Unit Plan

Properties of Matter & Studio Glass

Students will explore how art and science together can create innovation. In this mini-unit, students explore how synthetic materials come from raw materials and exhibit different properties. This is also an alternative lesson that can be used to teach the properties of matter.

Intended Audience: 6th-8th Grade Science

Duration: Four 55-minute lessons, plus recommended field trip at conclusion

	Lesson 1: Basics of Glass and Batching	**Lesson 2: Plain Candy Trial**	**Lesson 3: Colored Candy Trial**	**Lesson 4: Chemical Reactions/Using Glass**	**Recommended Field Trip: Greenfield Village**
Essential Question:	How is glass made?	What properties do I observe before, during and after a chemical reaction?	What changes can I make to result in a more artistic product?	Has a chemical reaction occurred? How else does glass impact our lives?	How is glass made? How does glass impact our lives?
Learning Outcome:	Pose ideas on and identify basics of glass making. Identify candy as a model for glass.	Observe and record properties of matter during candy making process.	Make choices, then observe and record the results about coloring and manipulating candy.	Determine whether a chemical reaction has occurred and support the argument with evidence. Identify ways society uses glass.	Experience in person how glass is made. See examples from history of how glass impacts our lives.
Standards:	MS-PS1-3: Gather and make sense of information to describe that synthetic materials come from natural resources and 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-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	MS-PS1-2: 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.	MS-PS1-3: Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
Key Concepts:	Raw material, synthetic material, batch	Properties, chemical reaction		Chemical reaction, functional, artistic	Batch, gather, blown glass, pressed glass, studio glass

Interdisciplinary Connection: A complementary unit plan exists for an art class to follow up on the topic of studio glass after science has completed this unit plan. The plan is available online. If you plan to coordinate with an art teacher, keep the candy “sugar glass” your students make for them to use in art.

Properties of Matter & Studio Glass Lesson Matrix

Lesson 1: Studio Glass & Collaboration	**Lesson 2: Independent Studio Glass**	**Lesson 3: Curators and Exhibits Part 1**	**Lesson 4: Curators and Exhibits Part 2**
1. Think-Pair-Share: How do we move from sand to finished artistic glass piece?	1. "Observations Before Heating" and "Claim" on Properties of Matter Observation Worksheet 1	1. Review summaries	1. Gallery walk of colored candy samples
2. Give purpose: Create a model for glass, showing how matter can change physical properties by undergoing chemical reaction.	2. Check for understanding on physical properties	2. Additional "Observations After Pouring and Cooling"	2. Davidson-Gerson Gallery of Glass
3. Video: "Glass – raw material to art"	3. Procedure for creating sugar glass	3. Develop artistic vision	3. Chemical reaction, sugar and glass
4. Discussion	4. Carry out experiment	4. Carry out experiment	4. Homework Part 1
5. Introduce candy as model for glass	5. Complete "Observations After Pouring and Cooling" on Properties of Matter Observation Worksheet 1	5. Complete "Observations After Pouring and Cooling" on Properties of Matter Observation Worksheet 2	5. Students' use of glass
6. Lab groups create "batch" with sugar raw materials	6. Check for Understanding	6. Homework: "Evidence" and "Reasoning" on Properties of Matter Worksheet 2	6. Students' use of glass (sharing)
7. Check for Understanding	7. Homework: "Evidence" and "Reasoning" on Properties of Matter Observation Worksheet 1		7. Society's use of glass
			8. Homework Part 2

Recommended Field Trip:
Greenfield Village*

Glass Shop
or Davidson-Gerson Gallery of Glass

*If Greenfield Village is closed for season, consider visiting Davidson-Gerson Gallery of Modern Glass in Henry Ford Museum of American Innovation.

Properties of Matter & Studio Glass

Students will explore how art and science together can create innovation. In this mini-unit, students explore how synthetic materials come from raw materials and exhibit different properties. This is an alternative lesson that can be used to teach the properties of matter.

Lesson 1 Basics of Glass and Batching

Essential Question: How is glass made?

