

Lesson 6: How can we explain another phenomenon where gas bubbles appear from combining different substances together?

Previous Lesson We analyzed the density and flammability data for common gases. We tested the flammability of the gas from the bath bomb. We carried out an investigation to see if the gas from the bath bomb rises or sinks. We argued from evidence that the gas from the bath bomb can be narrowed down to three candidate gases.

This Lesson
Putting Pieces Together



We apply what we have figured out about properties to explain a related phenomena (elephant's toothpaste). We revisit our Driving Question Board (DQB) and reflect on what other related phenomena we might be able to explain using the same key model ideas.

Next Lesson As a class we will summarize key model ideas we figured out in earlier lessons. We will develop a new way to represent everything we figured out using an input/output table to represent the particles in the system. We will identify an unanswered question about where the particles that make up the substance(s) of the gas come from.

BUILDING TOWARD NGSS

MS-PS1-1, MS-PS1-2, MS-PS1-5,
MS-LS1-8



What students will do


6.A Apply key model ideas and patterns in mass and property data to construct three explanations for: a) why the mass of a system decreases when substances are mixed together, b) which substance(s) could or could not be produced in that process, and c) what additional tests could be done on the gas (or other gases) to help identify additional substances that aren't being produced in this process.

What students will figure out

- The mass of a partially open system where potassium iodide and hydrogen peroxide are combined decreases because a gas is formed and some of it escapes the system.
- The gas produced makes a glowing ember burst into flame and an already burning flame glow brighter.
- Flammability data can help us identify the types of gases that aren't being produced in this process.

- Testing the melting/freezing point, density and/or comparing the results of the flammability test to results from controls could help identify additional substances that aren't being produced in this process.

Lesson 6 • Learning Plan Snapshot

Part	Duration		Summary	Slide	Materials
1	7 min		NAVIGATION We are introduced to a context for a new phenomenon to investigate using what we have figured out so far about identifying substances with their properties.	A	Related phenomena poster from Lesson 1, computer, projector, https://youtu.be/s30CuhiHwOg
2	20 min		DEVELOP INDIVIDUAL ARGUMENTS Construct explanations using key model ideas and evidence to account for three aspects of the phenomenon in the previous video.	B–C	<i>Explaining Another Phenomenon</i> or <i>Alternate: Explaining another phenomenon</i> , sticky notes, three different highlighters or colored pencils, https://youtu.be/kMbYDjq1z4M , computer, projector
3	15 min		REVISIT THE DRIVING QUESTION BOARD	D	One copy of the Driving Question Board (DQB) questions, Driving Question Board
4	3 min		NAVIGATION Brainstorm what is happening between the particles of different substances to produce a new substance.	E	

End of day 1

Lesson 6 • Materials List

	per student	per group	per class
Lesson materials	<ul style="list-style-type: none">● <i>Explaining Another Phenomenon</i> or <i>Alternate: Explaining another phenomenon</i>● science notebook● sticky notes● three different highlighters or colored pencils	<ul style="list-style-type: none">● One copy of the Driving Question Board (DQB) questions	<ul style="list-style-type: none">● Related phenomena poster from Lesson 1● computer● projector● https://youtu.be/s30CuhiHwOg● https://youtu.be/kMbYDjq1z4M● Driving Question Board

Materials preparation (20 minutes)

Review teacher guide, slides, and teacher references or keys (if applicable).

Make copies of handouts and ensure sufficient copies of student references, readings, and procedures are available.

Be prepared to show <https://youtu.be/s30CuhiHwOg> and <https://youtu.be/kMbYDjq1z4M> . Each student will need a copy of *Explaining Another Phenomenon* or *Alternate: Explaining another phenomenon*.

Lesson 6 • Where We Are Going and NOT Going

Where We Are Going

This assessment serves as a near transfer task for assessing students' engagement in all three dimensions of NGSS to explain a phenomenon that is very closely aligned to an NGSS PE (MS-PS1-2), without an explicit focus yet on this being a chemical reaction.

Students are arguing for what gas could have been produced from an investigation combining potassium iodide and hydrogen peroxide (sometimes called “elephant’s toothpaste”). In this assessment, students are using DCIs related to PS1.A: Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. They are using the crosscutting concept of patterns (at a macroscopic scale), and they are developing an evidence-based explanation based on their analysis and interpretation of data they receive from a laboratory experimentation demonstrated in a video and known property information from Lesson 5, to determine similarities and differences in findings.

Where We Are NOT Going

The reaction that occurs during the elephant’s toothpaste investigation is exothermic and gets extremely hot initially. The focus in this assessment avoids any reference to temperature or energy changes in the system, and this aspect of the phenomenon should not be introduced. Energy changes in chemical processes will be a focus of the work students will be doing in their next unit *OpenSciEd Unit 7.2: How can we use chemical reactions to design a solution to a problem? (Homemade Heater Unit)*.

