

## Formative Assessment Exemplar - 8.1.3

### Introduction:

The following formative assessment exemplar was created by a team of Utah educators to be used as a resource in the classroom. It was reviewed for appropriateness by a Bias and Sensitivity/Special Education team and by state science leaders. While no assessment is perfect, it is intended to be used as a formative tool that enables teachers to obtain evidence of student learning, identify gaps in that learning, and adjust instruction for all three dimensions (i.e., Science and Engineering Practices, Crosscutting Concepts, Disciplinary Core Ideas) included in a specific Science and Engineering Education (SEEd) Standard.

In order to fully assess students' understanding of all three dimensions of a SEEd standard, the assessment is written in a format called a cluster. Each cluster starts with a phenomenon, provides a task statement, necessary supporting information, and a sequenced list of questions using the gather, reason, and communicate model (Moulding et al., 2021) as a way to scaffold student sensemaking. The phenomenon used in an assessment exemplar is an analogous phenomenon (one that should not have been taught during instruction) to assess how well students can transfer and apply their learning in a novel situation. The cluster provides an example of the expected rigor of student learning for all three dimensions of a specific standard. In order to serve this purpose, this assessment is NOT INTENDED TO BE USED AS A LESSON FOR STUDENTS.

Because this assessment exemplar is a resource, teachers can choose to use it however they want for formative assessment purposes. It can be adjusted and formatted to fit a teacher's instructional needs. For example, teachers can choose to delete questions, add questions, edit questions, or break the tasks into smaller segments to be given to students over multiple days.

### General Format:

Each formative assessment exemplar contains the following components:

1. Teacher Facing Information: This provides teachers with the full cluster as well as additional information including the question types, alignment to three dimensions, and answer key. Additionally, an example of a proficient student answer and a proficiency scale for all three dimensions are included to support the evaluation of the last item of the assessment.
2. Students Facing Assessment: This is what the student may see. It is in a form that can be printed or uploaded to a learning platform. (Exception: Questions including simulations will need technology to utilize during assessment.)

### Accommodation Considerations:

Teachers should consider possible common ways to provide accommodations for students with disabilities, English language learners, students with diverse needs or students from different cultural backgrounds. For example, these accommodations may include: Providing academic language supports, presenting sentence stems, or reading aloud to students. All students should be allowed access to a dictionary.


### References:

Moulding, B., Huff, K., & Van der Veen, W. (2021). *Engaging Students in Science Investigation Using GRC*. Ogden, UT: ELM Tree Publishing.

## Teacher Facing Information

**Standard:** 8.1.3

**Assessment Format:** Online Only (Requires students to have online access)

Phenomenon	
<p>In the United States of America, the fourth of July is a celebration of its independence. Fireworks are a symbol of triumph. You wondered how every firework displays a variety of colors.</p> <p>Figure 1: Fireworks</p>  <p>"Fireworks in front of the Lincoln Memorial and Washington Monument" by WilliamMarlow is licensed under CC BY-NC-SA 2.0</p> <p><a href="#">Video clip on fireworks</a></p>	<p>Proficient Student Explanation of Phenomenon:</p> <p>The bright sparkles in fireworks come from adding heat to small bits of metal that release energy which indicate that a chemical reaction has occurred. Once the firework is in the sky, the properties of the metals used are changed and give off energy that we see as light, color or feel as heat or hear as sound.</p>
Cluster Task Statement	
<p>(Represents the ultimate way the phenomenon will be explained or the design problem will be addressed)</p> <p>In the questions that follow, you will analyze and interpret the data provided in order to identify patterns in the changes of a substance's properties to determine if a chemical reaction has occurred.</p>	
Supporting Information	
<p><a href="#">The science of firework</a></p>	

The basic firework requires three ingredients: oxygen, a fuel, and a chemical mixture. Oxygen causes fuel to burn to produce heat. The chemical mixtures are composed of a variety of elements. When different elements burn, their electrons are exposed to heat and they gain energy. Then, they get excited and jump to a higher energy level. When it cools off, the electron goes back to its normal energy level. In other words, the electron loses the energy it had gained. This energy is released as light at a certain wavelength.

Each wavelength corresponds to a certain color. For example, lithium and strontium carbonates produce deep reds and purples when they are burned. Copper chlorides produce blue. Titanium, aluminum and magnesium are silvery. Calcium chloride is orange, sodium is yellow and barium burns green.

Figure 2: Chemical reaction of fireworks



## Cluster Questions

Gather:

Cluster Question # 1

Question Type: Multi-Select

Addresses:

✓ DCI: (PS1.A) Structure and Properties of Matter

SEP

✓ CCC: Patterns

**Answer:**

Light

Sound

Question 1:

[Video clip on fireworks](#)

Watch the short video clip on fireworks using the link above.

What **types of evidence(s)** shown in the video clip are indicators that a chemical change has occurred? Choose all that apply.

