

COPPER CONNECTS US



ACTIVITY | Grades 6–8

Video Topic Series Episode: Innovation

Overview

Throughout *Copper Connects Us*, a five-part Video Topic Series, students will explore how copper is a natural resource essential for helping the world meet its future environmental, economic and societal needs. In this special *Innovation* segment, students will learn about the techniques and technologies used in copper mining to enhance safety, efficiency, and sustainability.

The accompanying activity included here will reinforce learning from the video by deepening students' understanding of copper leaching through a hands-on activity and discussion. It also will strengthen and extend learning from the video by helping students explore copper innovations that improve sustainability, increase safety and efficiency and advance technology.

Learning Objectives

Students will:

- **Experiment** with separating salt from sand and **design** a method to do so
- **Explain** how the separation method they created compares to the copper leaching process
- **Examine** and sort various copper innovations to demonstrate their understanding of innovation within the industry

Materials*

For groups of three or four students:

- Mixture Cup: a cup containing a mixture of about one cup of sand and three tablespoons of table salt
- Coffee filters, several
- Water, warm and cold
- Bowl
- Tweezers[†]
- Magnets[†]
- Paper towels[†]
- Magnifying glass[†]
- Strainer[†]
- *Copper Connects Us: Innovation* video, to show students
- Copper Innovation Cards (cut out in advance), one set for student pairs

[†]The entire class also may share these items.

*Estimated average cost as of 2024: \$40–45 for a classroom of 30 students

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Activity | Grades 6–8

Engage

- Begin by holding up one of the **Mixture Cups**. Explain that inside the cup is a mixture of about one cup of sand and three tablespoons of salt.
- Then tell the class it will be their challenge to work in groups to try to separate the salt from the sand!
- Explain that groups may use any of the materials assembled: paper towels, a strainer, coffee filters, warm water, cold water, extra bowls, tweezers, a magnifying glass, magnets, etc.
- Then divide students into groups of three or four, give each group a Mixture Cup, and encourage them to begin!
- Once 10–15 minutes have passed, bring the class back together and encourage groups to share the results of their investigation. Ask: Were you able to separate the salt from the sand? Which process seemed to work best and why?

Investigate & View

- Tell students they now are going to watch a video called *Copper Connects Us: Innovation*, which will explore some of the innovations that are occurring within copper mining.
- Encourage students to listen for connections between the video and the challenge they just completed.
- Play the **Copper Connects Us: Innovation video**.

Apply

- Ask students to share: Which process used with copper is similar to the challenge you just completed?
- Be sure students understand the activity they completed is similar to the process of copper leaching: a process that uses sulfuric acid to help leach as much copper as possible from material that already has been mined. In their challenge, the sand represented ore and the salt represented copper. Those groups that used warm water and a coffee filter to filter out the sand and then collect the salt-infused water performed something similar to leaching—except, in leaching a chemical solution is dripped over rocks to collect copper molecules.
- Then tell the class leaching is just one type of copper innovation!
- Divide the class into pairs and give each pair a set of shuffled **Copper Innovation Cards**. Explain that their challenge is to sort the cards into sets of three. Each set should include a card labeled *1—Early Product/Process*, a card labeled *2—Innovative Product/Process*, and a card labeled *3—Explanation*. Each complete set should explain a different copper innovation.

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Activity | Grades 6–8

- Then give student pairs time to read through their cards and create their sets.
- Bring the class back together near the end of the session and ask pairs to share their sets. (You may use the **Copper Innovation Cards** handout as an answer key.)
- Wrap up by discussing: How do these copper innovations improve society both today and in the future?

National Standards

NEXT GENERATION SCIENCE STANDARDS

MS–ETS1–1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Disciplinary Core Idea:

ESS3.C: Human Impacts on Earth Systems: Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

COMMON CORE ENGLISH LANGUAGE ARTS STANDARDS

CCSS.ELA-Literacy.CCRA.SL.1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

CCSS.ELA-Literacy.CCRA.SL.2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively and orally.

<p>1 – Early Product / Process</p> <p>Maintenance Needed:</p> <p>When a haul truck broke down or had a problem, the truck would be taken out of service as engineers searched for the problem and tried to fix it.</p>	<p>2 – Innovative Product / Process</p> <p>Preventative Maintenance:</p> <p>Data now is constantly collected from hundreds of sensors in each haul truck so that issues can be identified and addressed <i>before</i> they turn into a problem.</p>	<p>3 – Explanation</p> <p>Each two-story-tall haul truck costs about \$5 million. Technology that helps with preventive and regular maintenance means that these trucks now can operate for 15 or more years!</p>
<p>1 – Early Product / Process</p> <p>Human-Operated Vehicles:</p> <p>Today, trained drivers are responsible for driving and operating the massive haul trucks.</p>	<p>2 – Innovative Product / Process</p> <p>Self-Driving Vehicles:</p> <p>In the future, haul trucks may become autonomous, which means they would be self-driving and would have an operating system that thinks for itself!</p>	<p>3 – Explanation</p> <p>Autonomous haul trucks would increase safety, productivity and sustainability. The more idle time a truck has (which is the time when a truck is running but not doing anything), the more fuel it burns. An autonomous vehicle would have much less idle time than a driver-operated vehicle!</p>
<p>1 – Early Product / Process</p> <p>Human Analytics:</p> <p>Humans used to analyze data from mining sites to check for impurities in the copper and make sure that the mining process was running smoothly.</p>	<p>2 – Innovative Product / Process</p> <p>AI Analytics:</p> <p>Artificial Intelligence (AI) now collects over 13 billion data points from mining operations around the world and constantly makes sure the mining process is running as efficiently as possible.</p>	<p>3 – Explanation</p> <p>AI can analyze a lot more data than humans, and in much less time! It then uses this data to suggest ways to make mining more efficient and more sustainable.</p>
<p>1 – Early Product / Process</p> <p>Wired Earphones:</p> <p>These types of headphones connect the speaker in your device to speakers in your ears with a wire.</p>	<p>2 – Innovative Product / Process</p> <p>Wireless Earbuds:</p> <p>These types of headphones connect wirelessly to your device with Bluetooth technology.</p>	<p>3 – Explanation</p> <p>Copper is an important part of all headphones. In wireless headphones, the copper inside helps make sure the sound is clear and that the headphones’ battery charges well.</p>
<p>1 – Early Product / Process</p> <p>Watches:</p> <p>In the past, watches worn on people’s wrists only could be used to tell time!</p>	<p>2 – Innovative Product / Process</p> <p>Smart Watches:</p> <p>Today, watches can be used to tell time, receive texts, check apps, track your fitness, and more!</p>	<p>3 – Explanation</p> <p>Copper is crucial in all types of watches. In smart watches, copper powers complex circuits, manages connectivity and helps with efficient battery charging.</p>
<p>1 – Early Product / Process:</p> <p>Incandescent Light Bulbs:</p> <p>These bulbs produce light by heating a tiny wire inside until it glows.</p>	<p>2 – Innovative Product / Process</p> <p>LED Lights:</p> <p>These bulbs produce light using tiny electronic chips called diodes, which glow when electricity passes through them.</p>	<p>3 – Explanation</p> <p>LED lights use less energy, last longer and produce less heat than regular incandescent bulbs. Copper is used in both types to connect the bulb to electricity. In LED lights, copper also helps control heat and makes sure they work efficiently.</p>