Learning Outcome: Pose ideas on and identify basics of glassmaking. Identify candy as a model for glass.

Key Concepts: Raw material, synthetic material, batching.

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

Preparation:

Have available sample of raw sand and a finished glass piece.
Have online video "Glass – raw material to art" projected for class viewing.
For experiment:

- 400 mL beaker for each small group
- Scales (two or three groups could share one if needed)
- Sugar (if you have nine groups of four students per group, you will need 3 lbs. per class section)
- Corn syrup (32 fl. oz. per class section)
- Access to water

(10 min.)

1 Think-Pair-Share: How do we move from sand to finished artistic glass piece?

Provide samples of raw sand and finished glass piece (could use inexpensive decorative piece or glass instruments from the lab), and pose open-ended question in Think-Pair-Share format.

- How do we start with this sand and end up with this finished glass product?
- How might glass artists be able to create so many variations of glass from color to texture, to shape, etc.?

All students should think on their own, then pair with neighbor to discuss, then have a few groups share ideas with class. (Wait to reveal answers in step 3.)

(5 min.)

2 Give purpose: Create a model for glass, showing how matter can change physical properties by undergoing chemical reaction.

Explain that students will be observing the properties of the raw materials as well as the properties of synthetic material.

Define the following terms:

Physical properties – properties that can be observed or measured without changing the composition of the matter. They include: appearance, texture, color, odor, melting point, boiling point, density, solubility, polarity and many others.

Chemical reaction – occurs when two or more substances combine to form a new substance. The physical properties of the product differ from those of the raw material.

Raw material – a substance that will be processed into a different final product.

Synthetic material – a compound that has undergone a chemical process initiated by humans, as opposed to a natural material.

(5 min.)

3 Video: “Glass – raw material to art”

Introduce video of glass being made at the Glass Shop in Greenfield Village at The Henry Ford. Ask students to pay attention to

a) Raw materials

b) Properties of the material before the process

c) Properties of the material during the process

d) Properties of the material after the process

(5 min.)

4 Discussion

Ask students to report out on what they saw in video.

- What is batching, in the context of making glass? First step in glass making, mixing the raw materials and minerals that provide color.
- What were the raw materials? Silicon dioxide, sodium carbonate, lime, black iron oxide. Note: The words on the bag “Spruce Pine Batch” refer to the company that provides our batch – there is no spruce pine in the batch.
- What were the properties of the material before the process? Batch is a fine white powder solid. Black iron oxide is a fine, dark gray powder solid.
- What were the properties of the material during the process? After mixing, it becomes a gray powder with some chunks in it. During melting, the material turns orange hot, and it goes from a powdery solid to a very viscous liquid. It bubbles during the melting process.
- What were the properties of the material (glass) after the process? Light gray yet clear, hard but breakable solid. Formed into a very detailed shape.
- What temperatures are required in glassmaking? 2,350 degrees Fahrenheit is the temperature of the hot shop’s furnace.
- What surprised or interested you most?

(5 min.)

5 Introduce candy as model for glass

Explain that sugar candy has some properties similar to glass (though it is not a perfectly matching model).
Also, just as the artists Littleton and the scientist Labino had to experiment to find out the right formulation of materials, tools and techniques, candy making takes some trial and error. In this unit’s lab, students will be making candy from sugar, with different groups trying different formulas and techniques, and observing its properties at all stages.

Point out that while the temperature required to convert sugar to candy is far less than converting batch to glass, during the next days they will be handling dangerously hot materials.

(15 min.)

6 Lab groups create “batch” with candy raw materials

Assign small groups to one of the following formulations. They should label their beaker with their names and formulation, measure the correct amount(s) of materials and place their beakers in a holding location for tomorrow.

1. Batch type 1: Sugar 70 g **2.** Batch type 2: Sugar 70 g , Water 60 g **3.** Batch type 3: Sugar 70 g, Water 30 g, Corn syrup 30 g

Clean up.

(10 min.)