- A. Heat
- B. Light
- C. Sound
- D. Electrical
- E. Nuclear

Gather:

Cluster Question # 2

Question Type: Multiple Choice

Addresses:

✓ DCI: (PS1.A) Structure and Properties of Matter

✓ SEP : Analyzing and Interpreting Data

\_\_\_ CCC : Patterns

**Answer:**

- a. The colored light is not a permanent change and the different color light is produced by the change in energy of the electrons.

Question 2:

The production of different colored lights are examples of a physical change. Which of the following is the best reason why it is a physical change and not a chemical change?

- a. The colored light is not a permanent change and the different color light is produced by the change in energy of the electrons.
- b. Changes in color are always a physical change.
- c. The change in energy of the electrons is an example of a chemical change.
- d. The colored light that is produced during fireworks is a different color because of the different elements used.

Reason:

Cluster Question #3

Question Type: Multi-Select

Addresses:

✓ DCI: (PS1.A) Structure and Properties of Matter

✓ SEP: Analyzing and Interpreting Data

✓ CCC: Patterns

**Answer:**

Question 3:

**Use Table 1 above** to help you answer the question.

What effects does the chemical reaction of fireworks produce?

	Yes	No
A new material is produced		
Sound is produced		
Electric is		

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<p>Communicate:</p> <p>Cluster Question # 4</p> <p>Question Type: Long Answer</p> <p>Addresses:</p> <ul style="list-style-type: none"> <li>✓ DCI: (PS1.A) Structure and Properties of Matter</li> <li>✓ SEP: Analyzing and Interpreting Data</li> <li>✓ CCC: Patterns</li> </ul> <p>Answer:</p>	<p>Question 4:</p> <p><b>Claim, Evidence, Reason</b></p> <p>Write a <b>claim</b> about the chemical reaction that occurs in a firework, supporting your claim with at least 3 pieces of <b>evidence</b> from the readings, videos, or tables provided above, and the reason why fireworks are an example of a chemical change.</p>																																	
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	<p>mathematics, and/or computation.</p> <p>Compare and contrast data collected in order to discuss similarities and differences in their findings.</p>	<p>identify temporal and spatial relationships.</p> <p>Distinguish between causal and correlational relationships in data.</p> <p>Analyze and interpret data to provide evidence for phenomena.</p> <p>Analyze and interpret data to determine similarities and differences in findings.</p>	
<p><b>CCC:</b> Does not meet the minimum standard to receive a 2.</p>	<p>Uses similarities and differences in patterns to sort, classify, communicate, and analyze simple rates of change for natural phenomena and designed products.</p> <p>Uses patterns of change to make predictions.</p> <p>Uses patterns can as evidence to support an explanation.</p>	<p>Identifies that macroscopic patterns are related to the nature of microscopic and atomic-level structure.</p> <p>Uses patterns to identify cause and effect relationships.</p> <p>Uses graphs, charts, and images to identify patterns in data.</p>	<p><b>CCC:</b> Extends beyond proficient in any way.</p>
<p><b>DCI:</b> Does not meet the minimum standard to receive a 2.</p>	<p>When two or more different substances are mixed, a new substance with different properties may be formed.</p>	<p>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.</p>	<p><b>DCI:</b> Extends beyond proficient in any way.</p>

		Some chemical reactions release energy, others store energy.	
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**(Student Facing Format on following page)**

Name: \_\_\_\_\_ Date: \_\_\_\_\_

### Stimulus

In the United States of America, the fourth of July is a celebration of its independence. Fireworks are a symbol of triumph. You wondered how every firework displays a variety of colors.

Figure 1: Fireworks



"Fireworks in front of the Lincoln Memorial and Washington Monument"  
by WilliamMarlow is licensed under CC BY-NC-SA 2.0

### [Video clip on fireworks](#)

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Figure 2: Chemical reaction of fireworks





**Table 1: Chemical reaction for fireworks.**

Reactants	Properties Before Launch	Properties of Products After Launch
Aluminum (Al)  <a href="https://en.wikipedia.org/wiki/Aluminium">https://en.wikipedia.org/wiki/Aluminium</a>	Silver Solid	White crystalline solid and brown solid is produced  Produces White Light  Sound is produced  Heat is produced  Not Flammable
	Malleable (capable of being shaped)	
	Non-flammable	
Potassium Perchlorate (KClO <sub>4</sub> )  <a href="https://en.wikipedia.org/wiki/Potassium_perchlorate">https://en.wikipedia.org/wiki/Potassium_perchlorate</a>	White Solid	
	Flammable	

### Your Task

In the questions that follow, you will analyze and interpret the data provided in order to identify patterns in the changes of a substance's properties to determine if a chemical reaction has occurred.

### Question 1

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What **types of evidence(s)** shown in the video clip are indicators that a chemical change has occurred? Choose all that apply.

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## Question 2

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## Question 3

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What effects does the chemical reaction of fireworks produce?

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## Question 4

### Claim, Evidence, Reason

Write a **claim** about the chemical reaction that occurs in a firework, supporting your claim with at least 3 pieces of **evidence** from the readings, videos, or tables provided above, and the reason why fireworks are an example of a chemical change.