



# COPPER

## More Than Metal





# Copper: It's Everywhere

Did you know that copper is one of the world's most important natural resources? What do you know about copper? List what you know here.

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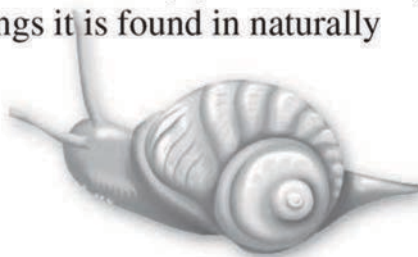


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## What is Copper?

Copper is a metallic substance that is naturally present in many aspects of nature. Some of the things it is found in naturally include:

- Rocks and soil
- Selected plants
- Some insects and snails
- And even the human liver



## If it can't be grown, it has to be mined!

Look around. If you are inside, look at the walls, ceilings, lights, furniture, appliances and all of the other things around you. If you are outside, look at the buildings, cars, power lines, streets and anything else that you see. Do you realize that if it wasn't grown, it must have been mined?

## Minerals and You...

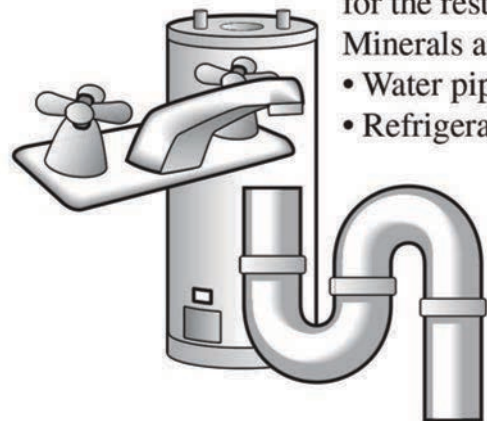
You wake up in the morning and switch on the light. You wash your face, brush your teeth and get dressed. You turn on the radio and eat breakfast - a bowl of cereal, a glass of juice, and perhaps some toast. You look out the window then head for the door ready to start the day.



Almost everything you've done so far, and everything you'll do for the rest of the day would be impossible without minerals.

Minerals are found in:

- Water pipes and electric wiring
- Refrigerators, radios, toasters, lamps and light bulbs
- Sheets, towels and clothing, (rayon, polyester, nylon, acrylic...)
- Soap and toothpaste
- Windows, cereal bowls, juice glasses, coffee cups,
- Water faucets, spoons and doorknobs



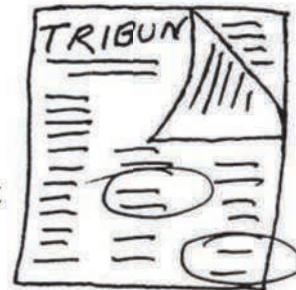
## FACTS

— A child born today will use approximately 1,398 pounds of copper in his or her lifetime in housing, transportation, electrical and other consumer products.

— Every year, the world's demand for copper is about 28.6 million metric tons and growing!

## Newspaper Activity

Look through today's newspaper. Cut out pictures of anything you can find that contains copper. How many pictures did you cut out?



Did you find anything that does not contain copper or some other mineral?

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## ACTIVITY:

### "What is it?"

1. Pick an object in the classroom. Identify the origin of the object and classify each item into one of the three categories (animal, plant, or mineral). *Example:* Even printing ink in textbooks is made of minerals, including copper.
2. What minerals are in toothpaste? Do some research to find out!



## FACTS

- Copper is perpetually recyclable. It can be used over and over without losing its original form!
- Copper is biostatic, which means bacteria will not grow on it!
- Copper is essential to human beings as a micronutrient in our diets.

# Uses of Copper

## Prehistoric societies used copper in:

- Utensils
- Tools
- Weapons
- Piping
- Surgical Instruments
- Ornaments/Jewelry

## Today, you'll find copper in:

- Construction (buildings, bridges, etc.)
- Telecommunication devices (telephones, pagers, etc.)
- Electrical and electronic products (tvs, computers, video game players, radios, etc.)
- Transportation equipment (cars, airplanes, etc.)
- General everyday products (cookware, coins, etc.)



## Copper is the key element in conducting electricity . . .

Copper conducts electrical current better than any other metal except silver, and is used in almost every facet of our lives - watching tv, driving a car, turning on a light or making a phone call.

## The human body needs copper...

Copper is essential in the human diet. It helps iron-rich foods make red hemoglobin in the blood. If our bodies don't get enough copper, we can develop high cholesterol levels and heart disease.

## Foods rich in copper . . .

Copper is present in a wide variety of vegetables, fruits, grains, dried beans, nuts, meats, seafood and chocolate, as well as drinking water. Natural foods such as cereals, meat and fish generally contain sufficient copper to provide up to 50% of the required copper intake in a balanced diet.

Some foods that are especially rich in copper are:

- Most nuts (especially brazil and cashew)
- Seeds (especially poppy and sunflower)
- Chickpeas
- Liver
- Oysters

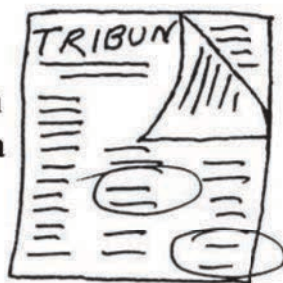


List at least 10 things we would have to do without if we didn't have copper.

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

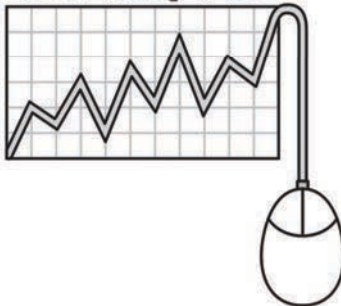
## Newspaper Activity

**Freeport-McMoRan** currently operates mines in Arizona, New Mexico, South America, Indonesia and Africa. Look on the Internet to find other mining companies. Look these businesses up on the stock market page.



How much would it cost to buy ten shares of stock in each company?

## STOCK QUOTES



What factors can make stocks gain or lose value? Track these stocks over the next week and report on what happens.




## Statue of Liberty Facts:

- Title of Statue: "Liberty Enlightening the World"
- Sculptor: Auguste Bartholdi
- Statue completed in Paris: June 1884
- Statue presented to America by the people of France: October, 1886
- Number of spikes in the crown: Seven (for the 7 oceans of the world and the 7 continents)
- Height from base to torch: 151'1" (46.50m)
- Total weight of Statue: 450,000 pounds (225 tons)
- Steps to crown: 354 steps (22 stories)

# Copper's History



## Man's Oldest Metal . . .

- Copper is man's oldest metal. Its use dates back more than 10,000 years.
- Archeologists have recovered a portion of a water plumbing system from the Pyramid of Cheops in Egypt. The copper tubing used was found in serviceable condition after more than 5,000 years.
- When Columbus sailed to the Americas, his ships, the Nina, Pinta and Santa Maria, had copper skins below the water line. The copper sheathing extended hull life and protected

against barnacles and bacteria. Today, virtually all ships are coated with a copper-based paint below the waterline to keep them from becoming coated with plant life, barnacles and other marine organisms. This lengthens the life of the ship.

- Human understanding of the effect of heat on copper-bearing rocks ushered in the Copper Age. People were able to make a wide variety of useful objects including metal axes and swords.

- Ancient Egyptian mirrors were originally made of copper. Later, mirrors were made of bronze, which is a copper **alloy**. An alloy is a mixture of metals.
- Ancient Egyptian women used cosmetics as much as their modern counterparts.

