



You Can't Fool Me!

8th Grade

Duration

2-3 classes and a
Museum visit

Location

Classroom and Gem &
Mineral Hall

Supplies

- See individual lessons

Standards

Science 8.7.a.c

Social Studies 7.7.11.1.2

CCS ELA Grades 6-12:

Reading Standards for
Literacy in History/

Social Studies 1.2.4.7

Reading Standards for
Literacy in Science and
Technical Subjects 3.4

Vocabulary

Ore

Smelt

Privateer

Physical Property

Chemical Property

Density (specific gravity)

Streak

Color

Transparency

Luster

Cleavage

Double refraction

Hardness

Fluorescence



Student Work

Module Overview

This module explores how we use the chemical and physical properties of matter to identify unknown substances.

Module Purpose

This lesson engages students in the study of chemical and physical properties of matter by revealing their application to real life situations.

Module Outline

1. In one pre-visit session students read a historical account of Martin Frobisher, an English seaman who mistook pyrite for gold and shipped over one-thousand tons of it back to Queen Elizabeth I. This stage reviews 7th grade social studies content and part of the 8th grade California Standards Test
2. During a visit to the Museum students learn about some of the different chemical and physical properties scientists observe to classify and identify matter.
3. In one to two post-visit sessions, students learn the definitions of chemical and physical properties and relate the knowledge they gained at the museum to the story of Sir Martin Frobisher. They then apply their learning in a lab by identifying an unknown substance.

Module Prerequisite Skills & Concepts

- Students make qualitative and quantitative observations.
- Students can distinguish between an observation and an inference.

Assessment Opportunities

Lesson/Phase	Before and During the Lesson		End of Lesson
	<i>Uncovers Student Ideas</i>	<i>Checks for New Understandings</i>	<i>Evaluates Learning</i>
Pre-Visit	The Pirate Frobisher and His Golden Mistake	The Pirate Frobisher and His Golden Mistake	
Museum		Gem and Mineral Hall Discoveries	Mineral research project
Post-Visit		Informal observations	Identifying an Unknown

References and Resources

Using Dissolving to Identify an Unknown Lesson Plan. Middle School Chemistry.com
<http://www.middleschoolchemistry.com/lessonplans/chapter5/lesson5>

Martin Frobisher." Martin Frobisher. N.p., n.d. Web. 25 June 2012.
http://www.east-buc.k12.ia.us/00_01/Exp/mf/mf.htm

Neathy, L. (1983, December). Martin Frobisher (ca. 1540-1594). *Arctic* , 36 (4), pp. 374-375.

"Sir Martin Frobisher". Encyclopædia Britannica. Encyclopædia Britannica Online. Encyclopædia Britannica Inc., 2012. Web. 25 Jun. 2012
<http://www.britannica.com/EBchecked/topic/220573/Sir-Martin-Frobisher>

University of Toronto. "Sir Martin Frobisher." - Dictionary of Canadian Biography Online. University of Toronto, 2000. Web. 25 June 2012.
http://www.biographi.ca/009004-119.01-e.php?&id_nbr=230



Background

Pre-Visit

Duration

30-60 minutes

Location

Gem & Mineral Hall

Supplies

- Worksheet
- Pencils
- Optional maps, pictures, videos, etc.

Purpose

This lesson engages students in the concepts they will study at the Museum by making them relevant and introducing problems for students to solve. It also provides students with an opportunity to review previously learned content.

Objectives

- Students will summarize the events of three voyages of Sir Martin Frobisher to North America.
- Students will explain how the discovery of "black gold" influences Frobisher's voyages.
- Students will brainstorm methods by which one could distinguish between pyrite and gold.
- Students state that scientists can use the physical and chemical properties of matter to identify unknown substances.

Outline

1. Give students 5 minutes to begin working on the worksheet. Then, have them share responses with neighbors, then the class. Write their ideas for "why the mistake occurred" on the board, looking for patterns.
2. Introduce the reading "Sir Martin Frobisher activity. Based on students needs, complete the reading and questions using your preferred method (whole group, small group, independently).
3. Have students share their ideas for how the Royal assayer might have been able to tell the difference between real gold and Fool's gold. Write their ideas on the board.
4. Explain that scientists trying to identify an unknown substances observe physical and chemical properties. A property is a characteristic or trait. Have students name properties of gold. It is not important to distinguish between chemical and physical properties at this point.

