Frame It in Gold

Lesson Plan

ART INSTITVTE CHICAGO

LESSON OVERVIEW

Grades: 6–12 **Duration:** 100–125 minutes

The **RLC Presents: Art + Science** video series and related curricula support middle and high school students in exploring science concepts and careers in museum conservation.This material is based upon work supported by the National Science Foundation under Grant No. OISE 1743748.

In the Lab: Frame It in Gold

In this video, frame builder and conservation technician Chris Brooks shares his path to a career in STEAM and provides a demonstration of the centuries-old art and science of gilding. Students will watch the video and respond to a brief set of reflection questions.

Frame It in Gold Lesson Plan Summary

Students will investigate physical properties of matter as they relate to frame construction and gilding. Through modeling, inquiry, and reflection, students will begin to understand how gilding and other conservation practices are informed by knowledge of a material's physical properties. Optional activities invite students to explore related concepts using the museum's collection. Engage your students in all of the activities provided, or select those most relevant to your teaching.

Driving Question

What is the best material to use when creating a frame that will be gilded?

Anchoring Phenomenon

Students will look at a video clip of a piece of gold leaf floating in the air to begin to consider the physical properties of gold and how it is used in gilding.

Lesson Objectives

Students will:

- Make observations and inferences and ask questions
- Create a model/explanation based on phenomenon, experience, and prior knowledge
- Engage with inquiry stations to learn vocabulary related to properties of matter, collect data, create diagrams, and explain phenomena
- Revise their initial model/explanation
- Reflect on their learning

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Key Vocabulary

- Gilding
- Matter
- Physical properties
- Chemical properties
- Pores/porosity
- Permeability
- Mass
- Hardness

Lesson at a Glance

1. **Video Viewing and Reflection (20 minutes)**
   Students watch a video of a museum conservator at work in his lab and reflect by responding to questions.

2. **Opening Activity: "See, Think, Wonder" (10 minutes)**
   Students make observations, inferences, and ask questions about a video clip of gold leaf.

3. **Initial Model: What is the best material to use when creating a frame that will be gilded? (10–15 minutes)**
   Students create an initial model and explain their choice of gilding material.

4. **Inquiry Stations: Physical Properties (40−60 minutes)**
   Students engage with three stations focused on physical properties of materials.

5. **Final Model: What is the best material to use when creating a frame that will be gilded? (10 minutes)**
   Students revise their initial model using their updated knowledge and understanding of physical properties.

6. **Learning Reflection (10 minutes)**
   Students choose from a variety of questions to reflect on what they learned within the lesson.

7. **Possible Extensions**
   This includes personal reflection, creative response, and exploring the collection.

Next Generation Science Standards

- **NGSS Disciplinary Core Ideas: PS1.A—Structure and Properties of Matter**
  - Different kinds of matter exist, and many of them can be either solid or liquid, depending on temperature.
  - **MS-PS1-1:** Matter can be described and classified by its observable properties).
  - **MS-PS1-2, MS-PS1-3**: Different properties are suited to different purposes).
- **NGSS Science and Engineering Practices**
  - Analyzing and interpreting data
  - Constructing explanations

- **NGSS Cross-Cutting Concepts**
    - Structure and function

National Core Art Standards

- **Connecting**
    - **Standard 10:** Synthesize and relate knowledge and personal experience to make art. Relating artistic ideas and work with personal meaning and external context.

FRAME IT IN GOLD LESSON PLAN

PREPARING THE MATERIALS

Materials

- *Frame It in Gold* video clip (minute 5:13–5:15) of gold leaf floating
- The following resource is at the end of this document:
    - Vocabulary dominoes (1 set per group)
- Piece of fabric (1 per group)
- Piece of metal without sharp edges (1 per group)
- Piece of wood, preferably sanded to minimize the risk of splinters (1 per group)
- Piece of plastic (1 per group)
- Piece of sponge (1 per group)
- Small- to medium-sized stone (1 per group)
- Balance (1 per group)
- Ruler (1 per group)
- Optional: Magnifying glass (1–2 per group)
- Water
- Cup or beaker (2 per group)

Worksheets

1 Per Student

- Frame It in Gold Student Resource
    - "See, Think, Wonder" chart (page 2)
    - Model/Explanation (pages 3, 11)
    - Gilding Inquiry Stations (pages 4–10)
    - Reflection on My Learning (page 12)
- Notebook, paper, and pencil for reflection

SET UP THE LESSON

Set Up the Lesson

1. Print the Frame It in Gold Student Resource for each student or provide them with electronic access.
2. Prepare station materials.