The blues and greens associated with eye "make-up" were derived from copper pigments. Blue was made out of azurite and a bit of silver, copper or calcium, and green from malachite. Azurite and malachite are copper bearing ores.



## How much copper is in THAT?

**The Statue of Liberty** contains 62,000 pounds or 31 tons of copper.

- **10,000 pounds** of copper are used to manufacture every **Space Shuttle**.
- Certain types of **nuclear submarines** use approximately **200,000 pounds** of copper.
- The amount of **copper products consumed** in the U.S. in most years would make an electrical wire that could encircle the Earth 2,630 times or make 140 round trips to the moon.
- The **U.S. nickel** is actually **75% copper**. The **dime, quarter** and **half-dollar** contain **91.67% copper**. The **penny** contains only **2.6% copper**.
- The average **American home** built today will consume an average of **400 pounds** of copper in its construction.
- There are approximately **50 pounds** of copper contained in a typical U.S. built **automobile**.
- About 2% (**9,000 pounds**) of the total weight of a **Boeing 747 jet** is copper.
- Since 1963, more than 28 billion feet, or over **5.3 million miles** of copper plumbing has been installed in U.S. buildings - equivalent to a tube wrapping around the earth **200 times**.

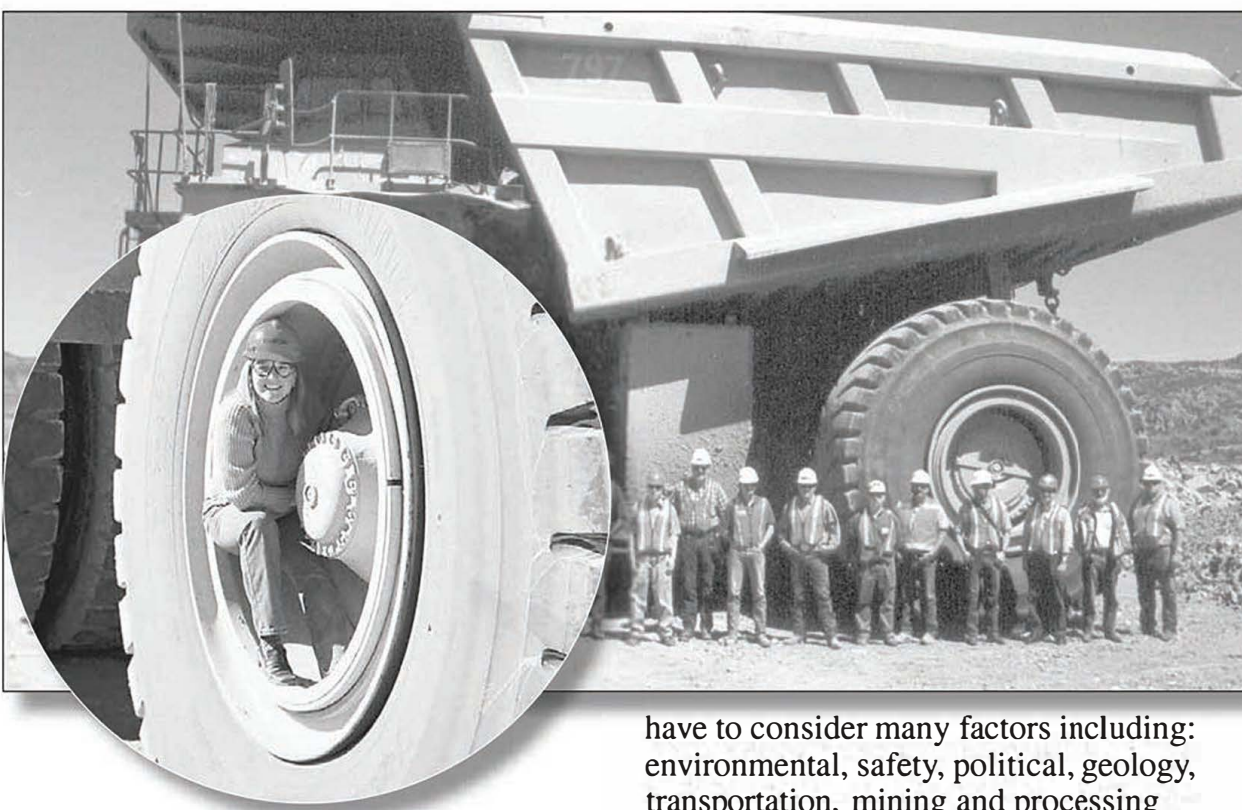


## ACTIVITY:

### "Find the Facts"

1. Try to find azurite and malachite in a book of minerals or on the Internet.
2. Do some research to find other uses of copper in history.
3. Study the history of the U.S. penny. When were pennies first minted in copper? Have they always had the same amount of copper? If today's penny only contains 2.6% copper, why does it look like copper?





have to consider many factors including: environmental, safety, political, geology, transportation, mining and processing methods to name a few. This process usually takes many years.

## Mining Process

### Blasting and Crushing

Ore must be blasted with explosives to break it into smaller pieces.

Most of the ore has only 0.4-0.6% copper

in each ton - kind of like a chocolate chip cookie with only one chocolate chip. Electric powered shovels pick up broken ore and load it into a haul truck. The shovels can load over 100 tons with each scoop. Haul trucks can carry hundreds of tons of ore (an "average" pickup truck holds 1/2 ton). The haul trucks take the ore to a large machine called a crusher where it is reduced to rocks that average eight inches in diameter - about the size of a soccer ball.



### Cupcake Core Drilling

#### The Drilling Process:

*Purpose: This activity demonstrates drilling for copper ore deposits.*

**You will need:**

- Clear drinking straws • Colored markers
- Knife • Marble cake ("Land" sample)
- Paper • Pencil • Scissors • Straight edge

#### Preparing the "Land" Sample:

This step can be done by the teacher, a student or parent. Use cake to make the "land." Purchase chocolate and either white or yellow cake mix. One flavor will represent copper ore, and the other land. Prepare the cake mixes as directed on the package. Do not mix them together at this time. Line a baking pan with aluminum foil. Spoon the cake mixes unevenly in the pan. You can be very creative with this step, pouring the land material in the pan first in a thin layer; dotting the "ore" on top in big or little blobs, lines, and masses; finishing with the waste material on top; making some "ore" sit on the surface; locating the "ore" in one place - the choices are endless. Bake the cake according to package directions. Remove the cake from the pan but leave the foil around the sides and the bottom of the cake.

#### Procedure:

1. Only the surface of the "land" is visible. Do not remove the foil from the "land" sample.
2. On the surface of the "land" sample, mark a grid of lines. Number each square in the grid.
3. Choose a square on the grid and push a straw, or "drill," through the layers of the "land" sample. Remove the straw. Label the straw with the grid number. Use new straws to repeat this step at least 2 but no more than 4 times, each time "drilling" in a different square in the grid on the "land" sample.
4. Use the core samples to draw a cross section of how the "land" might look below its surface. On the diagram connect the areas of known types of material by drawing lines through the unknown material types. Color or shade in the boundaries of materials shown by the colors on the core samples.

#### Analysis:

1. From the cross section tell whether you think there is a mineable "ore" deposit in the "land" sample.
2. Cut through the "land" sample to determine the actual appearance of the deposit. Compare your cross section diagram to the actual appearance of the deposit and surrounding material. Describe the correlation between your cross section diagram and the actual material.
3. If more samples had been taken, what might have been your thinking about the deposit? What does this reveal about exploration for mineable ore bodies?

