Patina Stories: Chemical Change and Copper Oxidation on the Statue of Liberty (10th Grade, ELL Advanced)

Prompt

Develop a 10th-grade chemistry lesson plan about the Statue of Liberty's color and the chemical changes to the copper skin over time for English language learners with Advanced English proficiency. Include scaffolds such as sentence starters, graphic organizers, word banks, and multilingual glossaries in English and Haitian Creole.

Engage

- **Phenomenon prompt (whole class, 10 minutes):** Show two images side-by-side — (a) newly polished copper (bright metallic orange) and (b) the Statue of Liberty's green exterior. Ask students: "Why is the statue green now if it was built from copper?" Use a short, 60–90 second teacher narration that includes the key vocabulary listed below.
- **Quick think-pair-share (5 minutes):** Students turn to a partner. Using the sentence starter: "I think the statue turned green because ____" each student shares one idea. Partners write one question they have about what caused the color change.
- **Scaffold:** Display a word bank and visual timeline (construction → early brown/orange copper → weathered green patina). Provide bilingual mini-glossary (English / Haitian Creole) and sentence starters on the board.

Sentence Starters (scaffold)

- "I notice ___."
- "I think this happened because ___."
- "My evidence is ___."
- "A question I have is ___."

Word Bank (English → Haitian Creole)

- copper — kwiv
- oxidation — oksidasyon
- patina — patin
- react/chemical reaction — reyaji / reyaksyon chimik
- corrosion — korozyon
- air/oxygen — lè / oksijèn
- water/moisture — dlo / imidite
- carbonate — kabonat
- sulfate — sulfaat

Multilingual glossary note: Display on one slide or handout the English term, Haitian Creole equivalent, and a one-line definition in both languages.

Explore

Hands-on lab stations (2 class periods; partner work; 35–45 minutes each)

Station 1 — Simple copper oxidation (safe, teacher-supervised)

- **Materials per pair:** small copper strip or penny (if allowed), shallow dishes, vinegar, salt, distilled water, droppers, tweezers, safety goggles.
- **Procedure (students follow checklist):** Place copper sample in dish; add solution (vinegar + salt) or plain water for control; observe immediately and at 10-minute intervals; record color/texture changes and time.
- **Data recording:** use a two-column observation table (time / appearance). Provide a sentence-frame: "At time ___ minutes, the copper looks ___ because ___."

Station 2 — Model patina formation (mini "weather" box)

- **Materials per pair:** small copper sample, sponge, container with damp paper towel, cotton swab, small labeled containers for acid (vinegar) and salt water; timer.
- **Activity:** Create a moist, oxygen-rich environment for accelerated corrosion; check after set intervals.
- **Comprehension Check:** Students sketch before/after images on provided graphic organizer (Observation Sketch → Description → Possible Cause).

Station 3 — Comparing metals (extension for faster groups)

- **Materials:** small samples (or pictures) of copper, iron, aluminum; dilute salt water spray; students compare which metals corrode and how.
- **Partner roles (rotate):** Observer/Recorder, Reporter/Presenter, Materials Manager, Safety Monitor. Provide role checklist cards.
- **Scaffolds:**
    - Graphic organizer: 3-column table (Observation | Evidence (what I see) | Claim (short sentence using word bank))
    - Guided inquiry questions on worksheet:
        - "What changes do you notice first?"
        - "Which conditions (moisture, salt, acid) speed up the change?"
        - "How would you test whether oxygen is required?"
    - Sentence frames for lab discussion:
        - "We observed ___ when we added ___."
        - "This suggests that ___ is causing the change because ___."

Explain

Whole-class synthesis (30 minutes)

Student-presented findings: Each partner pair gives a 2–3 minute report using frames: "Our procedure was ___. We observed ___. We think the chemical cause is ___."

Teacher-led mini-lecture (10 minutes): Link student observations to chemistry:

- Explain oxidation of copper: formation of copper oxides, then copper carbonate and copper sulfate in presence of air and pollutants; introduce the term patina as a protective layer.
- Model with a simple reaction equation (display on board; students have printed copies and bilingual glossary). Wrap key expressions in accessible language.

        - Example reaction description (teacher reads aloud, students see printed forms in both languages):
            - Copper reacts with oxygen and water to form copper(II) oxide and then reacts with carbon dioxide and other compounds to form green copper carbonate (patina).
            - Emphasize that patina is both a chemical change and a protective layer that slows further corrosion.

- Language scaffolds:
    - Sentence starters for explanations: "The data shows ___. This supports the idea that ___ because ___."
    - Provide a completed example organizer and an example short paragraph (academic model) in English and Haitian Creole.

Important teacher note: Use accessible visuals (diagram of copper surface reacting with oxygen, water, and pollutants) and allow students to annotate using bilingual labels.