Station 1: Vocabulary Dominoes

Print and cut out the vocabulary dominoes. The term on each domino will **not** match its adjacent definition.

Station 2: Reflecting and Refracting Light

Gather materials for the stations, which should each accommodate a group of 4 students. Make sure each piece of material is large enough for students to easily handle and observe. If supplies are limited, a single station can be set up, and groups can rotate through.

Each group of 4 students should have:

- Balance (1)
- Ruler (1)
- Piece of fabric (1)
- Piece of metal (1)
- Piece of plastic (1)
- Piece of wood (1)
- Piece of a sponge (1)
- Stone (1)

Station 3: Porosity and Permeability

Gather materials for the stations.. The same materials used in Station 2 can be used in station 3.

Each group of 4 students should have:

- Balance (1)
- Piece of fabric (1)
- Piece of metal (1)
- Piece of plastic (1)
- Piece of wood (1)
- Piece of a sponge (1)
- Stone (1)
- Optional: Magnifying glass (1-2)
- Beaker or cup half filled with water (1)
- Empty beaker or cup (1)

FACILITATION INSTRUCTIONS

Video Viewing and Reflection (20 minutes)

1. Ask the students to answer the following question in a whole class discussion, small group, or pairs:
    - Did you know that scientists work in some museums?
    - What do you think they might do?
2. Have students watch the video *In the Lab: Frame It in Gold* (runtime: 6 minutes 42 seconds) as a class or individually.
3. Ask students to reflect on the following questions in writing, whole-class discussion, or in pairs, sharing with a partner:
    - How does Chris Brooks's work relate to both art and science?
    - What did you learn about his career path? What advice did he offer?
    - What else did you learn that is new or surprising?

Opening Activity: See, Think, Wonder (10 minutes)

1. Review the sections of the "See, Think, Wonder" chart (page 2) as a class.
   **Recommendation: Give students a concrete number of items to put in each column.*
2. Project the video clip (minute 5:13-5:15) of gold leaf for the students to view.
3. Allow the students 3 to 5 minutes to independently observe the video clip and complete their chart. Once completed, ask for volunteers to share one thing they noted.
   **Opportunity for differentiation: To simplify, complete this in pairs or small groups.*
4. Students can share observations, inferences, and questions from their charts with an elbow partner, small group, or the whole class.

Initial Model: What is the best material to use when creating a frame that will be gilded? (10–15 minutes)

1. As a class, read the introduction on gilding (page 3).
2. In pairs or small groups, students explain which material they think will work best for making a gilded frame. Students can use words, pictures, or a combination of both to explain which material they chose and why. Ultimately, this is intended to be an educated guess.
   **Opportunity for differentiation: To simplify, begin a model together as a class and let students finish it in smaller groups.*
3. Student groups share their ideas with the class. Models will be revised later.

Gilding Inquiry Stations (40–60 minutes)

- **Student Gilding Inquiry Stations** (page 4–10)

Station 1: Vocabulary Dominoes

1. At the station, students work with a set of vocabulary dominoes. Each domino has a term and a definition. The term and definition on the same domino **do not** match.

2. Students must move the dominoes around to match the correct term to the correct definition. They may need to reposition the dominoes as they connect more terms and definitions. The dominoes will create a shape when they are matched correctly.
   **Opportunity for differentiation: Match one or two terms together as a class.*
3. Students should record the definition of each term in the appropriate place on their student document.

Station 2: Physical Properties

1. Students use their observational skills and available tools (rulers, balance) to identify the physical properties of provided materials.
2. For each material provided, groups describe at least four of the following properties: color, shape, length, hardness, texture, and mass.

Station 3: Porosity and Permeability

1. Students examine the objects from Station 2 with their eyes or a magnifying glass to determine if the materials have pores and if they think they are permeable and record their thoughts and reasoning in the appropriate place on Table 2.
2. Using a balance, students measure the mass of each material and record their findings in Table 3.
3. Students place all materials in a beaker of water and let them soak for 2 minutes.
4. Students remove objects one by one from the beaker and shake off excess water into the empty beaker.
5. Students measure each object's mass post-soak and record it in the appropriate place on Table 3.
6. Next, students calculate how much water was absorbed by each material and record it in the appropriate place on Table 3. They then answer a question.
   **Opportunity for differentiation: Complete one example together.*
7. Using the water absorption data, students revise their ideas about the porosity and permeability of each material and record their thoughts and reasoning in the appropriate chart.
8. Students place the various materials in order, from least porous to most porous, and record their reasoning.
9. Finally, students order the materials from least permeable to most permeable, record their reasoning, and respond to an additional question.