### Where does it come from?

Copper is found in deposits formed in the earth's surface as the result of early volcanic disturbances. **Sulfide ores** were formed when molten solutions flowed into the earth's crust. **Oxide ores** were formed as weather and other natural forces altered ancient rocks. Both sulfide ores and oxide ores are mined and processed to extract copper metal. Rock is considered to be ore when enough copper minerals are present for mining. In Arizona most ore contains less than 1% copper.

### How do we "get" copper?

There are many steps in taking copper ore from the ground to the market. Currently there are two primary ways to mine and process copper - Concentrating & Smelting and Leaching & SX/EW. What comes out in the end is the copper we use on a daily basis!

Before any mining can happen, a mineral deposit must be located through exploration. But a mineral deposit does not make a mine. Some deposits are too deep, too complex or the ore grade is too low to be mined. Once a deposit is found, drilling, testing and engineering are done to see if a mine should be developed. Mining companies



# The Concentrating & Smelting Process

For many sulfide copper minerals, the removal of copper is accomplished with fire - so it is known as a **pyrometallurgical process** (pyro is the Greek word for fire). Sulfide ore is processed and then melted at temperatures of more than 2000 degrees.

## Milling

From the crusher the ore is put into a huge mixer-like machine called a mill where it is mixed with water to form a muddy substance called **slurry**.

## Flotation and Concentrating

The slurry flows to the next step in the process called flotation. Special liquids called **reagents** are added to the slurry on its way to the flotation area. The slurry and reagents flow into large metal containers called flotation cells. One reagent, called a **collector** is attracted to copper. Another reagent called **frother** forms a strong bubble to which the "collector" will eventually clean. Propeller-like agitators blow air into the bottom of the flotation cells. The agitator keeps the slurry mixed up and breaks the air into little bubbles that travel to the surface.

## FACTS

— An open pit mine is "an excavation or cut made at the surface of the ground for the purpose of extracting ore and which is open to the surface for the duration of the mine's life." (mine-engineer.com)

— Underground mining is done when an ore body lies a considerable distance below the surface. The amount of waste that has to be removed in order to uncover the ore through surface mining becomes prohibitive, and underground techniques must be considered.

(Encyclopedia Britannica Online)

The "collectors," with copper attached, stick to the bubbles and are carried to the surface where they attach to the "frother" strengthened bubbles. The agitation causes the bubbles to move to the edge of the vat where they overflow and are carried to large tanks called thickeners. The copper slurry produced in flotation is now called **concentrate**. The copper concentrate sinks to the bottom of the thickeners where it is pumped to filters that vacuum water out of it, preparing it for transport to the next step - the smelter. The water that is removed from the thickeners is pumped back into the mill and reused. The resulting copper concentrate is approximately 30% copper.

## ACTIVITY:

### "Slurry Slush"

You can demonstrate the milling process by putting something breakable, like crackers or potato chips, in a coffee can. Then add nails or metal bearings and shake the can up. This will show how the ore breaks down in the mill. Or, you could just add water and shake it up to make paste. This might take a bit longer (and your arms might get tired!).



## Smelting

At the smelter, the copper concentrate goes through four processes. These processes remove impurities from the copper.

### 1. The smelting furnace

Here the concentrate is **smelted**, instantly converting the ground-up rock into a molten liquid that is 2,300 degrees Fahrenheit and looks like molten lava from a volcano. It is now called **matte**.

### 2. The converter

The matte goes to the converter where most of the remaining impurities are removed by blowing air into the mixture. The resulting product is **blister copper** that is more than 98% pure.

### 3. The anode furnace

The blister copper is poured into the anode furnace where air and natural gas are added to the mixture.

### 4. The anode casting wheel

Copper from the anode furnace is then poured into copper molds to produce **anodes**. Anodes are slabs of copper that are about 2 inches thick, 3 feet wide and 3 1/2 feet tall. The anodes weigh about 750 lbs. each and are about 99.0% pure copper. They are then shipped to the refinery where the copper is purified even more.





# Refining

Even though the anodes from the smelter are 99.0% pure copper, they still contain too many impurities for the strict demands of most manufacturers. The process at the refinery uses electricity, rather than heat, to refine the copper.

## At the Refinery - turning Anodes into Cathodes

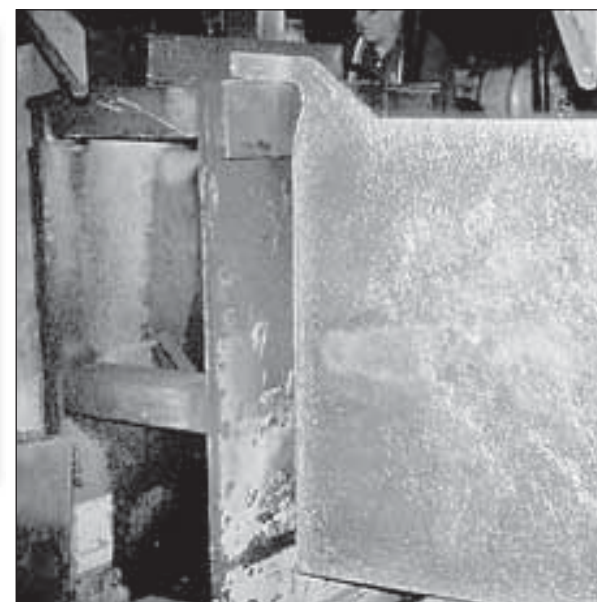
The anodes are hung in a solution of sulfuric acid and copper sulfate between two starter sheets (thin sheets of copper) in large tanks similar to swimming pools.

As an electrical current is passed through the tanks, the copper from the anodes is dissolved into the solution and *plates*, or sticks, onto the



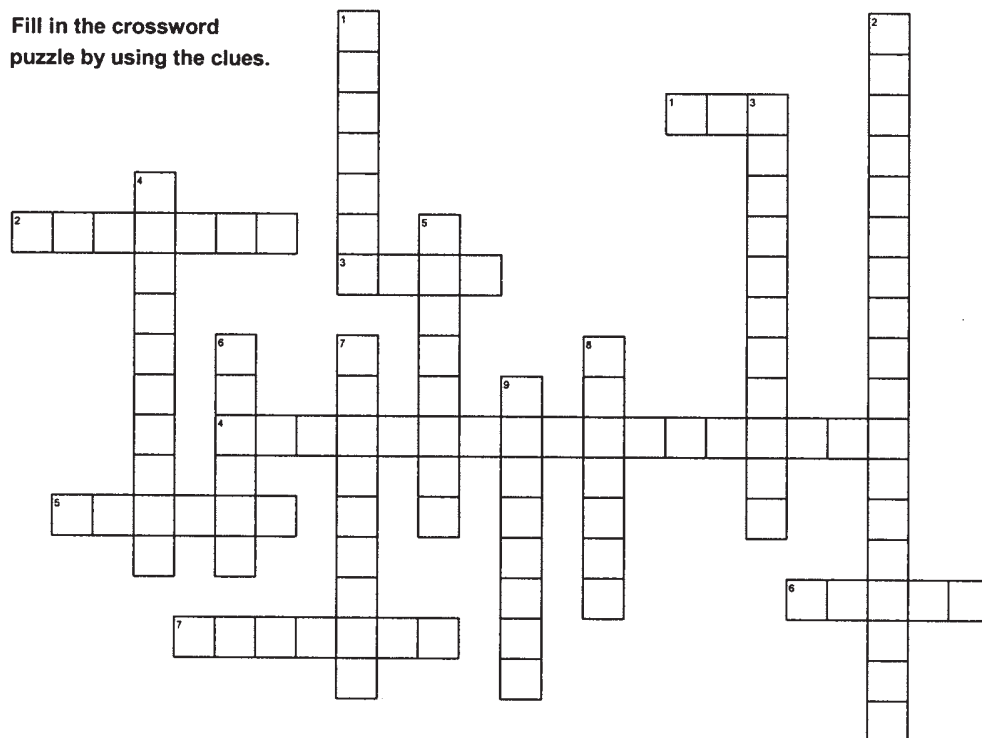
Row of anodes.

starter sheets. It is now called a cathode and is 99.8% pure copper. It is pure enough to be sold to manufacturers.