5. Explain that when students visit the Museum, they will learn about more properties that can be used to identify substances.
6. Go over your behavioral and academic expectations for your trip to the Museum and explain the activities students will be completing while there.

Example Supplemental Materials





1,300 tons =



X
35



Mistaken Identity

Have you ever been involved in a case of "mistaken identity?" Did you mistake someone (or something) for someone else? Or maybe *you* were mistaken for someone else? What happened? What might have caused the confusion?

The Pirate Frobisher

Read the passage below, and answer the questions.

In the time of Queen Elizabeth, pirates were a dangerous menace on the high seas. Though many English ships were robbed and fortunes lost, there was a legal form of piracy called privateering. Queen Elizabeth gave permission for privateers to attack the treasure ships of enemy nations of England, such as France and Spain. One such privateer was a man named Martin Frobisher. Frobisher was the sixteenth child born in his family. Even as a child, he was known for being not only courageous, but also uncontrollable and reckless. He was never very interested in school, and quit when he was a teenager to become a privateer.

Like many privateers of the day, Frobisher was also an explorer. Trading with other nations was of great importance to the English throne, so privateers were sometimes ordered to search for faster, better routes. Queen Elizabeth was desperate to find a channel to Asia that traveled above America, known today as the Northwest Passage. The ambitious Frobisher decided that he would be the one to find such a passage, and after receiving an order from Queen Elizabeth, he set sail.



On his first voyage, Frobisher explored Greenland and the Arctic regions of Canada. While searching for the Northwest Passage, he sailed around Baffin Island and discovered an estuary that would eventually be named in his honor--Frobisher Bay. He and his team of explorers landed on an island, where they met an Inuit tribe who were uneasy with his aggressive attitude. Distrusting Frobisher, the tribe captured five of his men. Although he failed to free his men, some of the crew found a mysterious substance they called "black earth" as they were escaping. *(Continued on next page)*

When the crew returned to England, rumors broke out that the "black earth" was actually gold. Frobisher was able to secure funds for a second voyage partly because of the supposed gold. On this second trip, the group returned to Frobisher Bay and spent most of their time collecting the alleged gold ore. They returned to England with 200 tons of the mystery substance, and Queen Elizabeth commissioned a third expedition, which set off before the ore could be smelted, the process of extracting metal from raw material.

Key Terms

- Privateer
- Northwest Passage
- Ambitious
- Estuary
- Ore
- Smelt
- Fleet
- Pyrite

Even though the ore had not been confirmed as gold, the Queen had great faith in the project, and the third fleet was much larger than the earlier two. While the first two fleets consisted of three ships, the second was made of fifteen--enough to establish a colony on the island as well as carry back a much greater amount of ore. Though the prospects looked good, disaster struck. Just after the crew sighted Frobisher Bay, the fleet faced both deadly ice and fearful storms. Frobisher attempted to navigate up the Hudson Strait, but when this proved to be a dead end, the fleet had to turn back and follow the original route. The settlement was unsuccessful--perhaps due to the terrifying nature of the journey there. Though the colony failed, a large quantity of the mystery ore, (1,100 tons), was shipped back to England.

Here is where Frobisher's fortunes took yet another turn for the worse. While the expedition was gone, the mystery ore from the first two voyages was smelted. Instead of gold, the ore was actually pyrite, otherwise known as Fool's Gold. The ore that Frobisher had worked so hard for was utterly worthless, and his reputation fell to pieces.

Interestingly, the court's Royal Assayer, (who in modern days would be known as a geologist), correctly identified the original samples as pyrite. The court ignored this advice and instead continued the project under the council of an Italian assayer. The useless pyrite was used to pave the streets of London, and Martin Frobisher narrowly avoided being thrown in jail over the mistake. Desperate, the expedition's backers asked Frobisher to make yet another journey, assuming he had mined the wrong area. Disheartened and cautious, Frobisher said no. Despite his struggles with "black earth" and the Northwest Passage, Martin Frobisher went on to lead one of the four English naval squadrons against the Spanish Armada, which led to a period of great prosperity for England. He was knighted in honor of his actions during the defeat of the Spanish Armada.