7 Check for Understanding

Have students complete the table to see if they understand the terms “raw material,” “synthetic material” and “batch.”.

Properties of Matter & Studio Glass

Lesson 1: Basics of Glass and Batching

Background Information for Teachers

Science Background Info:

Physical properties are properties that can be observed or measured without changing the composition of the matter. They include: appearance, texture, color, odor, melting point, boiling point, density, solubility, polarity and many others.

A chemical reaction occurs when two or more substances combine to form a new substance. The physical properties of the product differ from those of the raw material.

Chemical formula of sugar: C12H22O11

Chemical formula of corn syrup: C6H14O7

The chemical reaction occurs due to the heating of the raw materials to their melting points. The heat causes the chemical structures to change, creating new products with different physical properties.

Art Background Info:

In March 1962, Harvey Littleton, a ceramics instructor at the University of Wisconsin-Madison, decided to hold a two-week glassblowing workshop in a shed on the grounds of the Toledo Museum of Art. These workshops set the stage for what would become known as the studio glass movement.

Up to this point, glass was looked upon as a functional craft, not an art form or particular style of art. This was partly because glass had to be made in a factory setting due to the high temperatures and materials involved. An individual artist couldn't create glass works in his/her own studio.

At the Toledo Workshop, with the help of Dominick Labino, who had been trained as an engineer and had a professional career in a glass manufacturing plant, Littleton experimented to see if they could work with glass on a smaller scale. They created a furnace using bricks from Littleton's pottery studio kiln in Wisconsin. However, the first batch did not melt properly, and Littleton's stoneware crucible broke apart in the heat. Labino suggested that they melt the glass directly in the furnace. Labino also used a low-melting formula #475 marble that he had developed for John Manville for the production of fiberglass. The marbles melted at a relatively low temperature and produced glass that was malleable enough to blow. Thanks to this collaboration between artist and scientist, the workshop's experiments in glassblowing were was able to continue.

Littleton would go on to found the first studio program in art glass in the United States, paving the way for others. Labino went on to open his own glass studio, design glassblowing and finishing tools and build his own furnaces and annealing ovens. Through his research and development of new technologies, he provided multiple ways to create glass as art in a studio. For the first time in its 3,500-year history, glass was no longer limited to a factory-like setting. It has since become the fastest-growing studio art medium.

Properties of Matter & Studio Glass

Name _____

Lesson 1: Basics of Glass and Batching
Check for Understanding

Fill in the table with the raw materials and synthetic materials used in both glassmaking and in candymaking.

	Glass making	Candy making
Raw material(s)		
Synthetic material(s)		

Identify the batch by writing it into the appropriate box (either raw or synthetic materials).

Describe what you think your group's glass may look like, based on the raw materials you used.

Properties of Matter & Studio Glass

Students will explore how art and science together can create innovation. In this mini-unit, students explore how synthetic materials come from raw materials and exhibit different properties. This is an alternative lesson that can be used to teach the properties of matter.

Lesson 2 Plain Candy Trial

Essential Question: What properties do I observe before, during and after a chemical reaction?

Learning Outcome: Observe and record properties of matter during candy making process.

Key Concepts: Properties, chemical reaction.

Standards: 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.

(10 min.)

1 "Observations Before Heating" and "Claim" on Properties of Matter Observation Worksheet 1

Lab groups rotate to two other workstations and complete the "Observations Before Heating" column of the **Properties of Matter Observation Worksheet 1.** Students are to make note of all physical properties they can find in each beaker of raw materials. Lab groups should discuss observations while each member completes their own worksheet. Teacher will set the timer for 5 minutes for this activity.

Students will complete the "Claim" section of the Claim/Evidence/Reasoning portion of the **Properties of Matter Observation Worksheet.**

(3 min.)

2 Check for understanding on physical properties

Ask for a volunteer to report out on the physical properties of each formulation.

(5 min.)

3 Procedure for making candy

Review the handout Procedure for Making Candy. Emphasize that students must be extra careful with the hot tools and materials being used.

(20 min.)