Final Model: What is the best material to use to create a frame that will be gilded? (10 minutes)

1. Review the introduction of gilding (page 11).
2. In the same pairs or small groups, students revise their explanation of which material would be the best to use for gilding. Students can use words, pictures, or a combination of both to explain as thoroughly as they can.
   **Opportunity for differentiation: review as a class what was learned in each section of the lesson before students begin their revisions.*

Reflection on My Learning (10 minutes)

1. Students complete a written reflection about their learning, selecting and responding to one question from each column (page 12).

About the Conservator

Christopher Brooks works as a frames technician in Conservation and Science at the Art Institute of Chicago. In addition to gilding, Brooks's job includes assessing and documenting the condition of frames, building and repairing frames, preparing artworks for shipment and display, and moving and installing large works in the museum's galleries. He led a two-year project inventorying and creating a digital catalog of the museum's frame collection.

Brooks studied art in college when he became interested in building, studying, and repairing frames. He would like to help bring more people into the field. He says, "This was never a conversation in school, but not many people are going to make a living making paintings. There are a lot of jobs in museums and galleries that people don't know about, and not all of them require a degree, like collections care, art handling, and moving and framing."

Possible Extensions

Personal Reflection

- What connections or memories do you have related to gold in your own life? Where have you seen it—in popular culture, a loved one's belongings, or somewhere else? What does gold represent or symbolize in this situation? Describe using words or pictures.

Creative Response

- In some cultures, gold has been prized for its expense and beauty and has been used to create money or currency in the form of coins. Currency can teach us about the values of a time and place through the people and objects or symbols represented.

  Take a look at coins from your own pockets or collection. Who or what do you see? What might they represent? Design your own coin. What people and qualities do you think are most important to teach others about your own time, place and culture? How would you show that?

For Further Study

- Students seeking additional challenges could research gold within one of the cultures featured below such as ancient Rome, 19th Century France, 20th century Ghana or ancient Peru.

Explore the Collection

Explore the artwork featured in this lesson by clicking on the link below. Access the museum's full collection by browsing the collections page at https://www.artic.edu/collection.

- Francisco de Zurbarán, *Saint Romanus of Antioch and Saint Barulas*, 1638

Gold, Art, and Culture

Gold is a chemical element and is considered a precious metal that has been used to create currency, jewelry, works of art, and other special items throughout history. Gold has significance to many cultures and demand for gold has fueled trade and even warfare among nations over time.

The following art objects from the Art Institute of Chicago's collection feature gold. Some are made using gold while others depict gold. All

suggest the importance of gold within a culture, time, and place. Browse through these highlighted works and engage with the following questions.

Look carefully at the work of art and scroll down to read the information provided including the “medium” or materials used to create the work.

- What do you notice? How or where is gold used in this work?
- Does this look like or connect to anything you have seen before?
- How do you think this artist or culture might feel about gold? Why?

Works of Art

- Issued by Hadrian, *Aureus (Coin) Portraying Emperor Hadrian*, 120-123
- Yeesookyung, *Translated Vase_2015 TVGW 3*, 2015
- Egyptian, *Portrait of a Man Wearing a Laurel Wreath*, Roman Period, early to mid–2nd century
- Kerry James Marshall, *Africa Restored (Cheryl as Cleopatra)*, 2003
- Rembrandt van Rijn, *Old Man with a Gold Chain*, 1631
- Sèvres Porcelain Manufactory, *Londonderry Vase*, 1813
- Coclé, *Filagree Pendant in the Form of a Frog or Toad*, 500–1000
- Chimú, *Ceremonial Knife (Tumi)*, 1100–1470
- Asante, *Pectoral Disk (Akrafokonmu or Awisiado)*, early to mid-20th century

Video Viewing and Reflection

- How does Chris Brooks's work relate to both art and science? *Answers vary but may include: Chris uses his knowledge of the properties of materials including gold and wood to restore art frames.*
- What did you learn about his career path? What advice did he offer? *Answers vary*
- What else did you learn that is new or surprising? *Answers vary*

See, Think, Wonder Opening Activity

Answers vary

Initial Model: What is the best material to use to create a frame that will be gilded?