Anode ready to be shipped to refinery.

Fill in the crossword puzzle by using the clues.



**Select your answers from the following words:**

Liberty	pyramid	Sulfide
pyrometallurgical	silver	Copper
diet	smelter	hydrometallurgical
Oxide	recyclable	refinery
Bacteria	ore	exploration
chocolate		

Answer key on back page.

### Across

- Haul trucks can carry hundreds of tons of \_\_\_\_\_.
- The Statue of \_\_\_\_\_ is plated with 179,000 pounds of copper.
- Copper is essential in the human \_\_\_\_\_.
- Sulfide ore goes through a \_\_\_\_\_ process to remove the copper.
- Copper conducts electricity better than any other metal except \_\_\_\_\_.
- \_\_\_\_\_ ores were formed as weather and other natural forces altered ancient rocks.
- At the \_\_\_\_\_, ground-up rock is converted into a molten liquid that looks like lava from a volcano.

### Down

- Archeologists recovered a portion of a plumbing system from a \_\_\_\_\_.
- Oxide ores go through a \_\_\_\_\_ process to remove the copper.
- Before any mining can happen, a mineral deposit must be located through \_\_\_\_\_.
- Copper is perpetually \_\_\_\_\_.
- At the \_\_\_\_\_ anodes are turned into cathodes.
- \_\_\_\_\_ can be found in many aspects of nature.
- Copper is present in \_\_\_\_\_ and many other foods.
- \_\_\_\_\_ ores were formed when molten solutions flowed into the earth's crust.
- \_\_\_\_\_ will not grow on copper.



## ... WHAT IS COPPER AND HOW IS IT FOUND?

## OXIDE COPPER MINERALS



MALACHITE AZURITE ORTHOCCLAS

## SULFIDE COPPER MINERALS



BIOBATE    CHALCITE    CHALCOPYRITE



## EXPLORATION AND DISCOVERY

Copper, found in many minerals and used in many different ways, is labeled "Cu" on the periodic table of elements. An exploration team uses many techniques and new technologies to search the earth's surface and sub-surface for copper ore deposits that can be mined economically. These geoscientists look for copper bearing ores such as sulfide ores or oxide ores.

## ...HOW IS COPPER REMOVED FROM THE EARTH?



## MINING METHODS

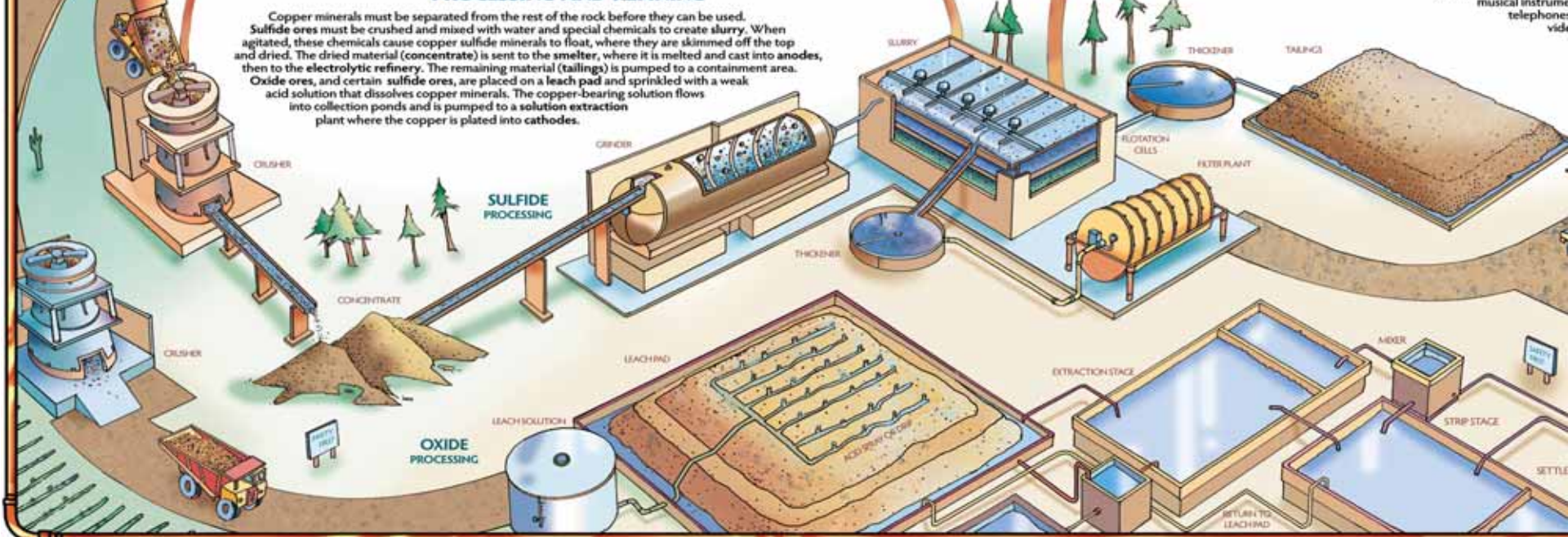
Technologically advanced earth-moving equipment such as dozers, haul trucks, and loaders are used in mining. **Open-pit** mining is used to extract deposits found at or near the earth's surface through the creation of benches or terraces. **Underground** mining is used when a copper ore deposit lies deep beneath the earth's surface. Miners dig a **shaft** into the ore deposit and an **adit** into the side of the hill or mountain to remove the copper-bearing rock.

...HOW DO YOU GET  
COPPER OUT OF A ROCK?



## PROCESSING AND REFINING

Copper minerals must be separated from the rest of the rock before they can be used. Sulfide ores must be crushed and mixed with water and special chemicals to create slurry. When agitated, these chemicals cause copper sulfide minerals to float, where they are skimmed off the top and dried. The dried material (concentrate) is sent to the smelter, where it is melted and cast into anodes, then to the electrolytic refinery. The remaining material (tailings) is pumped to a containment area. Oxide ores, and certain sulfide ores, are placed on a leach pad and sprinkled with a weak acid solution that dissolves copper minerals. The copper-bearing solution flows into collection ponds and is pumped to a solution extraction plant where the copper is plated into cathodes.



...HO  
COPPE



### USES OF

Copper is one of the natural resources. It is used in kitchen appliances, cars, musical instruments, telephones, video



# WONDER OF COPPER

## ... WHAT CAREERS ARE AVAILABLE IN THE COPPER INDUSTRY?



### CAREERS IN MINING

The copper mining industry requires a wide variety of jobs for people with a high school and/or college education. The industry provides employees an opportunity to receive top salaries, travel to unique places around the globe, work with advanced technology and help humanity by producing a critical resource we all need... copper!