Elaborate

Extension project (2–3 class sessions; partner work; project-based)

Option A — Heritage & Chemistry

Research the Statue of Liberty's history and write a short multilingual brochure (English + Haitian Creole) explaining how the statue's color changed and why it's important to preservation.

- **Tasks:** Research brief (teacher-provided articles), create a two-sided brochure (side 1: science explanation; side 2: cultural/historical significance and preservation efforts).
- **Scaffolds:** Brochure template, sentence frames for each section, word bank, checklist for scientific accuracy.

Option B — Preservation Design Challenge:

- **Prompt:** "Design a plan to preserve a copper statue in a coastal environment while maintaining its historical appearance." Partners propose a solution, model costs/benefits, and present to class.

- **Criteria rubric** (teacher-provided): scientific accuracy, feasibility, cultural sensitivity, clarity of communication (bilingual summary).
- **Cross-curricular tie:** Social Studies/History connection—discuss why the patina is part of the statue's heritage and what preservation means for public monuments.

Elaborate language supports:

- Graphic organizer for brochure (Title | Science Explanation (3 sentences) | Why it matters (2 sentences) | Preservation ideas (bullet list)).
- Sentence frames: "One way to protect copper is ___. This is helpful because ___."

Evaluate

Formative assessments (ongoing)

- Exit ticket (end of a class): 2–3 short prompts (one in English, one in Haitian Creole optional):
  - "Explain in 2–3 sentences why the Statue of Liberty is green now." (Use word bank)
  - "List two conditions that speed up copper corrosion."
- Lab notebook checks: teacher reviews observation tables and claims for evidence-based reasoning. Use a short rubric with feedback comments.
- Peer check: pairs swap lab sheets and use a checklist to verify that claims are supported by observations.

Summative assessment (end of unit; partner + individual components)

- **Part A (partner presentation):** 3–5 minute presentation or digital slide (partners present lab results and propose a preservation idea). Assess with rubric (science accuracy, use of evidence, clarity, bilingual elements).
- **Part B (individual written task):** Short explanatory paragraph (4–6 sentences) in English describing the chemical changes of copper and explaining why patina formed; include one diagram label. Provide sentence starters and the word bank.
- Optional language assessment alignment: Provide an oral interview in which the student explains the process using the vocabulary and sentence frames.

Rubrics and Feedback

- Provide rubrics with clear performance levels for science content and language use (content accuracy, use of evidence, vocabulary usage, and clarity). Include space for teacher comments and student self-reflection.

Assessment Scaffolds (for ELLs)

- Allow use of Haitian Creole glossary during assessments.
- Provide reduced-length prompts and paragraph frames.
- Offer choice of demonstration modes: oral, written, or illustrated explanations.

Safety and Accommodations

- Safety: goggles required; teacher handles any acids or potentially hazardous materials. Substitute demonstration for stations if materials not permitted.
- Accessibility: Provide printed materials in larger font, digital copies compatible with screen readers, and extended time as needed.

Classroom timeline (approx.)

- Day 1: Engage intro + Lab Station setup + Begin Explore (Station rotation)
- Day 2: Complete Explore + Analyze data
- Day 3: Explain (presentations + mini-lecture)
- Day 4: Elaborate project work (brochure/design) in partners
- Day 5: Presentations + Evaluate summative tasks

Materials checklist (per pair and teacher)

- Copper samples (strips or pennies), shallow dishes, vinegar, salt, distilled water, droppers, tweezers, safety goggles, station instruction cards, graphic organizers, bilingual glossary handouts, rubric copies, devices for research (optional), poster/brochure paper, markers.

Differentiation suggestions

- Advanced students: design and run an extra trial to test the role of pollutants (e.g., sulfates) or quantify rates of color change.
- Struggling students: provide sentence frames with fill-in-the-blanks, and allow oral reporting instead of written.
- Translation supports: permit students to plan in Haitian Creole and produce final product in English with bilingual captions.

Aligned Standards

- NGSS (selected, high-school level alignment): "Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation." (Use this NGSS cluster tie to the idea of environmental processes influencing materials over time and to modeling chemical change. If you prefer a closer chemical reaction standard, use the HS-PS1 or HS-ESS2 related standards.)
- WIDA English Language Development (ELD) Standard (brief alignment): Focus on Collaboration, Academic Language for Science, and the ability to "Construct and present oral and written explanations of grade-appropriate scientific phenomena." (Use WIDA ELD standards for supports in language objectives, especially for productive (speaking/writing) and collaborative tasks.)

Review this closely for accuracy, especially in chemistry descriptions and standard codes; adapt the precise NGSS/WIDA standards codes per your state or district expectations as needed.