

HAUL!



Grades 6–8

EDUCATOR GUIDE

HAUL! Interactive Learning Experience

Overview

In this activity, students will explore how copper is used in their everyday lives and the equipment the mining industry uses to keep up with global demand. Students will play a game where they learn about some diverse uses of copper and identify classmates who have used this important mineral in different ways. Then, they'll participate in HAUL!—an interactive learning experience where students load and dump a virtual haul truck in an open-pit mine and investigate the reasons behind the massive size of these trucks. Students will be guided through calculations that consider what each load of copper ore equates to in terms of cell phone and computer production, and they ultimately will develop an explanation around why large equipment, like a haul truck, is needed to meet the world's demands.

Subject

STEM, with a mathematics focus

Objectives

Students will:

- Understand the diverse uses of copper and identify peers who use copper in different ways
- Calculate the number of haul truck loads needed to fulfill global copper demand for different forms of technology
- Develop and support a written explanation about why large haul trucks are needed for copper mining

Duration

Three class sessions

- **Boot Up:** 20 minutes, to be implemented in a class period before the HAUL! Virtual STEM Mission
- **Experience:** 20 minutes
- **Reorient and Download:** 45 minutes, to be implemented in a class period following the HAUL! Virtual STEM Mission

Materials

- Boot Up handout, one per student
- Reorientate #1 handout, one per student
- Reorientate #2 handout (three pages), one per student
- Calculators, at least one per student pair

HAUL!



EDUCATOR GUIDE

Boot Up

Begin by asking students to share ideas of how they use minerals and other mined materials in their everyday lives.

Then distribute a Boot Up handout to each student and explain that students will be investigating the many uses of one mineral in particular: copper. Explain that this handout describes some ways they may have used copper, perhaps without even being aware! After reading through each of the squares, challenge students to get signatures from classmates who meet each criterion. Students only may sign each handout once. The first student to complete their board, or the student who has the most signatures when time is up, wins.

When students are finished, or once 15 minutes have passed, bring them back together. Guide the class in discussing how often they rely on copper in their everyday lives and whether any of these uses surprised them. Be sure students understand that copper use isn't limited to what is included on the Boot Up handout. For instance, because copper is used in circuit boards and electrical wiring, it also can be found in tablets, computers, radios, smart watches, medical devices and automotive equipment, just to name a few more examples. Explain that one reason copper is found in so many products is because it is a sustainable material! Copper helps make products more energy efficient, *and* it is infinitely recyclable. Once copper is mined, it can be recycled and used again and again without losing any of its properties! **Copper is critical to many innovations around the world and continues to have a supply demand that is greater than what is in circulation.**

Continue to explain the prevalence of minerals in students' daily lives by sharing that the average American uses over 40,000 pounds of mined materials every year! In addition to copper, some of these materials include stone, salt, aluminum and coal. To better understand what the mining process for copper entails, tell students they are about to participate in a Virtual STEM Mission and practice operating a haul truck, a vehicle used to move large amounts of material at mining sites.

Experience

Students will launch [HAUL!](#) and practice operating a haul truck at a copper mining site.

Reorient

Begin with a discussion around the Virtual STEM Mission students just completed and encourage them to share their observations. What thoughts did they have as they observed the haul truck from the ground and then operated the haul truck from the driver's seat?

Then pass out one Reorient #1 handout to each student. Explain that the picture is an example of a real-life haul truck used for copper mining. Instruct students to observe the photograph, read the fast facts and discuss their reactions.

Now tell the class that they are about to further investigate why the haul trucks at

DIG DEEPER

Encourage students to complete the [Metals in Your Everyday Life Digital Exploration](#) to further investigate the prevalence of copper in their day-to-day lives.

DIG DEEPER

Encourage students to watch the [Dig into Mining Day of Learning Virtual Field Trip](#) to understand the mining process from start to finish.

¹ <https://nma.org/facts-stats-and-data/>

HAUL!



EDUCATOR GUIDE

copper mining sites are so large! Divide students into pairs, and distribute one Reorient #2 handout to each student. Read through the instructions provided and give students about 30 minutes to complete all three pages. They may use a calculator to assist with their calculations. Depending on the students' ability level, it may be helpful to complete Parts 1 and 2 as a class before they work with a partner on Parts 3 and 4.