LEARNING PLAN for LESSON 6

1 · NAVIGATION

7 min

MATERIALS: Related phenomena poster from Lesson 1, computer, projector, <https://youtu.be/s30CuhiHwOg>

Connect to related phenomena. Bring the related phenomena poster from Lesson 1 to an area of the room where students can see it. Display **slide A**.

Say, Up until now we have been trying to figure out what gas is produced when the bath bomb is placed in water. We have figured out some ways to collect data to try to identify this gas. Last class, we figured out that there are properties we can use to help us identify different gases. We used this property data to argue what gas could be produced from the bath bomb when added to water. But we also have identified other phenomena that we wanted to try to explain that also produce bubbles.

Ask students to restate what some of those phenomena were. *

Say, Let's take some time today to see if we can use what we have figured out about identifying substances in relation to the bath bomb to another related phenomenon. I have a video of this phenomenon. It is sometimes referred to as "elephant's toothpaste." Some of you may have heard of this. We will watch the video of it a couple times to see what happens. Then you will try to explain various aspects of what you see happening. Ideally, what we have figured out so far about bath bombs should be able to help us explain other related phenomena too. But we don't always know the limitations of these model ideas until we try using them to explain a wider range of phenomena. So this is our chance to test how generalizable our key model ideas are.

Play <https://youtu.be/s30CuhiHwOg> once through. When it ends, pause for a couple of minutes to let students have time to record their observations. Then play it a second time if needed.

* ATTENDING TO EQUITY

Supporting Universal Design For Learning:

When possible, returning to the Related Phenomena poster to see if they can be explained using what has been figured out in class can be very satisfying for students and helps to broaden their conceptual understanding of the content and practices they have been figuring out. In addition to referring to this phenomenon on the poster, you might place a checkmark or sticky note next to it to notate this is a phenomenon we are revisiting. This can help support student *engagement* as they see the shifts in the work they are doing in lessons like this (motivating a transfer task to take account of a related phenomenon) as still being very relevant to making progress on their original questions and ideas for investigations.

If your class has elephant's toothpaste on the Related Phenomena poster, then this next introduction to this transfer task could be altered to refer to that instead.

2 · DEVELOP INDIVIDUAL ARGUMENTS

20 min

MATERIALS: *Explaining Another Phenomenon* or *Alternate: Explaining another phenomenon*, science notebook, sticky notes, three different highlighters or colored pencils, <https://youtu.be/kMbYDjq1z4M>, computer, projector



Introduce the transfer task questions. Show slide B. Distribute a copy of *Explaining Another Phenomenon*. Emphasize that the questions on the handout are an individual assessment and that these questions will help you gauge student progress on analyzing data and making arguments using key model ideas and evidence for a related phenomena.

Show slide C. Read through the top of the handout together as well as the instructions for the first question. Ask students if they have any questions.

Show the second video: <https://youtu.be/kMbYDjq1z4M> . Give students a couple of minutes to write down their observations and then show the video a second time.

Say, *Now that we have watched the video of the elephant's toothpaste phenomenon, let's look through the rest of the assessment and make sure we all know what we are being asked to do. For the assessment, you will use different resources from your notebook. Read through the prompts for questions 2–4 and think about how many resources you will need to reference for each question. Be ready to share with the class.*

Students will notice that they are asked to use 2 resources for question 2, 3 resources for questions 3 and none are specified for question 4. Suggest the students highlight with a different color, each of the resources they will need for question 3 first. Here is an example of that using yellow, green, and blue highlighting:

Use these three resources: A) your observations B) your key model ideas, and C) the data table in your notebook of *Some Common Gases*, to make an argument to answer this question:

Next, suggest they color 3 corresponding sticky notes and add them to the relevant pages where these resources are found. In this example that would include adding:

- a yellow-colored note to the first page of *Explaining Another Phenomenon* or *Alternate: Explaining another phenomenon*
- a green-colored note to the corresponding page(s) in their Progress Tracker
- a blue-colored note to the data table *Some Common Gases* in their science notebook

Ask students to color code the remaining questions using the same color scheme. This will help save them time as they work through the assessment so they will not need to keep re-finding these resources. If students do not have colored highlighters available, they could use colored pencils and shade them or they could use three different symbols next to each resource instead.

Give students the remaining time to continue recording their observations and complete the remainder of the assessment. **

* SUPPORTING STUDENTS IN DEVELOPING AND USING SYSTEMS AND SYSTEM MODELS

Up until this point in the unit, students have figured out that in closed systems, the mass shouldn't change because nothing can get in or out of the system. Yet, they also know that if the mass changes then it means something has left the system, and since they know gas has mass and is made of particles too small to see, they are combining what they know about matter with what they know about systems to conclude that matter must be flowing out of the system (it isn't completely closed) in this investigations. The rattling of the stopper on the flask seen in the videos is further evidence of this matter flow.