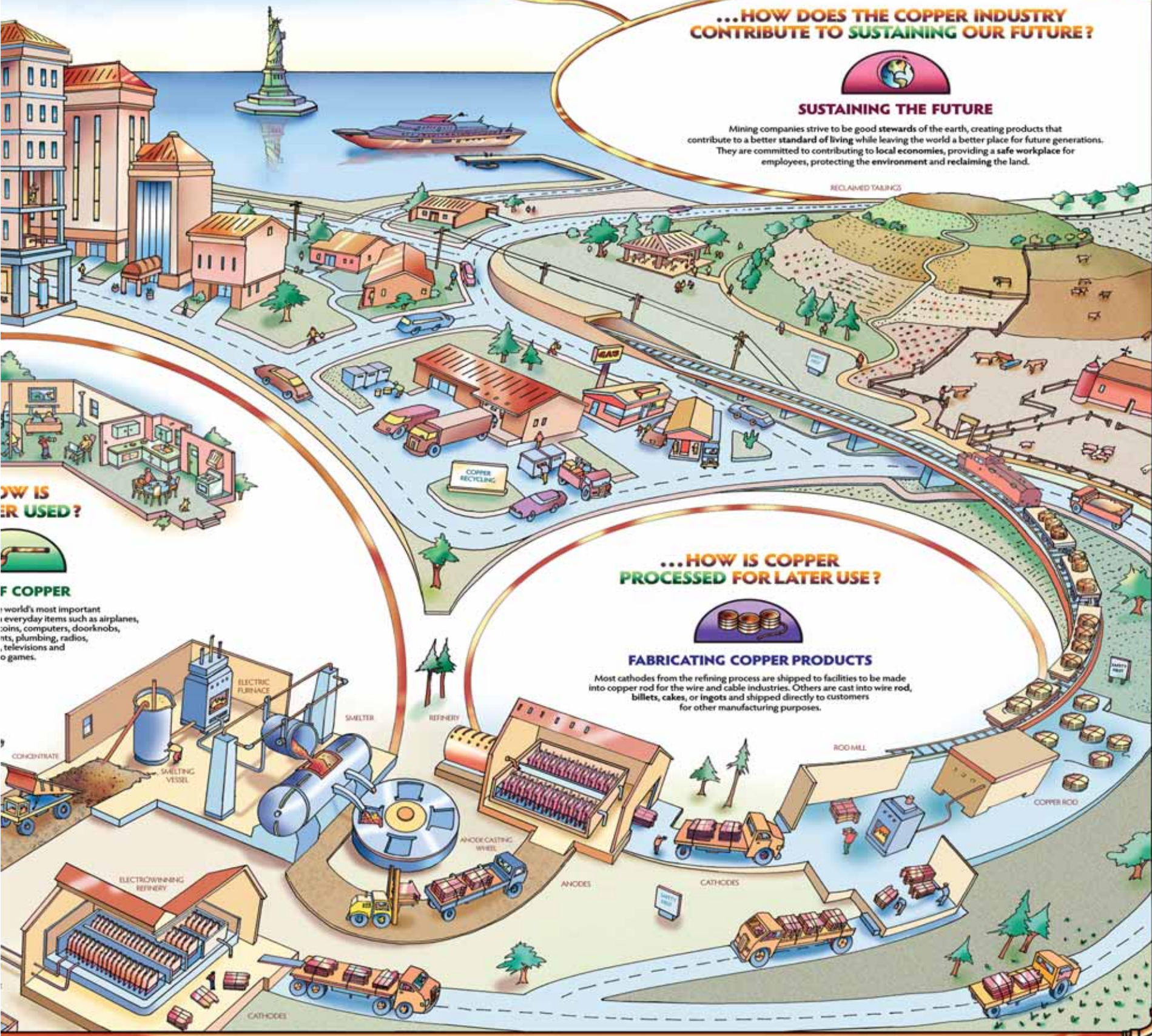


## ... HOW DOES THE COPPER INDUSTRY CONTRIBUTE TO SUSTAINING OUR FUTURE?



### SUSTAINING THE FUTURE

Mining companies strive to be good stewards of the earth, creating products that contribute to a better standard of living while leaving the world a better place for future generations. They are committed to contributing to local economies, providing a safe workplace for employees, protecting the environment and reclaiming the land.



## HOW IS COPPER USED?

### OF COPPER

Copper is the world's most important metal. It is used in everyday items such as airplanes, coins, computers, doorknobs, pipes, plumbing, radios, televisions and toys.

## ... HOW IS COPPER PROCESSED FOR LATER USE?



### FABRICATING COPPER PRODUCTS

Most cathodes from the refining process are shipped to facilities to be made into copper rod for the wire and cable industries. Others are cast into wire rod, billets, cakes, or ingots and shipped directly to customers for other manufacturing purposes.



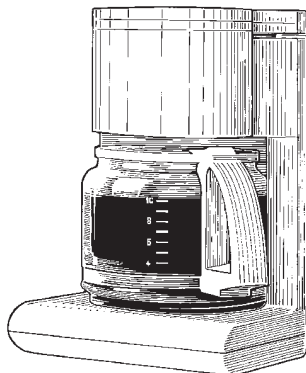
# The Leaching & SX/EW Process

## Oxide Ores

Primarily, oxide ore is mined using a **hydrometallurgical process** known as leaching (hydro is the Greek word for water). **Leaching** is a hydrometallurgical process because it uses liquid to separate the copper from the other minerals in the rock. The leaching process used by the copper mining industry is known as **Solution Extraction/Electrowinning (SX/EW)**.

## Like making coffee?

The blasted and crushed ore is taken to the **leach pad**. A weak solution of sulfuric acid and water is sprayed or dripped onto the ore from plastic tubing distributed across the pad. As the liquid percolates down through the layers of ore, it gathers copper much like water in a drip coffee maker picks up coffee as it passes through ground coffee beans. However, unlike a coffee filter, the leach pad liner is made of heavy plastic that prevents any kind of leaking into the Earth.



## Pregnant Leach Solution

The resulting solution (or coffee) is a mixture called **pregnant leach solution**

(**PLS**) that contains copper, sulfuric acid and water. The PLS is collected in plastic-lined holding ponds and pumped to the solution extraction plant.

## Grabbing Copper

The Solution Extraction (SX) step involves mixing the PLS with another solution called **organic solution**. The organic solution contains a small amount of a molecule called a **chelator** (the word chelate is Latin for crab claw).

The chelator grabs copper **ions** (particles that are electrically charged), changing the solution from low grade PLS to high grade **electrolyte solution**.

## ACTIVITY:

### Oil & Water

Using a glass jar or beaker, fill it half way with water. Now pour cooking oil into the water. What happens?

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### Like Oil and Water

Once mixing is stopped the solutions are allowed to settle. In settling, the organic, now loaded with copper, floats on top of the PLS (just like oil floats on top of water). The solutions are easily separated. The high grade, or rich, electrolyte solution then proceeds to the tankhouse to be electroplated.

## Recycling

The PLS, stripped of its copper, is pumped back to the leach pads to pick up another load of copper to begin the process again. The pad can be "leached" over and over and many of the materials are used multiple times throughout the process.

## From Liquid to Metal

The rich electrolyte solution moves on to the **electrowinning** (EW) part of the process. It is now ready to be converted into solid metal. Turning liquid into copper is accomplished by passing an electrical current through the solution. This happens in a tankhouse where rows of starter sheets or stainless steel blanks are submerged into the solution. Starter sheets and blanks are thin sheets of metal to which the copper ions will stick or plate because of the electric current.

## Copper Cathodes

In 5 to 10 days, 250 pounds of copper have been electrically "won" from the solution and plated onto starter sheets making 99.9999% pure copper **cathodes**. Copper cathodes do not need to be refined further before being sent on for manufacturing. This process eliminates the need for refining necessary with copper anodes.