4 Carry out experiment

Circulate to be sure students are behaving safely and remembering to record their observation data.

(10 min.)

5 Complete "Observations After Pouring and Cooling" on Properties of Matter Observation Worksheet 1

Lab groups should discuss observations while each member completes own worksheet.

Students work cooperatively to clean up their lab stations before leaving class. Beakers or pots can sit overnight filled with water for easier cleaning. Save the samples of candy made for future parts of the unit.

(5 min.)

6 Check for understanding

Ask for groups with each formulation to report out on observations during heating and after pouring and cooling. Other groups can take notes on Properties of Matter Observation Worksheet 1.

(2 min.)

7 Check for understanding on physical properties

Students should complete this individually in any extra time or at home. This will be discussed in Lesson 3.

Properties of Matter & Studio Glass

Name _____

Lesson 2: Plain Candy Trial

Procedure for Making Candy (aka Sugar Glass)

Materials

- Safety goggles
- Sugar (5 lb. bag)
- Corn syrup (16 oz. bottle)
- Access to water
- Bunsen burner or hot plate for heat source
- Tongs or oven mitts to handle hot glass
- Balance (triple-beam or electronic)
- Timer
- Aluminum foil (one box)
- 400 mL beakers
- Wooden dowels (or something similar to stir with)
- Candy thermometer (to test the temperature of sugar)
- Cold water and cup for testing temperature
- Microwave-safe dish
- Plastic wrap

Procedure for Batch Type 1 (sugar alone):

*If the circumstances do not allow for the heating of the raw materials over a Bunsen burner or hot plate, the following are **instructions for creating the sugar glass using a microwave-safe dish and microwave.**

1. Fold pieces of aluminum foil into a tray or cookie sheet to pour the liquid sugar onto.

- Make sure the foil trays are placed on a heat-resistant surface.

2. If not already completed on previous day, pour 70 g of sugar into a 400 mL beaker.

3. Start the timer and begin heating beaker over a Bunsen burner or hot plate, stirring regularly with the wooden dowel or glass stir rod until the sugar melts and begins bubbling.

- The ideal temperature for the liquid sugar is between 149°C and 154°C.
- If there is not access to a thermometer that can reach this temperature reading, you can test whether the liquid is at the necessary temperature by dropping a bead of the liquid from your stirring rod into a cup of cold water. If the liquid sugar solidifies into a bead or string in the water, it is at the correct temperature for pouring. If the sugar drop disintegrates in the water, it is not ready yet.

4. Once the desired temperature has been reached, record the time and carefully remove the beaker from the burner or hot plate and pour it onto the foil tray.

5. The liquid sugar should begin to cool and harden into glass candy after a few minutes.

6. DO NOT PUT WATER INTO THE HOT BEAKER; IT WILL CRACK. SET IT ASIDE TO COOL DOWN FOR AT LEAST 20 MINUTES BEFORE ADDING WATER.

Procedure for Batch Type 2 (sugar and water mixture):

1. Fold pieces of aluminum foil into a tray to pour the liquid sugar onto
- Make sure the foil trays are placed on a heat-resistant surface.

2. If not already completed on previous day, pour 70 g of sugar into a 400 mL beaker. Add 60 g of water to the beaker and stir.

3. Follow steps 3-6 from the Procedure for Batch Type 1.

Procedure for Batch Type 3 (sugar, water and corn syrup mixture):

1. Fold pieces of aluminum foil into a tray to pour the liquid sugar onto.
- Make sure the foil trays are placed on a heat-resistant surface.

2. If not already completed on previous day, pour 70 g of sugar into a 400 mL beaker. Add 30 g of water to the beaker and stir. Add 30 g of corn syrup to the beaker and stir.

3. Follow steps 3-6 from the Procedure for Batch Type 1.

Procedure:

1. Combine raw materials in a microwave-safe dish.

2. Stir with wooden dowel.

3. Cover microwave-safe dish containing mixture with plastic wrap.

4. Microwave for 3 minutes.

5. Remove dish from microwave. CAUTION: Will be HOT. Recommended to remove with gloves or hot pads.

6. Remove plastic wrap and stir with wooden dowel. At this time, you may add food coloring for solid color. CAUTION: Plastic may have melted to dish.