Answers will vary as this is intended to be an educated guess. Answers will be revised later.

Station 1: Vocabulary Dominoes

The dominoes should make the shape of a frame, with the vocabulary word appropriately placed by its definition:

- Gilding: *Applying very thin sheets of gold to a surface*
- Matter: *Substances that have mass and take up space*
- Physical Property: *A property of material that is measurable*
- Chemical Property: *A property of a material that appears during or after a chemical reaction*
- Pore: *Small spaces or holes in a substance that air or water can enter*
- Permeable: *The physical property that describes the ability of water to move through a material*
- Mass: *Amount of matter in an object*
- Hardness: *The physical property that measures the ability of a material to not be scratched*

Station 2: Physical Properties

Using the items provided at the station, complete the physical properties chart for each material. *Answers may vary depending on the specific materials available for the station.*

Station 3: Exploring Porosity and Permeability

**Note: Generally, fabric, sponge, and wood will be porous while stone, metal, and plastic will not. However, this may vary depending on the specific materials the teacher sources for the lesson.*

1. Examine each object with your eyes or a magnifying glass and decide if you think it has pores and if it is permeable. *Answers vary as these are based on students' educated guesses through observation.*
2. Record the mass of each material in grams and record it in the "Mass before soaking" column in the table below. *Answers vary depending on the specific materials available for the station.*

5. Measure the mass of each material in grams and record it in the "Mass after soaking" column in the table below. *Answers vary depending on the specific materials available for the station, but the following materials will likely be noticeably heavier: fabric, wood, sponge.*
6. Calculate the mass of water absorbed in each material. *Answers vary depending on the specific materials available for the station, but the following materials will likely have absorbed water: fabric, wood, sponge.*
    - Do you think the mass of water absorbed by any of the materials would be different if it soaked in the water longer than 2 minutes? *Answers vary, but students should notice that fabric, wood, and sponge may be heavier if they soaked longer since they absorbed water in this experiment.*
7. Use your initial observations, and mass data to make conclusions about the porosity and permeability of each material.

    **Note: The following are the anticipated responses, however, answers will vary depending on the materials used.*

    - Fabric - *yes - The mass became heavier after soaking in water*
    - Metal - *no - The mass did not become heavier after soaking in water*
    - Plastic - *no - The mass did not become heavier after soaking in water*
    - Wood - *yes - The mass became heavier after soaking in water*
    - Sponge - *yes - The mass became heavier after soaking in water*
    - Stone - *no - The mass did not become heavier after soaking in water*
8. Put the materials in front of you (fabric, metal, plastic, sponge, wood, stone) in order starting with the material with the least pores to the one with the most pores. *Answers may vary but should align with data collected.*
    - Why did you place them in this order? *They are placed in an order from least amount of water retained to most. The more water retained, the more permeable they are, meaning they have more pores.*
9. Put the materials (fabric, metal, plastic, sponge, wood, stone) in order in front of you from least permeable to most permeable. *Answers may vary but should align with data collected.*
    - Why did you place them in this order? *They are placed in an order from least amount of water retained to most. The more water retained, the more permeable they are.*
10. Based on what you learned in your experiment, how do you think the physical properties of porosity and permeability relate to one another? *The more porous a material, the more permeable it is.*

Final Model: What is the best material to use to create a frame that will be gilded?

Revisions may vary but should include: Wood is the best material to make a gilded frame because it is the most porous of the listed materials, so it will hold the gold best in the water gilding process.

Learning Reflection

Answers vary

ADDITIONAL TERMS FROM THE VIDEO

Bole: Made of refined, colored, clay bole creates the surface the gold leaf sticks to and allows it to be buffed to a warm, bright finish.

Gesso: A liquid mixture of finely crushed chalk and rabbit skin glue that is applied to a wooden frame to create a smooth, hard surface before gilding.

Gold leaf: An extremely thin layer of gold.

Solution: A mixture of two or more substances that stay evenly mixed.

VOCABULARY DOMINOES

✂

Gilding	**Matter**	**Physical Property**	**Chemical Property**
A property of a material that is measurable	Applying very thin sheets of gold to a surface	Small spaces or holes in a substance that air or water can enter	The physical property that describes the ability of water to move through a material
Pore	**Permeability**	**Mass**	**Hardness**
The amount of matter in an object	The physical property that measures the ability of a material to not be scratched	A property of a material that appears during or after a chemical reaction	Substances that have mass and take up space