Science Assessment Grounded in Equity: Unit 7.1 Lesson 6 Mid-Unit Assessment

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About This Task

Task Name	What happens when the ingredients of Elephant's toothpaste are combined?	**Grade Level or Course**	7th grade
Phenomenon or Phenomenon Based Problem Description	When hydrogen peroxide and potassium iodide are combined, a gas is formed.	**Type of Phenomenon** Everyday, Societally Relevant, Culturally Significant, Contemporary Scientific	Everyday
Task Description (from the learner perspective)	Learners will use what they figured out about substances and their properties to explain what gases are made when combining the substances in elephant's toothpaste:	**Time Required & Materials**	30-35 minutes Videos needed: Part 1 Use this procedure to make Elephant's toothpaste in class.
Profile of Identified Learner Population(s)	This task was written with Washington state teachers for a general population of middle school learners across Washington	**Special Considerations** Characteristics of the culturally and linguistically diverse groups that may introduce differential performance	This task was written in proper English which may present a barrier for learners for whom English is not their home language.

	experiencing OpenSciEd instructional materials.		
How is this task meant to be used? Mid Unit, instructionally embedded, End of Unit	Mid-Unit	**What instruction or experiences should learners have before completing this task?**	This midpoint assessment takes place after learners have figured out that substances have unique characteristics or properties *and* that these can be used to determine if something new was made when two substances are combined. They can then narrow down what new substance was made using the property data of the substances before and after combining.
Note(s)	This is an adaptation of the existing Transfer Task. This adaptation is designed as an option for learners to experience elephant toothpaste directly in the classroom through a teacher-led demonstration or by conducting the investigation themselves instead of accessing it through a video.		
Adaptation Suggestion(s)	An additional option would be to swap out the phenomenon of elephant's toothpaste with a different phenomenon from your class's Related Phenomenon poster. Though this will better connect to your learner's interests and experiences, it will take prep time on your part. Depending on the phenomenon you choose to use in place of elephant's toothpaste, you will need to design the investigation, collect the supplies and revise the student's handout for a space for them to record data specific to the investigation you choose to demonstrate.		

Standards Emphasis

Assessment is a balancing act involving multiple tradeoffs. No one task can do everything, and often good design carefully considers what *not* to assess. The targeted NGSS Performance Expectation and supporting dimensions are shown below. The parts of the standard not addressed in the task are ~~struck through~~. Each item in the task may target one or more of the dimensions - not every item has to assess every dimension. What matters is that the task as a whole addresses all three dimensions.

NGSS PE(s)

Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. (MS-PS 1-2)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyze and interpret data to provide evidence for phenomena. **Constructing Explanations ~~and Designing Solutions~~** Apply scientific ideas, ~~principles,~~ and/or evidence to construct, ~~revise and/or use~~ an explanation for real-world phenomena, examples, or events.	**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. (MS-PS1-2; MS-PS1-5) ● The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5)	**Patterns** ● Patterns can be used to identify cause and effect relationships. **Energy and Matter** Matter is conserved because atoms are conserved in physical and chemical processes.

Key Equity Feature(s):
Empowering: Ownership of Learning and Performance

Task Worksheet

Explaining Another Phenomenon

Watch the video of elephant's toothpaste with your class. This elephant's toothpaste investigation was the result of combining three different ingredients together: potassium iodide (a substance), a mixture of hydrogen peroxide and water, and soap (a mixture).

To help us figure out what is going on to result in the bubbles we see, here are the results from tests of different combinations of the three ingredients.

Combination	Ingredients combined	Bubbles?
A	hydrogen peroxide + soap	No
B	potassium iodide + soap	No
C	hydrogen peroxide + potassium iodide	Yes, lots!

Since combination C was the only one that produced bubbles, we will use this procedure to collect data about what happens when these substances are combined. Then we will use this data and our key model ideas to explain what is happening.

1. What happens when hydrogen peroxide and potassium iodide are combined? As your teacher carries out the investigation, use the space below to record your observations.

Observations:

Record the mass of the system before and after mixing the ingredients.

Mass of the system BEFORE mixing the ingredients:	**Mass of the system AFTER mixing the ingredients:**

2. *Explain* what happened to the mass of the system after combining the ingredients? Use these two resources: a) your observations and b) your key model ideas to construct an **explanation** to answer this question.

3. What gases could NOT have been produced in this process? Use these three resources: a) your observations, b) your key model ideas, and c) the data table included below of *Some Common Gases*, to construct an **explanation** to answer this question.