7. Using a wooden dowel, drip sugar into cup of cold water until a solid bead forms. If solid bead does not form, revisit step 4.

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Lesson 2: Plain Candy Trial
Properties of Matter Observation Worksheet 1

Fill in the table with your observations of each candy experiment before, during and after heating.

Ingredients	**Observations Before Heating**	**Time of Heating**	**Observations While Heating**	**Observations After Pouring and Cooling** (Include details about the physical changes)
Batch Type 1: Sugar 70 g				
Batch Type 2: Sugar 70 g Water 60 g				
Batch Type 3: Sugar 70 g Water 30 g Corn Syrup 30 g				

Extension/Assessment

Claim (Hypothesis): Based on the experiment, what do you predict the changes in the raw materials will be?

Evidence (Results Statement): Summarize your results in a detailed paragraph using the data that you have collected in the experiment.

Scientific Reasoning (Conclusion Statement): Explain how you know that a chemical reaction occurred using information from your experiment.

Properties of Matter & Studio Glass

Students will explore how art and science together can create innovation. In this mini-unit, students explore how synthetic materials come from raw materials and exhibit different properties. This is an alternative lesson that can be used to teach the properties of matter.

Lesson 3 Colored Candy Trial

Essential Question: What changes can I make to result in a more artistic product?

Learning Outcome: Make choices, then observe and record the results of coloring and manipulating candy.

Key Concepts: Properties, chemical reaction.

Standards: 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.

(5 min.)

1 Review summaries

Review Results and Conclusions statements from Properties of Matter Observation Worksheet 1.

(5 min.)

2 Additional "Observations After Pouring and Cooling"

Candy samples are likely to have changed since students last saw them. In particular, they may have hardened (or not). Give students a chance to see all groups' samples and make updated notes to this section of the worksheet.

(10 min.)

3 Develop plan

Tell students they now will have the opportunity to innovate the process of candymaking, just as Littleton and Labino did with glass. They will be able to make and color candy and can try to form it into various shapes. They will be using the same basic procedure from Lesson 2, but they have some room for making creative, artistic choices.

Introduce students to the materials they have to work with:

Students may choose to make batch type A, B or C – whichever they feel works best for their artistic purposes.

To color the candy, they can select from various colors of Pixy Stix, Jolly Ranchers, food coloring.

Introduce students to the idea of shaping their candy. This should be done with the wooden dowels or glass stirring rods shortly after pouring but before cooling and solidifying (less than 5 minutes). There is a short window of time to do this, and caution them that the candy is very hot. DO NOT ALLOW STUDENTS TO USE THEIR HANDS.

Have students develop a plan in their group about what they'd like to do/create. They can now fill in the "Ingredients" and "Hypothesis sections" on Properties of Matter Observation Worksheet 2.

(25 min.)

4 Carry out experiment

Students should use the instructions from Lesson 2 to make their candy, adding their coloring to the batch. Circulate to be sure students are behaving safely and remembering to record their observation data on Properties of Matter Observation Worksheet 2.

(10 min.)

5 Complete "Observations After Pouring and Cooling" on Properties of Matter Observation Worksheet 1

Lab groups should discuss observations while each member completes own worksheet. Students work cooperatively to clean up their lab stations before leaving class. Beakers or pots can sit overnight filled with water for easier cleaning. Save the samples of candy made for future parts of the unit.

(Homework)

6 Homework: "Evidence" and "Reasoning" on Properties of Matter Observation Worksheet 2

Students should complete this individually in any extra time or at home. This will be discussed in Lesson 4.