Reading Questions

1. What is a privateer?
2. How is this different from a pirate?
3. What do you think the "enemy nations" thought of privateers?
4. What was the Northwest Passage? Does it exist?



Observation

Museum Visit

Duration

30-45 minutes

Location

Gem & Mineral Hall

Supplies

- Worksheet
- Clipboards with LED or similar lights (optional: it is quite dark in the Mineral Hall)
- Pencils

Purpose

The Museum visit allows students to authentically observe properties of matter and practice inquiry skills such as observation and classification.

Objectives

- Students will identify and define properties used to identify and classify minerals and gems.
- Students will describe qualitative properties of a mineral or gem they find at the museum.
- Optional: Students will use the periodic table to explain trends in the properties of minerals by group.

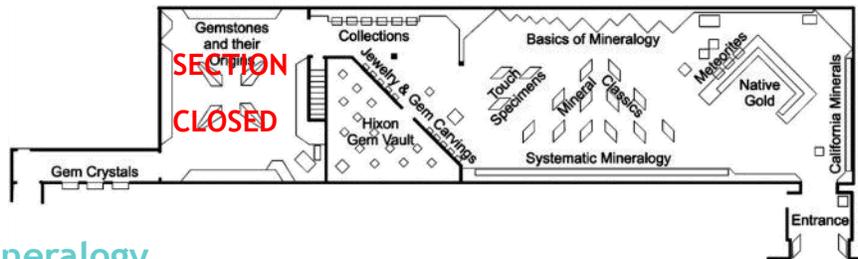
Outline

1. Verbally call on students before entering the hall and ask: What are the expectations for our visit?
2. Assign students to groups of 2-3 before arriving at the Museum. You may want to assign different groups different properties to focus on or take out some of the activities outside of the "Basics of Mineralogy" if you do not have a lot of time.
3. **Whole Group:** Gather students in front of the hall, pointing out the layout of the hall. Each group should start in a different part of the hall to avoid clumping. Make sure each group knows where to start and what time and where the class will meet up again. (5-10 min)
4. **Small Group:** Students work in groups to complete the assignment, observing the exhibits as they go. (30 min)
5. **Whole Group:** When it is time, gather the class back at the entrance to the exhibit.
6. **Small Group:** Either on the bus or back in class, allow students time to share their results with another group or two.



Observing Minerals

Gem & Mineral Hall



Basics of Mineralogy

Color and Streak

1. Read about the differences between mineral *color* and *streak*. Which one is a better property for identifying an unknown mineral? Why?
2. Choose one of the minerals in the display and observe it closely. Describe the difference between its color and its streak.

Transparency and Luster

3. Study the minerals in this display that show the property called *transparency*. Draw a picture below representing the difference between *translucent*, *transparent*, and *opaque* minerals. Be sure to label your drawings.

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4. What are some of the words used to describe different types of luster?

3. If you have studied the periodic table, do you notice any trends like those in the periodic table in the luster of minerals? If so, what do you notice?

Cleavage and Double Refraction

4. Draw a picture of two different cleavage patterns.

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5. Draw a picture of double refraction

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6. Think back to 7th grade science, what is refraction and why does it happen?

Specific Gravity and Hardness

7. Specific gravity is similar to density. How could we use density to help us identify an unknown substance?



- 8. What is the Mohr scale?

- 9. What substance is a 10 on the Mohr scale?

- 10. Does anything in the display surprise you?

Gemstones and their Origins

11. Read the informational panels and observe the gemstones in this display. Be especially observant of the information for specific gems. Fill in the table below with data on the properties of gemstones created in different environments.

