



# LESSON PLAN

## SYNTHETIC MATERIALS GRADES 6-8

### SUMMARY

Students engage in investigations about chemical reactions which produce synthetic materials and then research how these materials impact society.



**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-PS1-3.** Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

Science & Engineering Practices	Connections to Classroom Activity
<b>Analyzing and Interpreting Data</b> <b>Obtaining, Evaluating, and Communicating Information</b>	<ul style="list-style-type: none"><li>After investigating chemical reactions, students engage in a research investigation in which they gather, read, and synthesize information about synthetic materials and how they impact society.</li></ul>
Disciplinary Core Ideas	Connections to Classroom Activity
<b>PS1.A: Structure and Properties of Matter</b> Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. <b>PS1.B: Chemical Reactions</b> Substances react chemically in characteristic ways. In a chemical process, the atoms that make up original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	<ul style="list-style-type: none"><li>Students use ideas from the Generation Genius video to support an explanation of how substances chemically react to create new synthetic materials with different properties than the original substances used to form them and to identify synthetic materials that they will further investigate through research.</li></ul>

## Cross Cutting Concepts

### Patterns

### Structure and Function

### Interdependence of Science, Engineering, and Technology

### Influence of Science, Engineering, and Technology on Society and the Natural World

## Connections to Classroom Activity

- Students use science ideas from the Generation Genius video and their subsequent research to help explain how the changes in the properties of materials, as a result of chemical reactions, can create structures that are used for specific purposes.

## DURATION

90 min.



## ENGAGE

Tell students you have an interesting phenomenon you want to share with them. Ask students to create a t-chart and then write *Notice* on one heading and *Wonder* on the second. Tell them to record observations in the notice column and questions in the wonder column.

Share the “[Alka Seltzer Pop Top](#)” video with students.

Alternatively, you may want to use a water bottle and antacid tablets to demonstrate this phenomenon for students. Water bottles with a “pull up” top work particularly well for this demonstration. Small plastic storage containers may also be used to demonstrate this phenomenon.

After students watch the video clip, ask them to share their t-chart with a partner.

Next, ask students to share observations and questions with the whole class. Record them on a display board for the class (e.g., on a projection screen, white board, dry erase board, or chalkboard). Some students may wonder such things as *What caused the water bottle’s lid to burst open? What happened to the tablets? Why do the antacid tablets react differently when put into water versus your stomach? Do the antacid tablets react differently in your stomach compared to in water?*



## EXPLORE

Tell students many of us wondered what made the top pop off the container, and ask them if it makes sense to investigate that question first.

Provide small groups of students the materials needed to conduct an investigation for the purpose of collecting data. Tell students that they need to collect their observations as they conduct the investigation. You might discuss with students

## MATERIALS

### Per student group:

- 15 ml vinegar
- 150 ml heated milk
- Wooden stick or other device for stirring
- Cheesecloth or coffee filters
- Rubber bands
- Small beakers or cups
- Paper towels
- 1 tsp baking soda (sodium bicarbonate)
- 1 tbsp of calcium chloride
- Baggies (sandwich size and sealable)
- 10 ml phenol red solution (will result in a red to yellow color change) or red cabbage juice (will result in red to blue color change) (Note: This material can be substituted for water, but there will be no color change.)
- Pipette

what data they think they will need to collect to explain the phenomenon of the top popping off the water bottle.

## INVESTIGATION 1

### Before the Investigation

- Measure the chemicals for each group (or allow students to measure if you have a class set of measuring spoons).
- Create small containers of the phenol red solution or red cabbage juice (one for each student group).

