COMMON CORE CONNECTION
PROBLEMATIC METALS

NEXT GENERATION SCIENCE AND ENGINEERING PRACTICES

Practice 1 Asking Questions and Defining Problems

Practice 4 Analyzing and Interpreting Data

Practice 6 Constructing Explanations and Designing Solutions

Practice 8 Obtaining, Evaluating, and Communicating Information

COMMON CORE STANDARDS

CCSS.ELA-LITERACY.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

CCSS.ELA-LITERACY.RST.6-8.3 Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

OVERVIEW

The conservation laboratory at the Walters Art Museum has recently investigated a technique called atomic layer deposition (ALD) that reduces silver corrosion and oxidation. Students will learn about the problem of tarnishing of museum objects as well as the Walters' work on ALD through a video clip and/or article. Then students will experiment with various metals in solutions to theorize which metals might prove challenging to museum conservators and why.

TIME FRAME

Preparation 10 days

Active time 1 class period

SUPPLIES

- Walters video clip and/or article, "Saving Silver" found at http://articles.thewalters.org/saving-silver/ (running time: 2:31 minutes)
- Printed or digital copies of Saving Silver Worksheet
- Printed or digital copies of *Walking Lion; Striding Lion (Racing Trophy)* (27.167)
- 6 cm of brass wire cut into 2 cm sections
- 6 cm of silver wire cut into 2 cm sections
- 6 cm of steel wire cut into 2 cm sections
- 6 cm of copper wire cut into 2 cm sections
- 12 test tubes
- Distilled water
- Salt water solution (240 ml to 1 tablespoon of salt)
- Funnel

BACKGROUND

❶ Introduce students to the work that conservators do at the Walters Art Museum. Explain that one method that conservators use to clean works of art is the removal of tarnish from metal. Show students examples of what tarnished metal looks like.

❷ Show students *Walking Lion; Striding Lion (Racing Trophy).* This artwork is an example of an elaborately-shaped silver sculpture that would benefit from a new tarnish-prevention technology that the Walters is currently investigating. This sculpture (made in 1865) has been cleaned and lacquered twice since 1949, but ultimately experienced deterioration problems with its coatings. It is currently unlacquered but must be kept in a special exhibition case to ward off tarnish.

❸ Explain how oxidation occurs and causes tarnishing, tailoring this to the age and level of your students, as well as using curricular objectives and assessments as guidelines.

❹ Students will watch a video and/or read the article about the new technology that the Walters Art Museum is developing and testing to prevent oxidation of silver artworks. Have students complete Saving Silver Worksheet.

PREPARATION FOR LESSON

**Prior to lesson, teachers should set up metals in labeled test tubes. Each 2 cm wire should show examples of submersion in an empty test tube, a test tube filled with distilled water, and a test tube filled with the salt solution at 4 days and 10 days.

❶ Using the information provided in the video, students should design a lab to determine which metals would be problematic in a museum environment. Discuss how best to test metals in varying levels of humidity. In addition to moisture, what corrosive salts might be in the air? Why?
❷ Students should prepare 3 test tubes per type of wire: distilled water, salt water, and an empty test tube.
❸ Students should set up a table for data collection. A sample chart has been provided. They will examine their metals at the end of the class (1 day) and note observations. Students should also examine and note observations from the teacher samples from 4 days and 10 days.
❹ After the observation period, students should share and discuss their results. Possible discussion questions include: What materials seem the most problematic? What would happen if observation continued? Since museums are not underwater, how does submersing the metal in water suggest real-world problems for conservators? How can these problems be prevented? What ethical questions arise when determining treatment options?

EXTENSIONS

- Visit http://articles.thewalters.org/conservation/ to see other conservation techniques and projects that have been done recently at the Walters Art Museum.
- Have students remove tarnish from other metal objects using a variety of tarnish-removing substances.
- Have students oxidize metal objects in order to see how they become tarnished.

27.167

Name _____ Date _____

SAVING SILVER WORKSHEET

DIRECTIONS
Answer the questions either by watching the video or reading the article "Saving Silver" found at http://articles.thewalters.org/saving-silver/.

1. WHY is tarnishing a problem for objects in the museum?

2. WHY isn't polishing a viable solution to prevent tarnishing?

3. HOW do conservators currently prevent tarnishing?

4. HOW will they test atomic layer deposition (ALD)? Describe one way.

5. WHEN will this new tarnish-prevention technique be used?

Name _____ Date _____

SAMPLE DATA SHEET

METALS IN DISTILLED WATER

DAY	BRASS	SILVER	STEEL	COPPER
1				
4				
10				

METALS IN SALT WATER SOLUTION

DAY	BRASS	SILVER	STEEL	COPPER
1				
4				
10				

METALS IN EMPTY TEST TUBE

DAY	BRASS	SILVER	STEEL	COPPER
1				
4				
10				