Gem	Environment	Properties

Meteorites

12. What properties are used to identify real meteorites?

13. Do you think YOU would be able to tell a rock from a meteorite? Why or why not?

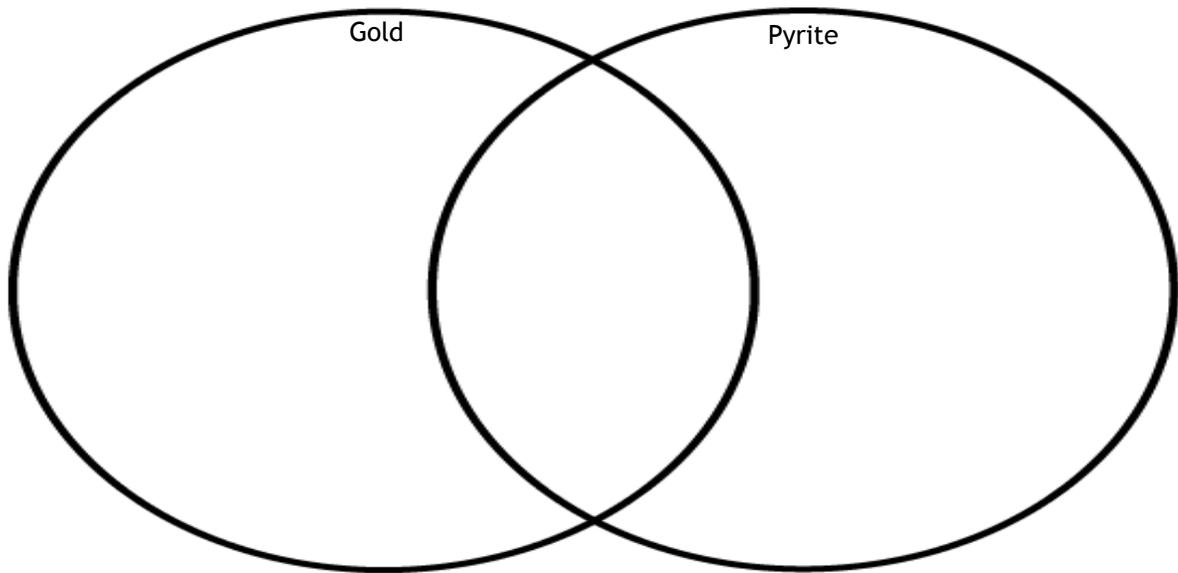
Native Gold

14. List some of the properties of gold.

15. Draw a picture of each different form of gold:

Crystals	Leaves	Trees	Wires
Specks	Nuggets	Dust	

16. Compare and contrast gold and pyrite:



The Remaining Displays

17. Find your favorite gem or mineral. What is it called?

18. Observe as many of its properties as you can, describing them below. Draw a picture as well if you would like.

At Home

Research your mineral, identifying more of its properties. Then, choose one of the following products to demonstrate your knowledge:

- Create a poster or brochure of your mineral.
- Write a story or comic strip about your mineral, in which it is the "superhero," using its properties as inspiration for its superpower.
- Create a PowerPoint, Keynote, or Prezi presentation to share with the class.
- Create a fake Facebook page for your mineral
- Write a song or poem about your mineral



Experimentation

Post-Visit

Duration

1–2 classes

Location

Gem & Mineral Hall

Supplies

- See lab "Using Dissolving to Identify an Unknown" <http://www.middleschoolchemistry.com/lessonplans/chapter5/lesson5>

Purpose

Following the visit to the Museum, students learn about the properties of matter in more detail and apply their knowledge to a laboratory investigation. This phase introduces concepts, ideas, skills, relationships and explanations while either verifying or validating students' ideas or challenging their alternative concepts.

Objectives

- Students will present possible answers to others and listen critically to another students' explanations.
- Students will accurately apply their knowledge of the properties of matter to identify an unknown substance.

Outline

1. At the beginning of class, invite students to list the properties of matter they found at the Museum. Write these on the board. You may want to introduce the terms chemical and physical properties at this time and have students distinguish between the two.
2. Ask, "How could Frobisher or Queen Elizabeth have used this information to their advantage 435 years ago?" "How can we use this information now?"
3. Introduce the lab activity, *Identifying an Unknown Using its Physical Properties*. There are many pre-written lab activities available for download that cover this premise. One you may consider using is "Using Dissolving to Identify an Unknown" from [middleschoolchemistry.com](http://www.middleschoolchemistry.com/lessonplans/chapter5/lesson5), it can be found at <http://www.middleschoolchemistry.com/lessonplans/chapter5/lesson5>.

You may wish to alter the activity to take out some of the emphasis on solubility if you have not yet studied that with your students. You could also extend the identification process to include conductivity if you have the equipment to do so.