Some Common Gases

All data reported is for measurements at sea level elevation and at 15°C					
Substances in rows A–I *(row J is a mixture)*		***Approximate % of this gas in the air outside***	***Boiling point (in °C)***	***Density (g/L) measured at 0°C***	***Flammability*** *Notes on how the gas interacts with flame*
A	**nitrogen**	78%	-196	1.250	Will extinguish a flame.
B	**oxygen**	21%	-183	1.430	Will increase a flame or cause a glowing ember to burst into flame.
C	**argon**	~1%	-186	1.780	Will extinguish a flame.
D	**carbon dioxide**	~0.04%	N/A *Changes straight from solid to gas with no liquid phase. This occurs at -78.4*	1.960	Will extinguish a flame.
E	**neon**	~0.0018%	-246	0.900	Will extinguish a flame.
F	**helium**	~0.0005%*	-268	0.179	Will extinguish a flame.
G	**methane** (natural gas)	~0.0002%*	-161.5	0.714	Will increase a flame. Can create an explosion.
H	**hydrogen**	0.0001%	-252	0.090	Will increase a flame. Can create an explosion.
I	**propane**	<0.0001%	-42	2.000	Will increase a flame. Can create an explosion.
J	**Air**	*N/A*	*N/A (mixture)*	~1.160	Can maintain an open flame.

Another student claims that the gas produced in this process was **methane**. If you wanted to collect additional evidence to either help support or refute this claim you would need additional data.

4a. What test could you do to collect additional data to support or refute this claim? Use the data table in your notebook of *Some Common Gases*, to help answer this question.

4b. How could the results help you either support or refute the student's claim?

Teacher Instructions

Use this midpoint task as a mini transfer task. The purpose of a transfer task is to provide learners an opportunity to apply key science ideas they have figured out about the anchoring phenomenon, to a new phenomenon. Learners use key science ideas about substances and their properties and how to use this information to determine if a new substance has been made.

The phenomenon and scenario in this task is *elephant's toothpaste*. In the field test of this unit, most of the classes had elephant's toothpaste as a related phenomenon on their class poster. If this is not on your class's related phenomena poster, consider swapping out the elephant's toothpaste as the phenomenon learners are explaining for one found on your class Related Phenomenon poster. Choose a phenomenon that will produce a gas as that will best mirror the sensemaking learners are being asked to do in this task.

If you choose to swap out the phenomenon for this task, you will need to adapt the handout for learners.

- Conduct an investigation with one of the related phenomena from your class. Collect data and replace what is in the handout to include the substances in your investigation and the results of the investigation. The introduction to the task and the data table at the top will need to be updated as well as the data in question 1.

An optional procedure for demonstrating elephant's toothpaste has been included here.

- You can choose to demonstrate this investigation with your learners so part of their task is to record the data on their handout from watching the investigation. The introduction as well as the data table at the top and in question 1 has been revised in this document.

Feedback and Scoring Guidance

NOTE: If you choose to revise the task to use a different phenomenon than elephant's toothpaste, then the key below will also need updating to include what to look for from the investigation of the new phenomenon.

Lesson 6: Answer Key

Elements to look for in learners' written arguments

The elements described below would be considered an exemplary response at this point in the unit. When scoring the evidence learners use to support their claim, learners need to provide evidence that is coordinated with their claim. However, they ***do not*** need to provide every piece of evidence listed below.

SEP (Arguing for Evidence to Explain): Through writing a claim supported by evidence with reasoning that explains why their evidence supports their claims through connecting them to key model ideas, learners are demonstrating their understanding and ability to engage in the practice of argumentation.

CCC (Patterns): In their reasoning, learners will be engaging in the crosscutting concept of patterns through explaining the patterns of cause and effect relationships in property data. For example, learners should use the reasoning that the gas produced when Substance A and Substance B of Elephant's Toothpaste are combined is flammable because when the glowing wood came in contact with the gas, it glowed brighter. These patterns come from learners' *Some Common Gases*. This is an example of using a pattern from the property table to support their claim (e.g., how the cause and effect relationship of the gas making a flame glow brighter [effect] means the gas is therefore flammable [cause]).

In the guide below, there are examples of what learners may include in their answers notated with a +. These +'s are not meant to be all inclusive; they are suggestions for what you may see your learners include.

You watched the video of the elephant's toothpaste, which was the result of combining three different ingredients together: potassium iodide (a substance), a mixture of hydrogen peroxide and water, and soap (a mixture).

To help us figure out what is going on, here are the results from tests of different combinations of the three ingredients.

Combination	Ingredients combined	Bubbles?
A	hydrogen peroxide + soap	No
B	potassium iodide + soap	No
C	hydrogen peroxide + potassium iodide	Yes, lots!

Since combination C was the only one that produced bubbles, we will collect data about what happens when these substances are combined. Then we will use this data and our key model ideas to explain what is happening.