Properties of Matter & Studio Glass

Name _____

Lesson 3: Colored Candy Trial

Procedure for Making Candy (aka Sugar Glass)

Materials

- Safety goggles
- Sugar (5 lb. bag)
- Corn syrup (16 oz bottle)
- Pixy Stix candy
- Jolly Ranchers candy
- Food coloring
- Access to water
- Tongs or oven mitts to handle hot glass
- Microwave-safe dish
- Balance (triple-beam or electronic)
- Timer
- Aluminum foil (one box)
- 400 mL beakers
- Wooden dowels (or something similar to stir with)
- Candy thermometer (to test temperature of sugar)
- Bunsen burner or hot plate for heat source
- Cold water and cup for testing temperature.
- Plastic wrap

Procedure for Batch Type 1 (sugar alone):

If the circumstances do not allow for the heating of the raw materials over a Bunsen burner or hot plate, the following are **instructions for creating the sugar glass using a microwave-safe dish and microwave.**

1. Fold pieces of aluminum foil into a tray or cookie sheet to pour the liquid sugar onto.
- Make sure the foil trays are placed on a heat-resistant surface.

2. If not already completed on previous day, pour 70 g of sugar into a 400 mL beaker.

3. Add your chosen materials to color the candy: Pixy Stix, Jolly Ranchers and/or food coloring.

4. Start the timer and begin heating beaker over a Bunsen burner or hot plate, stirring regularly with the wooden dowel or glass stir rod until the sugar melts and begins bubbling.
- The ideal temperature for the liquid sugar is between 149°C and 154°C.
- If there is not access to a thermometer that can reach this temperature reading, you can test whether the liquid is at the necessary temperature by dropping a bead of the liquid from your stirring rod into a cup of cold water. If the liquid sugar solidifies into a bead or string in the water, it is at the correct temperature for pouring. If the sugar drop disintegrates in the water, it is not ready yet.

5. Once the desired temperature has been reached, record the time and carefully remove the beaker from the burner or hot plate and pour it onto the foil tray.

6. The liquid sugar should begin to cool and harden into glass candy after a few minutes.

7. DO NOT PUT WATER INTO THE HOT BEAKER; IT WILL CRACK. SET IT ASIDE TO COOL DOWN FOR AT LEAST 20 MINUTES BEFORE ADDING WATER.

Procedure for Batch Type 2 (sugar and water mixture):

1. Fold pieces of aluminum foil into a tray to pour the liquid sugar onto
- Make sure the foil trays are placed on a heat-resistant surface.

2. If not already completed on previous day, pour 70 g of sugar into a 400 mL beaker. Add 60 g of water to the beaker and stir.

3. Follow steps 3-7 from the Procedure for Batch Type 1. .

Procedure for Batch Type 3 (sugar, water, and corn syrup mixture):

1. Fold pieces of aluminum foil into a tray to pour the liquid sugar onto
- Make sure the foil trays are placed on a heat-resistant surface.

2. If not already completed on previous day, pour 70 g of sugar into a 400 mL beaker. Add 30 g of water to the beaker and stir. Add 30 g of corn syrup to the beaker and stir.

3. Follow steps 3-7 from the Procedure for Procedure for Batch Type 1.

Procedure:

1. Combine raw materials, including those for coloring the candy, in a microwave-safe dish.

2. Stir with wooden dowel.

3. Cover microwave-safe dish containing mixture with plastic wrap.

4. Microwave for 3 minutes.

5. Remove dish from microwave. CAUTION: Will be HOT. Recommended to remove with gloves or hot pads.

6. Remove plastic wrap and stir with wooden dowel. At this time, you may add food coloring for solid color. CAUTION: Plastic may have melted to dish.

7. Using a wooden dowel, drip sugar into cup of cold water until a solid bead forms. If solid bead does not form, revisit step 4.

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Lesson 3: Colored Candy Trial
Properties of Matter Observation Worksheet 2

Fill in the table with the following information:

Ingredients you chose (both base batch ingredients and color ingredients).
Your observations about the experiment before, during and after heating.
Your observations during and after shaping.

Ingredients	**Observations Before Heating**	**Time of Heating**	**Observations While Heating**	**Observations After Pouring and Cooling** (Include details about the physical changes)	**Shaping Observations** (What did you try and how did it work out)

Extension/Assessment

Claim (Hypothesis): Based on the experiment, what do you predict the changes in the raw materials will be?

