



UTAH GOVERNOR'S OFFICE OF **ENERGY DEVELOPMENT**

Utah Copper

Grade/Subject: 8th-grade Integrated Science

Strand/Standard 8.4.2 Engage in an argument supported by evidence about the effect of per capita consumption of natural resources on Earth's systems. Emphasize that these resources are limited and may be non-renewable. Examples of evidence include rates of consumption of food and natural resources such as freshwater, minerals, or energy sources. (ESS3.A, ESS3.C)

Lesson Performance Expectations (description):

- Students will write an argument related to the per capita consumption of copper and its effect on the Earth's Systems.

Materials: Student computers

Time: Will vary depending on the length and depth the teacher assigns to the argument paper.

Teacher Background Information:

[Copper Mining and Production Wastes \(EPA\)](#)

[How Metal Mining Impacts the Environment](#)

[World Atlas](#)

[The Environmental Impact of the Mining Industry](#)

[Copper Alliance Copper Recycling](#)

[Sustainable Copper](#)

[RioTinto Kennecott](#)

Student Background Knowledge:

- Students should be familiar with copper in the form of pennies but may need to be reminded of other places copper is used. Copper is one of the oldest metals ever used and has been one of the important materials in the development of civilization. Because of its properties, singularly or in combination, of high ductility, malleability, and thermal and electrical conductivity, and its resistance to corrosion, copper has become a major industrial metal, ranking third after iron and aluminum in terms of quantities consumed. Electrical uses of copper, including power transmission and generation, building wiring, telecommunication, and electrical and electronic products, account for about three quarters of total copper use. Building construction is the single largest market, followed by electronics and electronic products, transportation, industrial machinery, and consumer and general products. Copper byproducts from manufacturing and obsolete copper products are readily recycled and contribute significantly to copper supply. ([USGS](#))
- Today, roughly 700 million metric tons of copper have been produced around the world. This would fit into a cube measuring about 430 meters on a side.

- Identified deposits contain an estimated 2.1 billion metric tons of additional copper, which brings the total amount of **discovered** copper to 2.8 billion metric tons. This would fit into a cube measuring 680 meters on a side, the size of seven football fields. It is also estimated that **undiscovered** resources contain about 3.5 billion metric tons of copper, which would mean that there are roughly 6.3 billion metric tons of copper on Earth. This would fit into a cube measuring about 890 meters on a side.
- Of the identified copper that has yet to be taken out of the ground, about 65% is found in just five countries on Earth -- Chile, Australia, Peru, Mexico, and the United States.
- Copper is usually found in nature in association with sulfur. Pure copper metal is generally produced from a multistage process, beginning with the mining and concentrating of low-grade ores containing copper sulfide minerals, and followed by smelting and electrolytic refining to produce a pure copper cathode. An increasing share of copper is produced from acid leaching of oxidized ores ([USGS](#)).

Teacher Step by Step: A 3-D lesson should insist that students think deeply. Provide time and space for the students to experience the phenomenon and ask questions.

Introduce *Phenomenon*: *Observation of event, data or other evidence of activity.*

The photo below shows the Bingham Canyon Copper mine in Salt Lake County, Utah. This is one of the world's largest copper mines.



https://farm4.staticflickr.com/3764/13613808365_effbb88d73_b.jpg

1. Ask students what questions they have about the phenomenon and to record them on their student sheets.
2. The background information on the student sheet may be enlarged into classroom sets rather than on student pages. Use it for classroom discussion to help students understand the ideas of per capita consumption and the concept of more and less developed countries.
3. Students will need help developing their claims. You might wish to limit the claims to one Earth system and check their claims before they proceed to write their argument. Most claims will state the obvious, copper mining is disruptive to Earth Systems and the evidence is easy to find. What is more important is the reasoning portion. Insist that students present reality-based solutions to the problem. The [Rio Tinto Kennecott](#) site has

some excellent examples of how this is being done. Ideally, students will also address per capita consumption of copper and ways that could be reduced.

4. Arguments can be shared between students, read out loud, published, sent to copper companies or senators.

Assessment of Student Learning.

A rubric for the argument might include the number of evidence statements required, documentation of sources, and the sophistication of the solutions presented.

Standardized Test Preparation:

1. Which of the following statements shows a “per capita” relationship?
 - a. Students collect as many pennies as they can.
 - b. Students in a class have a total of 423 pennies.
 - c. Students in a class have a range of 20 to 8 pennies.
 - d. Students in a class have an average of 14 pennies each.*
2. Less developed countries use less copper per capita than developed countries yet their demand for copper is predicted to rise quickly in the near future. Choose two reasons for this:
 - a. Lack of copper available for all countries.
 - b. Reduced demand by developed countries.
 - c. High population growth in less developed countries.*
 - d. Increasing demand for products in less developed countries.*
 - e. Over consumption of resources by less developed countries.
3. Which of the following are problems most likely found in a large copper mine like the Bingham Canyon mine? Choose two.
 - a. Difficulty finding copper.
 - b. Groundwater pollution.*
 - c. Disposal of rock wastes.*
 - d. Increased wildlife populations.
 - e. Tourists wishing to see the mine.
4. Which of the following are practical methods to reduce the effect of a mine on a community?
 - a. Refilling the hole created by the mine.
 - b. Closing the mine to reduce the impact.
 - c. Resurfacing and replanting the waste rock piles.*
 - d. Finding new uses for the product in the community.
 - e. Purifying water before it is allowed back into the groundwater.*

Extension of lesson and Career Connections:

1. A similar project could be done with different minerals or energy sources. Iron, magnesium, silver, oil, or coal are all mined in Utah.
2. Careers in mining are varied. Not just the mining engineers but the smelting, transporting, marketing, employment, environmental consultants and public relations personnel are possibilities for further research. Representatives from one of these careers can come and speak to the class.