## Recycling

The depleted, lean electrolyte solution is sent back through the system to gather more copper from the loaded organic. The 250-pound cathodes are pried from the blanks and sent to a rod mill or other manufacturers.

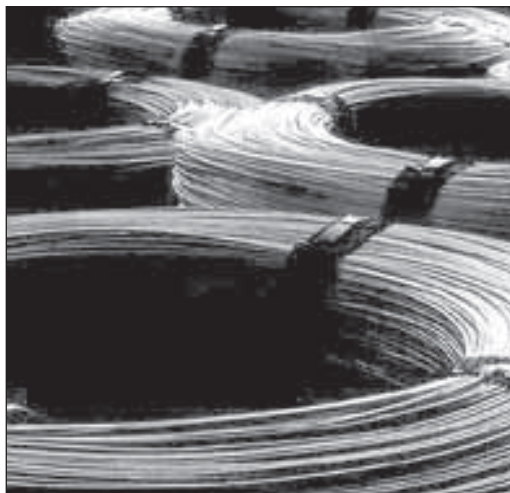
## ACTIVITY:

### "Mmmm, Yummm, Coffee!"

Use a coffee maker to show how water turns into coffee as it "leaches" the coffee from the ground coffee beans.



# Rod Mill



## Copper's Next Step

From both the concentrating and SX/EW processes, a large percentage of copper is sent to the rod mill. At the rod mill, the copper is melted and **cast**, or poured into the shape of a bar.

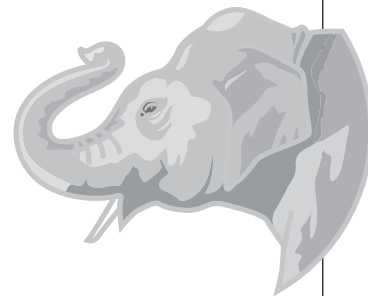
The rod is then fed to the mill, where it is reduced to the size of a pencil. From the mill the copper goes into a cleaning solution and is then rinsed and coated with wax to protect it from **oxidation** (reaction of metal when it comes in contact with oxygen). After being coated, it is collected into a coil, compacted, banded and weighed for shipment.

## How Much in a Day?

All of this happens at a continuous rate of 127,000 pounds of rod an hour. In a given day, including set-up time, a rod mill can produce over 2 million pounds

of copper rod. ***That's how much 120 African elephants weigh!***

Approximately 90% of copper produced goes through a rod mill.



## ACTIVITY:

### TIC-TAC-TOE

Place nine chairs in the middle of the classroom representing a tic-tac-toe diagram.

Divide the class into three groups. The Tic group on one side and the Tac group on the other. The third group is the Host group.

The Host group should prepare a number of questions to ask the Tic and Tac group about copper and mining. Members of the Host group take turns asking questions.

First ask a member of the Tic group a question; if the members answers correctly, then he/she takes a seat in any one of the nine chairs. If the answer is wrong, ask the Tac group the question.

Alternate groups as you call on new students. The group that can fill three chairs in a straight row (horizontally, vertically or diagonally) first is the winner. Either team can try to block the other from getting three in a row.

## ACTIVITY:

### Define the following words and phrases:

- Copper \_\_\_\_\_
- Ore \_\_\_\_\_
- Open Pit Mining \_\_\_\_\_
- Haul Truck \_\_\_\_\_
- Smelting \_\_\_\_\_
- Refining \_\_\_\_\_
- Leaching \_\_\_\_\_
- Pyrometallurgical \_\_\_\_\_
- Hydrometallurgical \_\_\_\_\_
- Safety \_\_\_\_\_
- Abandoned Mine Safety \_\_\_\_\_
- Recycling \_\_\_\_\_
- Reclamation \_\_\_\_\_
- Geologists \_\_\_\_\_
- Oxidation \_\_\_\_\_
- Electricity \_\_\_\_\_
- Plumbing \_\_\_\_\_
- Wire \_\_\_\_\_
- Slurry \_\_\_\_\_
- Tons \_\_\_\_\_



# The Importance of Safety

Safety is part of the culture of the mining industry. The use of massive equipment, chemicals and a lot of power make it essential that safety be at the forefront of the mind of every individual who enters a mine or processing site.

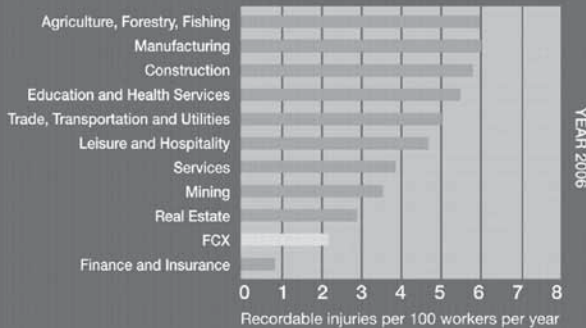
## Safety in Our Lives

The more information we have about safety and safe behaviors, the better the chance of living healthy and productive lives. The topic of safety is broad and there's a lot to learn through every stage of life - from childhood through old age.

*If safety is important, consider this...*

### Total Recordable Incident Rate

Recordable injuries per 100 workers per year (200,000 work hours)



Sources: U.S. Bureau of Labor Statistics, FCX

## Where Would You Want to Work?

- A mining operation?
- A retail store?
- A fast food restaurant?

## ACTIVITY:

### "Safety Issues!"

What safety issues directly affect your life?

How can you be safer in these situations?

- Playground \_\_\_\_\_
- Internet \_\_\_\_\_
- Pool/water \_\_\_\_\_
- Bike/skateboard/scooter \_\_\_\_\_
- Fire \_\_\_\_\_
- Car/driving \_\_\_\_\_

## Stay Out–Stay Alive!

Every year, dozens of people are injured or killed while playing on mine property.

Mines, whether they are old, abandoned or still operating, are very dangerous places. The only safe thing to do is STAY OUT and STAY ALIVE! Fences and "No Trespassing" signs are sometimes found on mine properties. You should never climb these fences to enter mine property. Some old abandoned mines may not have signs or fences. If you should find yourself at an old mine, quarry or gravel pit, leave immediately and stay away.



Do not walk anywhere near mine openings. The ground around shafts, open pits and caves can collapse without warning, and you could fall hundreds of feet down into these underground holes. At the surface, they may be hidden by plants or covered by rotting boards.



Do not swim in quarries, pits or mines. You could break your neck diving into the water. There could be sharp rocks or equipment near the surface, and the steep sides make it difficult to get out once you get in. Also, the water may be contaminated with chemicals.



Do not walk through or touch horizontal mine openings or supports. Timbers are used to support the mine's roof or walls and can rot easily. They may seem sturdy, but you could brush against them and cause the entire area to collapse or cave in.



Do not touch equipment or wires on the ground. They might explode. Unused explosives such as dynamite, black powder and blasting caps can be set off by your voice, a touch or a step.



Do not go into old mine buildings. Stairs, ladders or floors may collapse. Never play with equipment. Old buildings might contain explosives, electric hazards or other dangerous materials or equipment.



Do not climb or play on or around piles of tailings, rocks or sand. The entire pile can collapse or slide, hurting you or someone below you.

## Never go inside underground mines



...you could get lost or trapped and starve to death or die from thirst, exhaustion or exposure to the elements.



...you might get bitten by poisonous snakes, scorpions or spiders that often live in abandoned mines. Bears and mountain lions may make their homes there too.



...you might encounter poisonous gases in an abandoned mine. You can come upon these dangerous gases without warning as they are odorless and colorless.