Then bring the class back together and invite students to share their conclusions about why such big equipment is needed to supply the demand of copper, especially at a global level!

Level Up (cross-curricular extensions)

1. **Science:** Students can complete the [Microbe Probe](#) activity to better understand the antimicrobial properties of copper.
2. **Economics:** Now that students are aware of the scope of copper demand, they can explore the profitability of its production with the [Economic Feasibility Study](#) activity.
3. **Social Studies:** Students can complete the [Patterns of Natural Resources](#) activity to learn where copper can be found around the world and then design a virtual or paper map to display their findings.
4. **Careers:** Students work with their families to complete the [Mine Your Future](#) activity as they match their skills and interests to different careers in the mining industry.

National Standards

COMMON CORE MATHEMATICS STANDARDS

CCSS.MATH.CONTENT.6.RP.A.3: Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.

CCSS.MATH.CONTENT.7.RP.A.2: Recognize and represent proportional relationships between quantities.

STANDARDS FOR TECHNOLOGICAL LITERACY

6D. Throughout history, new technologies have resulted from the demands, values, and interests of individuals, businesses, industries, and societies.

C3 FRAMEWORK FOR SOCIAL STUDIES STANDARDS

D2.Eco.6.6–8: Explain how changes in supply and demand cause changes in prices and quantities of goods and services, labor, credit, and foreign currencies.

COMMON CORE ENGLISH LANGUAGE ARTS STANDARDS

CCSS.ELA-LITERACY.CCRA.W.2: Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

CCSS.ELA-LITERACY.CCRA.W.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Find a peer who....

<p>Owns a piece of silver jewelry</p> <p>Did you know copper is often mixed with silver to increase its hardness and strength and reduce how much it will tarnish?</p> <p>Signature:</p>	<p>Has been inside a hospital</p> <p>Did you know copper has been found to reduce the spread of bacteria, so it is being used on high-touch surfaces in more and more hospitals?</p> <p>Signature:</p>	<p>Uses electricity</p> <p>Did you know that copper wires are used more widely than any other type of electrical wire because they are resistant to heat, inexpensive and good conductors of electricity? This can help homes and buildings be more energy-efficient!</p> <p>Signature:</p>	<p>Likes the taste of water</p> <p>Did you know many of today's water supply pipes are made out of copper because it is resistant to corrosion and lasts for a long time?</p> <p>Signature:</p>
<p>Watched TV yesterday</p> <p>Did you know that TVs rely on coaxial cables to receive signals and distribute cable television channels? Coaxial cables are wires that have an inner conductor made of copper.</p> <p>Signature:</p>	<p>Plays a brass instrument <i>Such as the trombone, French horn, trumpet or tuba</i></p> <p>Did you know that brass is an alloy (mixture) of copper and zinc? The zinc helps increase its strength and ductility, which is its ability to have its shape changed without breaking.</p> <p>Signature:</p>	<p>Has a penny in their pocket</p> <p>Did you know that pennies used to be made entirely out of copper until the 1980s? Today, because copper is more expensive, pennies have a zinc core and a copper outer coating.</p> <p>Signature:</p>	<p>Used a smartphone this morning</p> <p>Did you know that copper is used in the printed circuit boards of smartphones? These boards are the power source of the phone and act as the "brain" as they work to support and connect all parts of the device.</p> <p>Signature:</p>
<p>Has seen a wind turbine</p> <p>Did you know that copper plays an important role in this type of renewable energy? Copper wire can be used to ground wind turbines and protect them from lightning, as well as carry their electrical currents where they need to go.</p> <p>Signature:</p>	<p>Took something cold out of their fridge today</p> <p>Did you know that refrigerators often contain copper coils that help keep them cool? The evaporator coil absorbs heat, and the condensation coil removes heat.</p> <p>Signature:</p>	<p>Enjoys dark chocolate</p> <p>Did you know that copper is an important mineral found in food? In addition to dark chocolate, it can be found in certain types of vegetables, nuts and seafood. Copper supports your growth and overall health!</p> <p>Signature:</p>	<p>Has gotten an X-ray or MRI</p> <p>Did you know that copper can be used to create a protective shield that reduces the force of electromagnetic waves? Copper can be used in the walls of MRI rooms as well as in body shields to protect the rest of your body from radiation during an X-ray or MRI.</p> <p>Signature:</p>



Haul Trucks Fast Facts

Read the facts below to learn more about the truck you operated during HAUL!

