Ask students to create a model of the chemical reaction between water and bath bombs. Have them work on their models individually for about 5–7 minutes. Place the students in small groups (3–4 students). Ask students to identify similarities and differences between their models. Then give students a large piece of paper or a white board to create a group model.

Look for these features to assess group understanding (formative assessment):

- Properties of substances can be observed before and after a chemical reaction.
- Chemical reactions form new substances.
- Chemical reactions have the same number of atoms before and after a reaction takes place.
- Atoms can be rearranged to form new substance(s) that have different properties than the original substance(s).

EVALUATE

There are multiple ways to assess your students' understanding of this topic. The exit ticket is an opportunity for students to use the science ideas they built in the lesson in a new context. Alternatively, you can use the Kahoot! quiz (which provides downloadable scores at the end of the game) and/or the paper quiz. All these resources are located right below the video in the assessment section.

EXTENSION

Have students investigate how water temperatures affect the rate of the chemical reaction. Encourage students to use ideas about thermal energy to explain their results.