Evidence (Results Statement): Summarize your results in a detailed paragraph using the data that you have collected in the experiment.

Scientific Reasoning (Conclusion Statement): Explain how you know that a chemical reaction occurred using information from your experiment.

Properties of Matter & Studio Glass

Students will explore how art and science together can create innovation. In this mini-unit, students explore how synthetic materials come from raw materials and exhibit different properties. This is an alternative lesson that can be used to teach the properties of matter.

Lesson 4 Chemical Reactions/Using Glass

Essential Question: Has a chemical reaction occurred? How else does glass impact our lives?

Learning Outcome: Determine whether a chemical reaction has occurred and support the argument with evidence. Identify ways society uses glass.

Key Concepts: Chemical reaction, functional, artistic.

Standards: 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.

(10 min.)

1 Gallery walk of colored candy samples

Have small groups prepare their exhibit by placing one member's Properties of Matter Observation Worksheet 2 alongside their colored candy sample at their lab table. Have students circulate to see other groups' creations.

If coordinating interdisciplinary experience with an art teacher, keep the candy "sugar glass" your students make for them to use in art.

(5 min.)

2 Check for Understanding

To bring Lesson 3's colored candy trial to a conclusion, review with students the summaries written for Results and Conclusions statements from Properties of Matter Observation Worksheet 2.

(10 min.)

3 Chemical reaction, sugar and glass

Having just reviewed the changes observed between sugar and candy, bring up the topic of glass. Have students talk about what they know about making glass from raw materials.

Ask students to decide whether they think glassmaking is a chemical reaction. You may want to remind them of the definition of a chemical reaction:

> **Chemical reaction –** occurs when two or more substances combine to form a new substance. The physical properties of the product differ from those of the raw material.

They should physically get up and go to one side of the room for yes, the other side for no. Ask representatives for each side to support their argument.

Responses should discuss knowing a chemical reaction has occurred due to the changes in physical properties and composition from the raw materials to the products. Look for comparisons of the properties of some of the raw materials and those of glass.

(5 min.)

4 Homework Part 1

Introduce this assignment: To conclude Lesson 4's discussion of chemical change, students will write two paragraphs using the Check for Understanding Worksheet.

(5 min.)

5 Students' use of glass

Transition by stating: "Now that students have an understanding of how raw materials can create a new product with different properties, they will be exploring different uses of glass."

Use the worksheet How Do You Use Glass? to help students identify how glass impacts their day-to-day lives.

Answers should include uses like: lightbulbs, TV screens, computer screens, phone screens, windows, food storage, food preparation, automobile windows, art decorating homes.

(5 min.)

6 Students' use of glass (sharing)

Allow students to share their uses of glass, coming up with a class list.

(10 min.)

7 Society's use of glass

To touch on additional uses, review the Davidson Gerson Modern Glass Gallery website to show students different ways our society uses glass and examples of innovations in glass. Have the students decide whether each use is functional or artistic (or both).

(5 min.)

8 Homework Part 2

Introduce this assignment: To conclude Lesson 4's discussion of how glass is used, students will write a third paragraph using the Check for Understanding Worksheet.

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Lesson 4: Chemical Reactions/Using Glass
Check for Understanding

Is sugar candy making a chemical change? Why or why not?

Is glass making a chemical change? Why or why not?

How would your life be different without glass?

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Lesson 4: Chemical Reactions/Using Glass
How Do You Use Glass?

Think back over your last 24 hours. Write down each instance in which you used glass in some way.

Type of glass used:	What you used glass for:

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Field Trip: Greenfield Village

Glass Shop

Draw or make notes on the steps you observe happening.

Davidson-Gerson Gallery of Glass

Through drawings or notes, represent the uses of glass that you see in the gallery.

If you could add an artifact to the gallery to represent a way you use glass, what artifact would it be?

This Unit Plan was developed by
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