* ATTENDING TO EQUITY

Supporting Universal Design for Learning: Providing scaffolds such as sentence starters and images can support students in *expressing* what they have figured out. This modified assessment in *Alternate: Explaining another phenomenon* includes these scaffolds as well as pre-organized selections from extra resources students would otherwise need to pull from (their Progress Tracker, data tables, and anchor charts), so that students will have all these resources in

ASSESSMENT OPPORTUNITY

Building towards: 6.A Apply key model ideas and patterns in mass and property data to construct three explanations for: a) why the mass of a system decreases when substances are mixed together (potassium iodide and hydrogen peroxide), b) which substance(s) could or could not be produced in that process, and c) what additional tests could be done on the gas (or other gases) to help identify additional substances that aren't being produced in this process.

What to look for/listen for: Use *Elements to look for in students' written arguments* for guidance on what to look for in their written argument. Use this guidance to provide feedback to students on their written arguments.

What to do: For students who need additional scaffolding for the written argument, use *Alternate: Explaining another phenomenon* that has sentence starters and other supports for students.

one place. This provides additional support for *representing* the lines of evidence and ideas they can draw on, rather than relying on students also needing to manage and reference across multiple pieces of paper, which relies on strong executive functioning skills. This consolidated set of representations enables students to focus more on *expressing* what they have learned, rather than managing and organizing their resources. As this is an editable document, please edit to match the level of scaffolding your students require. It is important that scaffolds be used purposefully and removed when no longer needed.

Students who don't need this scaffold may find this task more *engaging* when they draw on the previous artifacts they created in their own science notebooks.

3 · REVISIT THE DRIVING QUESTION BOARD

15 min

MATERIALS: One copy of the Driving Question Board (DQB) questions, Driving Question Board

Revisit the Related Phenomena poster. Say, *Now that you have analyzed data from a related phenomena that also produced gas bubbles, do you think we might be able to use the same strategies to investigate other related phenomena on our poster?* Let a few students share their ideas.

Revisit the questions from the Driving Question Board (DQB). Show slide D. At the end of day 3 of Lesson 1, after all classes had developed their DQB, you should have created a record of all the questions that are on the board that you printed out for students to reference the next day. Using this same record of DQB questions, print out one copy per group prior to class. Pass out one copy to each group.

Say, *Now that we have figured out some things about different substances and ways to identify them, let's take stock of what questions on our DQB we could answer. With your group, look through the questions from our DQB. Mark*

- *questions your group feels you can fully answer with evidence with a ✓ ✓ (tell students this represents questions that we feel we have made progress on and we have evidence for),*

- *questions your group can partially answer but need more evidence with a ✓, (tell students this represents questions we feel we have made progress on but don't yet have sufficient evidence for), and*
- *questions your group can't answer yet by leaving them as is (tell students these are the questions they feel we haven't made any progress on yet).*

After students have had some time to work with their group looking through the DQB questions, pull the class back together.

Say, Let's hear from a few groups about what percent of the questions you feel we have made progress on and have evidence for to help answer them. What percent have we made progress on but still need more evidence to answer? And, what percent have we not made any progress on?

Have some students share their findings. You may choose to annotate the actual sticky notes on your DQB or move those questions to indicate which have been answered.

Say, Great, it sounds like we have figured out some things, but we still have more work to do! Tell students to tape this handout of DQB.

ADDITIONAL GUIDANCE

At the end of day 3 of Lesson 1, after all classes had developed their DQB, you should have created a record of all the questions that are on the board that you printed out for students to reference the next day. When revisiting the DQB here, having this list of questions available can support students in identifying which questions they feel they can now fully answer with evidence, partially answer but still need more evidence, or can't yet answer. This handout will be revisited once more in Lesson 12. Encourage students to tape this into their notebook to refer to in later lessons.

4 · NAVIGATION

3 min

MATERIALS: None

Brainstorm possible explanations. Show slide E. *We've now seen two phenomena where a gas was produced from combining ingredients together that were not gases to start with. And we argued the gas that was produced in one case was different than the gas produced in another case.*

- *We still don't know what mechanism can explain how it is possible that we are able to produce different substances in each of these cases. What are some of your initial ideas about what is going on between the particles of matter in the system that could help explain this outcome?*

Pause the conversation before the end of the period and say, *This is interesting to keep thinking about. Even though we've made a huge amount of progress by reasoning about property changes, we still don't know **how** new substances are being produced. We still don't know what is happening at a particle level. We are going to have to shift to using some creative thinking about what could be happening at a particle level that could explain how this is possible along with everything else we know is happening in the system. Let's pick up here next time.*