- Freeport-McMoRan is an international mining company currently operating more than 400 haul trucks.
- Haul trucks have six 12-foot-tall tires—the same height as two people standing on each other's shoulders. Used tires are repurposed throughout the mine in other ways.
- A haul truck is similar to driving a 2-story house, with the steering wheel on the second floor.
- Haul truck engines are around the same size as a Volkswagen Bug car.
- A haul truck engine weighs almost 20,000 pounds and generates 2,400 horsepower. For comparison, the largest passenger car engine ever built weighs 573 pounds and generates 400 horsepower.
- Haul truck fuel tanks hold 1,350 gallons and generally are refilled with diesel fuel for every 24 hours of run time. The routes that they drive on are always the most direct to avoid excess emissions.

PICTURE THIS

In Freeport-McMoRan mines, haul trucks drive on the left, which is the opposite side of the road as vehicles do in the US!

A loaded haul truck can travel at speeds of 7.2 miles per hour uphill. For comparison, cars on the highway drive about 65 miles per hour!

Directions: Do you remember how little you felt when you stood next to your haul truck during your Virtual STEM Mission? Follow the steps below as you investigate why the trucks used for copper mining are so large!

PART 1

ALL ABOUT THE HAUL TRUCK

Learn: Freeport-McMoRan haul trucks can carry a max haul load of 400 tons of material.

Calculate: If one ton = 2000 pounds, how many pounds can a 400-ton haul truck carry?

Answer: _____

Learn: At copper mines, copper ore (or rock that contains copper) is removed from the ground. It then goes through a series of steps to remove the minerals inside of it. Only a small percentage of the ore contains copper!

Calculate: If the ore is 10% copper, how many pounds of copper is inside a 400-ton haul truck?

Answer: _____

Learn: A new haul truck costs around \$7 million and tires cost \$30,000. Tires generally last around 10 months, and each truck has six tires.

Calculate: How much will five years of tires cost for one truck?

Answer: _____

GIVING OLD TRUCKS NEW LIFE FOR A BETTER TOMORROW

Freeport-McMoRan continuously monitors its haul truck fleet for opportunities to increase efficient, sustainable operations. Today, the company rebuilds its haul trucks so the same equipment can be used for several years, reducing the carbon footprint of manufacturing new trucks. Freeport-McMoRan's oldest operating haul truck was purchased in 1990, and the newest truck was purchased in 2008. The company also purchases used haul trucks from other mining companies and shares vehicles among its own fleets.

Each haul truck has sensors that send about 150,000 data points per second to professionals who use the data to further reduce the company's carbon footprint.

PART 2

COPPER USES: CELL PHONES

Learn: A cell phone contains about 15 grams of copper. In 2021, about 1.54 billion (or 1,540,000,000) cell phones were sold.²

Calculate: How many grams of copper were used to create these cell phones?

_____ x _____ = _____ g

Calculate: How many 400-ton haul truck loads did this require?

First, convert the grams of copper used into pounds. There are about 454 grams in one pound. Therefore:

_____ g of copper / 454 = _____ lbs

Now, remember that only 10% of the material in a haul truck load is copper. Therefore, let's create a ratio. Fill in the pounds of copper that were used, and then calculate how many pounds of ore were needed to get this copper:

lbs of copper = $\frac{1}{10}$

lbs of ore = 10

Once you know how many pounds of ore were needed, you can calculate how many haul truck loads were needed to transport this ore! Divide the pounds of ore by the pounds of material that a 400-ton haul truck can carry:

_____ / _____ = _____

PART 3

COPPER USES: COMPUTERS

Learn: In 2021, about 340 million personal computers were sold and shipped around the world.³ Each PC contains about 700 grams of copper.

Calculate: Use your work from above to help you calculate how many 400-ton haul truck loads were needed to supply the copper for these computers in 2021.

² <https://www.statista.com/statistics/263437/global-smartphone-sales-to-end-users-since-2007/>

³ <https://www.statista.com/statistics/273495/global-shipments-of-personal-computers-since-2006/>



