Lesson Title	Investigating the Statue of Liberty Disintegration
Length of Lesson	2 days
Created By	Hannah Box
Subject	Chemistry
Grade Level	9-12
State Standards	5a, 7h
DOK Level	III
DOK Application	Compare, Investigate, Differentiate, Cite Evidence
National Standards	B. Physical Science
Graduate Research Element	In organometallic chemistry, the oxidation of metals can be harmful to reaction processes.

Student Learning Goal:

Oxygen is very reactive, especially when dissolved in water. Students will see how metals change when exposed to oxygen rich water and acidic water (mimicking polluted, moist atmosphere of New York Harbor).

State Standards:

5a. Describe what determines covalent, ionic, and metallic bonds.
7h. Identify redox reactions by recognizing the species that are oxidized and reduced.

National Standards: B. Physical Science:

A large number of important reactions involve the transfer of either electrons (oxidation/reduction reactions) or hydrogen ions (acid/base reactions). Chemical reactions can take place in time periods ranging from the few femtosec- onds (10·15 seconds) required for an atom to move a fraction of a chemical bond distance to geologic time scales of billions of years. Reaction rates depend on how often the reacting atoms and molecules encounter one another, on the temperature, and on the properties- including shape-of the reacting species.

Materials Needed (supplies, hand-outs, resources):

40 pennies (1983 or earlier), Vinegar, Table salt, 40 twist ties, 40 beakers, 40 petri dishes, 40 plastic cups, steel wool.

Lesson Performance Task/Assessment:

Students will perform a laboratory exercise involving oxidation and relate that to a historic example.

Lesson Relevance to Performance Task and Students:

Oxidation-reduction reactions occur around us all the time. How do you keep your jewelry from oxidizing? How do you keep your bike from rusting? By keeping it away from oxygen-saturated water!

Anticipatory Set/Capture Interest:

Use the overhead projector for demonstration:

- Set wedding ring inside petri dish.
- Take a beaker of hydrogen peroxide and pour into petri dish.
- Watch oxidation of "white" gold.

Guided Practice:

1. Which metal "rusted" the most? Why do you think that happened?
2. What conditions are necessary for oxidation-reduction reactions to occur with metals?
3. Would "rusting" occur in an oxygen-free environment? (trick question).

Independent Practice:

1. Fold a paper towel to line the bottom of the beaker.
2. Drip water onto the paper towel and sprinkle table salt to mimick the atmosphere around the statue of liberty.
3. Add a few drops of vinegar to the paper towel to mimick the acid pollution experienced by the statue of liberty, due to industrial processes occurring around the harbor.
4. Clean pennies by scrubbing the edges with steel wool until shiny.
5. Polish metal from inside twist ties with steel wool until shiny.
6. The wires are the iron structural bars inside the statue of liberty. The pennies represent the copper covering of the outside of the statue. Wrap one wire tightly around the penny. Wind the other wire around a pencil and make a tight coil, then gently slide the coil off the pencil.
7. Place the iron-wrapped penny, a plain penny, and the wire coil onto the paper towel. Make sure the metals do not touch each other!
8. Cover the beaker with clear plastic wrap to keep the ocean-like environment within the beaker. Leave overnight.
9. Record observations the next day.

Remediation and/or Enrichment:

Remediation:
Individual IEP. Work in larger groups or do the experiment together as a class.

Enrichment:

Have students bring in nails, hammer them into wood and do a long-term experiment on oxidation of different types of nails.

Check(s) for Understanding:

Review observations as a class discussion.

Closure:

Discuss how the pennies relate to the statue of liberty. Size doesn't matter; the chemistry is still the same.

Possible Alternate Subject Integrations:

History: This would be a fun activity for the teacher to show in a social studies/history class.

Teacher Notes:

Oxidation and Reduction/Metals. The Educational Film Center in association with the University of Maryland.