1. As your teacher carries out the investigation, use the space below to record your observations.

Observations:

Learner responses should include:

+ The potassium iodide is a white powder beforehand.
+ The hydrogen peroxide is a clear liquid beforehand.
+ As soon as the powder is poured into the liquid, the color changes (orangish/brown).
+ Bubbles begin immediately and fill the flask half way up.
+ When the stopper is put on the flask, it moves around and rattles.
+ Bubbling slows down/stops after a few seconds and there is an orangish liquid left.
+ By the end of this process the mass of the system decreases by X g.

Mass of the system before mixing the ingredients:	Mass of the system after mixing the ingredients:
Mass before should be a little more than mass after for elephant's toothpaste since some of the gas bubbles end up escaping around the stopper on the flask.	Mass before should be a little more than mass after for elephant's toothpaste since some of the gas bubbles end up escaping around the stopper on the flask.

2. Explain what happened to the mass of the system after combining the ingredients? Use these two resources: a) your observations and b) your key model ideas to construct an explanation to answer this question.

Learners should explain that the mass changed. They should explain that for this combination of materials a gas was formed and left the system. The data shows that a lot of bubbles were formed when hydrogen peroxide and potassium iodide were combined and that the mass went down for this combination. In the second video clip, there were a lot of bubbles produced and the cork on the top actually moved up and down as if the gas was escaping. Learners should use key model ideas in their explanation. Some may choose to include:

+ Gas is a type of matter and has mass and takes up space.
+ In an open system matter can get in and out of the system and when this happens the mass may change.
+ The mass is less because a gas was formed in the video.
+ We saw stuff (the gas) leaving the flask, which is why the mass went down.
+ We saw bubbles in the video; when we see bubbles it means there is a gas.

3. What gases could NOT have been produced in this process? Use these three resources: a) your observations, b) your key model ideas, and c) the data table included below of Some Common Gases, to construct an explanation to answer this question.

Learner responses should include:

+ A claim stating that the gas COULD NOT be nitrogen, argon, carbon dioxide, neon, helium, or air because they do not increase a flame.
+ Evidence from the lit match in the flask getting brighter in the gas.
+ Reasoning using the science principles in the anchor chart (and notebook) that the class has agreed upon for example (**or** Reasoning (which includes the use of these ideas)

    + Substances have properties that can help us identify them.
    + Flammability is a property.
    + The gas from the elephant's toothpaste must be flammable because it makes a flame burn brighter.
    + Since the flame burned brighter and didn't go out, the gas produced can't be any of these.

Example Response:
The gas that was collected from the elephant's toothpaste investigation can't be nitrogen, argon, carbon dioxide, neon, helium, or air because it puts out a flame. We know this based on the flammability of these gases. Flammability is a property, which means it doesn't change for a substance. Some gases are flammable, which means a flame in them gets brighter or bursts into flames. Some gases are not flammable, which means a flame goes out in them. The gas from the elephant's toothpaste makes a flame burn brighter so it is flammable and this means it can't be any of the non-flammable gases like nitrogen, argon, carbon dioxide, neon, helium, or air.

Another student claims that the gas produced in this process was methane. If you wanted to collect additional evidence to either help support or refute this claim you would need additional data.

4a. What test could you do to collect additional data to support or refute this claim? Use the data table in your notebook of Some Common Gases, to help answer this question.

Responses could include any of the following (i, ii, or iii):

i) A density test

+ I could do what we did with helium in class where we tested the density using a flame above and below.
+ If the ember glows brighter and flares up/explodes when the container is opened with this gas in it, then it could be methane because methane is less dense than air and should float upward.
+ If it doesn't then it is probably more dense than air and the flame would flare up when this gas is poured on it.

ii) Comparing to controls:

+ I could test some controls--each of known gases that I haven't eliminated yet (that are flammable and interact with an ember or flame).
+ I could compare what they do with an ember to see what is different about when they burst into a flame (oxygen) or create something more like an explosion (methane, hydrogen, or propane).
+ I could then argue which one it best matches with or which ones it doesn't match with.

iii) A boiling point/condensation point test:

+ I could try capturing and cooling down the gas until it turns into a liquid and measure the temperature at which this happens.
+ The temperature at which this happens is a property (boiling/condensation point).
+ This should help me determine which gas it is.

4b. How could the results help you either support or refute the student's claim?

Example response:

Methane is a gas that will increase a flame, so it is possible that it could be the gas produced from the elephant's toothpaste. But there are other gases on the Some Common Gases data table, so I would want to collect more data to help me narrow it down to methane. One test I could do with the gas is test its density. Density is a property that doesn't change for a substance, so testing its density could help me determine what it might be. In class we tested the density of gases with a flame by holding a flame above and below the gas to see if the gas is denser or less dense than air. Since methane is less dense than air, if I could collect some of the gas from the elephant's toothpaste, then I could hold a flame below it. If only the flame that is held above it gets brighter the gas is less dense than air and could be methane. If only the flame that is held below it gets brighter, the gas is more dense than air and could not be methane.