# Mining and the Environment

Because mining can impact our surroundings, mining companies follow strict regulations to take effective, responsible steps to protect the environment.

## Impacts of mining :

It is inevitable that there will be some sort of environmental impact accompanying the exploration, extraction and processing of minerals. Impacts vary based on:

- The type of mining being done
- The land and water make-up at the mine location
- The manner in which the mining and processing operations are undertaken.

## How much of an impact?

A modern world relies upon mining for raw materials that are used to make many products. While it is important to understand that all mining impacts the environment, it is an interesting fact that metal mining has touched less than one quarter of 1% of all the land in the United States.

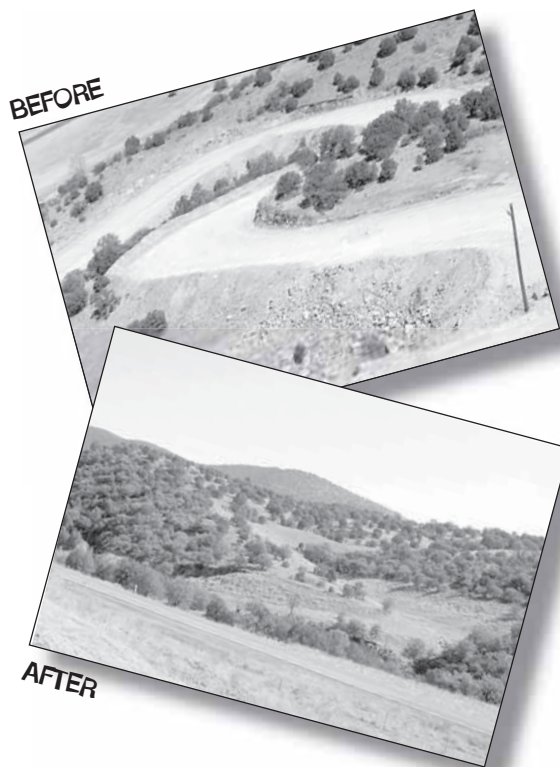
Less than .0002 of the land area of the United States is used by mining to produce the metal materials we use every day!



— Land area used by 50 years of metal mining (all metals, not just copper)

## Mine Reclamation

Planning and using environmental safeguards throughout exploration, mining, and reclamation can minimize the disturbances caused by mining. **Reclamation** is the restoration of mined land to a condition that protects human health, the environment and, where possible, returns the land to beneficial use.



Here are just a few steps that mining companies take. There are many others.

- Changing the slope of the impacted area to reduce erosion
- Removing or covering of soil with uncontaminated soil
- Treating or recycling contaminated soil
- Planting native plant species
- Changing direction of waterways to avoid exposure to minerals that might cause the water to become acidic
- Neutralizing acidic waters and moving metal contaminants
- Establishing wetland systems that naturally remove contaminants from water

## How Much Does It Cost?

The reclamation of copper mining sites is no small task. It is no small bill either! The costs of reclaiming a mine vary with the type of mine, location, size - any number of factors. Mining companies spend millions of dollars every year reclaiming and maintaining mined lands.

## Before Mining

Preparing a plan explaining how the company will mine and reclaim the land disturbed by mining is a good first step in the mining process. Environmental impact studies are completed to determine what type of impacts might occur when mining. The plan begins with the exploration phase and never stops. Mining companies need to take the responsibility of restoring mined lands very seriously.

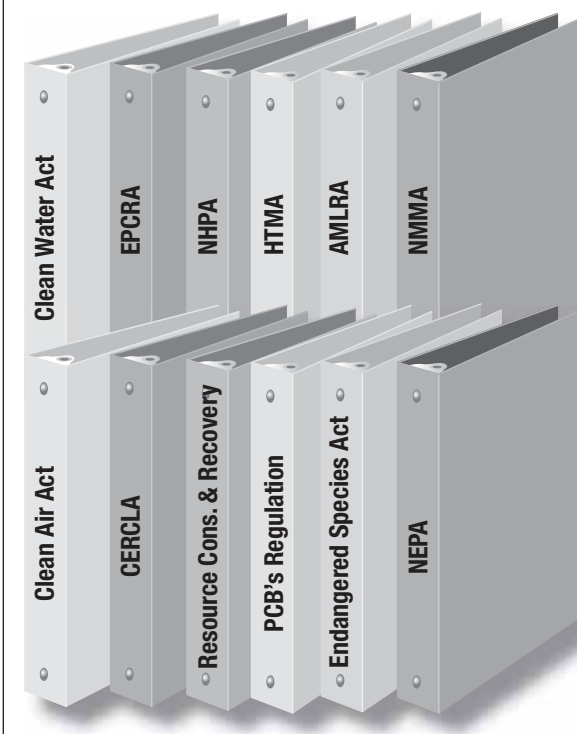
## Remediation

What can be done to restore mined land?

## Environmental Protection Laws

Below are a few of the environmental protection laws mining companies must follow when operating in the United States.

Environmental protection standards in the United States are some of the most stringent in the world and often serve as models for developing nations. Mining companies must meet strict standards for protecting the environment.





# Recycling Copper

## Infinitely Recyclable

Copper has been recycled since it was first mined. The coins in your pocket could very well contain copper that is thousands of years old. **Copper has an infinitely recyclable life.**

Copper is well suited to being recycled because it can be melted endlessly with no loss of properties. Copper plumbing, pipes and radiators are a major source of recycled copper. They can all be melted down and made into new products.

### Copper Quiz

1. Copper is a metal. (True or False)
2. Name a copper-bearing mineral.
3. Where is copper found?
4. The pyrometallurgical processing of copper is primarily used for what type of ore?
5. What is leaching?
6. A human needs copper as a part of their diet to maintain a healthy lifestyle. (True or False)
7. A baby born today in America will use an average of 1,615 pounds of copper in his/her lifetime. (True or False)
8. Bacteria will not grown on copper. That means it is what?
9. There is copper in chocolate. (True or False)
10. Which U.S. coins contain the most copper?
11. Copper is infinitely recyclable. (True or False)
12. The luster of copper is metallic. (True or False)

**ANSWERS:** 1. True; 2. Azurite/Malachite/Chrysocolla; 3. In the ground; 4. Sulfide; 5. A weak solution of sulfuric acid is sprayed or dripped onto ore to pick up copper as it passes through; 6. True; 7. True; 8. Copper is biostatic; 9. True; 10. dimes, quarters and half dollars; 11. True; 12. True.



## Can Recycled Copper Meet All Our Needs?

It is not possible to use recycled copper for all copper products. Copper must continue to be mined and processed to meet the world's demand for copper. The largest percentage of copper in use today is in the

form of electrical and electronic wire and cable. These products require the very pure sort of copper that flows from the mining process. In 2000, copper scrap provided 33% of the United States copper supply.

## ACTIVITY:

### "Erosion Landscape"

#### You will need:

- 2 large plastic trays (such as kitty litter boxes)
- a portable hand drill with 3/8" drill bit
- 1 watering can with a sieve style head
- soil mix (soil, sand, and gravel)
- grass seed (rapid growth)
- 2 coffee filters and coffee filter holders
- 2 empty juice cans or cartons of about 240 ml capacity
- wooden blocks to support the trays
- water

#### Procedure:

##### Part One

1. Drill a small hole at the end of each tray at the center 2.5 cm from the top.
2. Fill the two trays with soil mix to just below the drilled holes. Pack the soil mix slightly, but don't overdo it.
3. Leave one tray as it is, containing just the soil.
4. In a second tray, evenly spread a thin layer of rapid-growth grass seed over the entire area. Gently press the seed into the soil. Place the seeded tray on a sunny windowsill.
5. Using the watering can, gently water the grass seed daily. When the grass is firmly rooted, you are ready to conduct the experiment.