### During the Investigation

1. Place 1 teaspoon of baking soda into a baggie.
2. Place 1 tablespoon of calcium chloride into a baggie.
3. Shake the baggie so the two white powders mix.
4. Have students fill a pipette with 10 ml of phenol red solution or red cabbage juice. (If you do not have phenol red or red cabbage juice the reaction will still occur using 10 ml of water. There just won't be a color change.)
5. Have students dry off the pipette so that there is no moisture on the outside of it.
6. Gently place the pipette inside the baggie.
7. Gently remove as much air as possible from the baggie.
8. Seal the baggie, and instruct students to check the seal of their bags.
9. Squeeze the bulb of the pipette to release the phenol red solution (or red cabbage juice or water).

## INVESTIGATION 2

### Before the Investigation

- Cover the top of small cups or beakers with cheesecloth or a coffee filter. Secure the cover using rubber bands.
- Heat the milk for students so that it is 49°C (or steaming hot).
- Measure 150 ml of hot milk per group.
- Measure 15 ml of vinegar per group.

### During the Investigation

1. Have students stir 15 ml of vinegar into 150 ml of milk that has been heated to 49°C.
2. Have students pour their mixture into the covered beaker or cup to strain out the precipitate that is formed from the reaction.
3. Have students investigate the properties of the original substance and those of the new substance that has precipitated out.
4. Have students place the precipitate in paper towels and squeeze out the excess moisture. Students should knead their precipitate into balls and then flatten them out into a thin, pancake-like shape.
5. Instruct students to continue making observations.
6. Have students place the precipitate in trays or on dry pieces of paper towel.

Have groups share their data with the class. As each group shares, challenge them and other members of the class to use any science ideas they are familiar with to explain how the change caused the observed effect. Remind students to refer to their data and provide evidence to support their ideas.



## EXPLAIN

Present students with the following claim, *When the materials were mixed in both investigations, a chemical reaction occurred.*

Instruct students that they are going to create a written argument, using evidence and reasoning, to support this claim. Remind students that they will need to identify evidence from their data that supports the claim and articulate the reasons for how scientific principle(s) connect each piece of evidence to the claim.

Students will need to gather additional evidence to support this claim. To do so, they will need to read information from multiple sources.

Suggestions for the readings include the following:

- Classroom textbook
- [Chemical Reactions \(Chem4kids.com\)](#)
- [What is a Chemical Reaction?](#)
- [Newsela \(leveled texts\)](#)

You might ask students to read independently (Alone Zone). Consider using the Connect, Extend, Challenge reading protocol to support students in determining the central ideas and obtaining scientific information that will help them explain the phenomenon.

- **Connect:** How are the ideas and information presented connected to what you already knew?
- **Extend:** What new ideas did you get that extended your knowledge? What new things did you learn?
- **Question:** What questions or wonderings do you now have?

Have students share their written arguments orally with their small groups. To facilitate sensemaking, provide students with a series of prompts that they can use to respond to their partners arguments such as the following:

- How does the evidence for your argument compare with mine?
- \_\_\_\_\_ is strong evidence because...
- I believe that this is stronger evidence because...
- A different way to say that is....

Have the students revisit Quinn's scenario. Have students use the evidence that they collected from the Explore and Explain sections of the lesson to explain why Quinn's water bottle exploded.

Ask students to look back at their observations and questions about the phenomenon of the water bottle top popping. Can students use evidence from the data they collected in the Explore and Explain sections to explain why the top popped off?



## ELABORATE



### WATCH THE GENERATION GENIUS SYNTHETIC MATERIALS VIDEO AS A GROUP

After watching the video, have students revisit investigation 2 from the Explore section. Have students re-examine the precipitate that was created. Ask students to explain what happened in that experiment using ideas from the investigations, their written argument, and the Generation Genius video.

Use the following prompts to scaffold students' explanations.

- What happened? I observe that...
- How did it happen? In class we ..., which showed me evidence that...
- Why did it happen? In the video we learned .... So, I think it is happening because...



## 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

Using the examples presented in the Generation Genius video, have students gather information about synthetic materials and discuss their impacts on society. Additionally, teachers may want to dig more deeply into the [history of casin plastic](#).