##### Part Two

1. Place both trays side-by-side on a table with the ends with the holes lined up near the table edge.
2. Place a wooden block under each tray at the end opposite the one with the hole.
3. Place a bench at the end of the table to serve as a platform for two coffee cans, which will serve as water catchments for water draining from the two trays.
4. Rest a coffee filter holder inside each coffee can. Place a filter in each filter holder.
5. Using waterproof tape, attach small "troughs" made from empty juice cartons or cans to the ends of the trays to guide the runoff from the trays to the filters.
6. Gently pour about 500 ml of water over the tray containing just the soil.
7. Record your observations.
8. Measure and record the volume of soil that drained into the coffee filter.
9. Gently pour the same quantity of water over the tray planted with grass seed.
10. Record your observations.
11. Measure the volume of soil runoff.
12. Compare the movement of water through sites that have plant cover to those that do not.



# Mining Careers

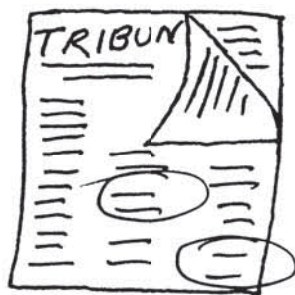
## Pick Ax & Donkey?

Not anymore! Mining has gone high tech. Mining relies heavily on technology and continually explores ways to further advance technology to improve the process for mining copper. There is always a need for talented people with technology skills to join the fascinating world of mining.

Working in the mining industry gives people the opportunity to travel and live in unique places around the world, to work outside and to help humanity by producing a resource we all need.

## Newspaper Activity

Look through the classified section of today's newspaper for job listings. Find at least five jobs that look interesting. What skills are needed for each job? Is a degree required? If so, what kind of degree is needed? Is there an age requirement? Does the position require previous experience? Does the ad mention salary or benefits? Is this a part-time or full-time position?



Go to the Freeport-McMoRan website, [www.fcx.com](http://www.fcx.com), and look at the job listings. What positions are open? Find five that look interesting. What skills are needed for each of these positions? Is a degree required? If so, what kind of degree is needed? Is there an age requirement? Does the position require previous experience? Does the ad mention salary or benefits? Is this a part-time or full-time position?

Would you be interested in any of these jobs?

The mining industry has a wide variety of jobs available for folks with a high school education or college degrees. Unfortunately, there is no way to list every career opportunity in mining in this short space. From Equipment Operators and Chemists to Engineers and Geologists, here are just a few:

- Blasters
- Drill Operators
- Environmental Engineers
- Chemists
- Belt Maintainers
- Environmental Services
- Exploration
- Electricians
- Geologists
- Hydrologists
- Mine Engineers
- Haul Truck Drivers
- Mechanics
- Metallurgists
- Operation Managers
- Shovel Operators
- Accountants
- Administrative Assistants
- Attorneys
- Government Relations
- Business Development
- Treasury
- Computer Information Systems
- Computer Programmers
- Community Affairs
- Communications
- Health and Safety
- Human Resources
- Pilots
- Purchasing Agents
- Sales
- Security Officers



Smelter Operator (Notice his safety equipment)



Powdermen



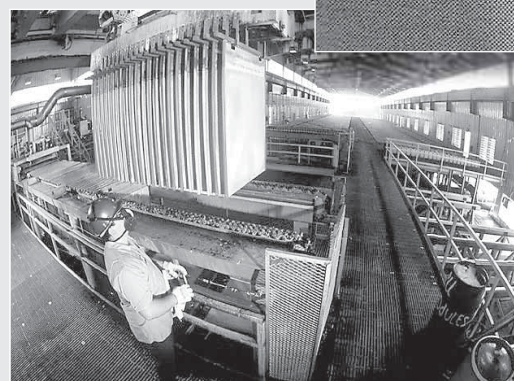
Research Technician



Shovel Mechanic



Shovel Operator



Process Operator (Notice safety equipment)



**Dig Into Mining**

Discovery Education and Freeport-McMoRan have partnered to create an interactive program for grades 6-8 that uncovers the use of transition metals such as copper, gold and molybdenum in our everyday life, and provides students a deeper understanding of today's hard rock mining industry. The initiative equips educators, students and families with dynamic resources - including a virtual field trip, interactive digital learning tools, and school-to-home connections with career exploration activities - designed to give students a front row seat to nature's geological wonders and inspire further exploration of the world around them.

[www.digintomining.com](http://www.digintomining.com)

**Mineral Education Coalition**

The Minerals Education Coalition's (MEC) mission is to identify, produce and disseminate fact-based K-12 minerals education lessons and activities and to inform and educate the general public about the importance of mining in their everyday lives.

[www.mineralseducationcoalition.org](http://www.mineralseducationcoalition.org)

**Copper Development Association**

The Copper Development Association Inc. is the market development, engineering and information services arm of the copper industry, chartered to enhance and expand markets for copper and its alloys in North America.

[www.copper.org](http://www.copper.org)

**Boy Scouts of America's Mining In Society Merit Badge**

Mining has been an important part of our nation since the 19th century. Today, the industry employs 3 million Americans, directly and indirectly, and is a major contributor to the global mining landscape. This merit badge covers the history of mining, explores the status of mining in the 21st century, introduces Scouts to modern mining careers, and explores the all-important topic of mining safety.

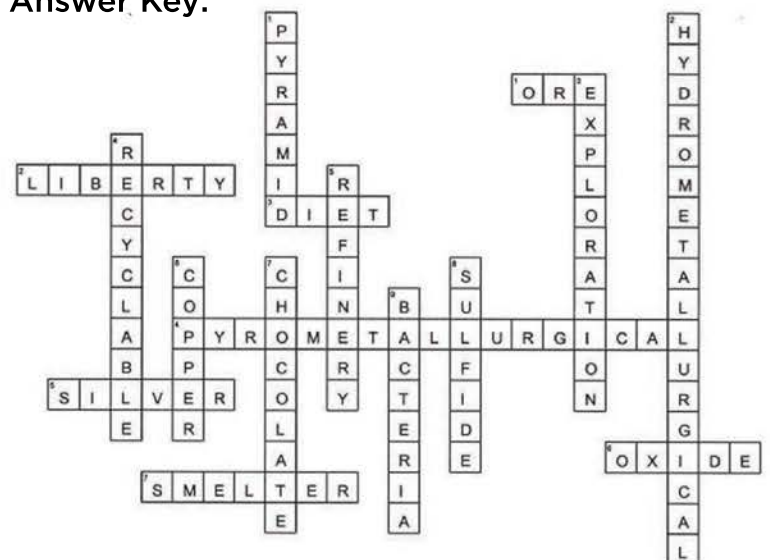
[www.scouting.org](http://www.scouting.org)

**Freeport-McMoRan**

Freeport-McMoRan Inc. (FCX) is a premier international natural resources company with headquarters in Phoenix, Arizona. FCX operates large, long-lived, geographically diverse assets with significant proven and probable reserves of copper, gold, molybdenum, cobalt, oil and natural gas. FCX has a dynamic portfolio of operating, expansion and growth projects in the copper industry. FCX is the world's largest producer of molybdenum and a significant gold, oil and natural gas producer.

[www.fcx.com](http://www.fcx.com)

[www.freeportinmycommunity.com](http://www.freeportinmycommunity.com)

**Answer Key:****CREDITS:**

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