ReadWorks®

ARTICLE-A-DAY™

The Earth's Resources

6 Articles

Check articles you have read:

- [ ] Biochar
  905 words
- [ ] The Allure of Gold
  1175 words
- [ ] The Elements of Jewelry
  932 words
- [ ] Where Did King Tut Get His Eyebrows?
  945 words
- [ ] High and Dry
  826 words
- [ ] Blood Mineral
  1477 words

Biochar

By ReadWorks

When researchers at the Virginia Polytechnic Institute Agriculture Program, also known as Virginia Tech, started work on a soil enhancement research project, they kept their minds open. The project was focused on the possible uses of biochar, charcoal used specifically for agricultural and other environmental applications.

Biochar has been in use for centuries. Pre-Columbian Amazonians used it as a means to revive nutrient-depleted soil. They burned agricultural waste under a cover of soil in order to create a layer of biochar in the ground. The resulting product is called "terra preta", or dark earth. Applying terra preta to this soil increased the agricultural yield of the land and enriched previously poor tribes and communities.

These Native Americans had discovered the benefits of using biochar as a soil amendment. When used in this way it doesn't only improve crop yield. It also improves water quality and reduces soil emissions of greenhouse gases, nutrients leaching, soil acidity, and irrigation and fertilizer requirements.

Biochar is still in use in South America. Scientists have learned that it is particularly good as a soil enhancement in areas with acidic clay soils and sandy soils. Biochar increases the soil's ability to attract and retain water. As a result, nutrients, phosphorus and agrochemicals are retained for the plant's benefit. Plants are therefore healthier and fertilizers leach less into surface or

groundwater. Biochar is a useful carbon sequestration tool. The hope is that rural farmers in Brazil will switch from traditional slash and burn farming to slash and char.

So what does an ancient agricultural technology have to do with the scientists at Virginia Tech?

The researchers at Virginia Tech work in environmental science. Many of them also live in central Appalachia. Central Appalachia is mining country. For generations, the area has been mined for coal. More recently, mining companies have been using a technique called mountaintop removal. This means they take layers of rock and mineral off the top of the mountain in order to get access to the coal seams inside. The removed mountaintop, called overburden, is replaced on the ridge and compacted to replicate the original mountain shape. Energy and environmental industry officials call these areas post-mined land.

Post-mining sites are difficult to reclaim. The resulting soil is highly acidic and infertile. The post-mined compacted soil proves more difficult to seed. The soil needs to be loose and open in order for seed to get into the soil. In post-mined land, the ground is too compact. Post-mining sites, therefore, typically look very different from the surrounding area. These sites are more likely to be home to invasive botanical species. Residents and environmental activists complain the landscape is ruined, that the mountain terrain is scarred.

Even if no new permits for mountaintop removal mines are issued, the problem of how to reclaim the post-mined sites remains. Researchers at Virginia Tech decided to try using biochar to help reforest the post-mining site soil. They got permission to apply a layer of biochar to a post-mining site before it was reseeded and replanted. What the team found was that the biochar worked, but not as well as they had hoped. Soil samples showed the biochar had improved the chemistry of the soil. But not enough biochar had been added to make a serious difference. Researchers learned they would have to seriously up the amount of biochar they applied to the site. The kind of biochar the team used, however, was expensive. It cost about $1,000 a ton. Ten tons per acre, the amount the researchers applied, wasn't enough biochar to make a significant improvement to the soil conditions across the site.

The research project had a practical constraint. The team was looking for a solution to the problem of post-mining land. If the biochar was going to cost a small fortune, it would not be feasible for local government or nonprofit groups to use in such large amounts.

The team went back to the drawing board. They redesigned the biochar tests by increasing the concentration of biochar in specific locations. In other words, the team created "planting cells" of biochar-enhanced soil on the post-mining site. Within these "cells" the soil recomposed itself quickly and well. The team had created healthy soil in which saplings could grow. Many trees die on post-mining sites, so improving the chances for individual trees to survive was a good result.

The team would have rather seen the same results with a small amount of biochar spread across the post-mining site. But getting some improvements, given the financial constraint, was better than nothing.

Happily, researchers working with biochar learned that its physical properties would make it ideal for working with other environmental problems. They hypothesized that the material would be useful in treating the biosolids that come from municipal waste, in other words, the sewage of urban areas. Urban waste is, in many areas, dumped into fields outside the municipality, creating zones that smell bad and can't be used for other purposes. The municipal waste is very wet and the biochar is very dry. Researchers hypothesized that biochar can be added to coat the waste to create a product that can be spread as fertilizer. In the process, the biochar reduces the smell of the waste and helps reduce greenhouse gases. Early studies show they are correct; biochar can be used in this way.

The Allure of Gold

By ReadWorks

The Egyptians used it to create funeral masks for their pharaohs. The Incas called it the "sweat of the sun." It is used to make medals for the best athletes in the world. It symbolizes wealth and riches. Over the centuries, gold has become important to humans. The heavy metal has cultural and economic meaning for human civilizations around the world. But this wasn't always the case.

Gold was used to make jewelry thousands of years ago. Some of the oldest pieces found date before 4000 B.C. Over the centuries, other cultures developed the ability to mine gold and began to use it to buy goods and services. The Ancient Greeks used gold as a form of currency and mined the metal throughout the Middle East and the Mediterranean. The Roman Empire also learned how to mine gold. Ancient Romans built waterwheels and diverted streams of water to extract gold from rivers.

The lure of gold has had a major impact on the course of history in the United States as well. When gold was found in California in 1848, it triggered a movement called the gold rush. Thousands of settlers moved west, hoping to find gold and become rich. In total, 300,000 people came from all over the world to California during the gold rush. Before the gold rush, San Francisco was a tiny town of only 200 people. By the end of the gold rush in 1870, San Francisco's population had grown to 150,000 people. Thousands of Native Americans were displaced by the new settlers and the natural environment was dramatically transformed.

So what exactly is gold? What are the properties of this metal that has become so important to

human society? Gold is a pure chemical element and its symbol on the Periodic Table is *Au*. The symbol, Au, comes from the Latin word for gold, *aurum*. Gold's atomic number is 79, one of the higher naturally occurring atomic number elements. Even for a metal, gold is quite heavy—over 19 times heavier than water.

Scientists believe that gold was formed by explosions in space. Dusts that contained metals, including gold, were spread by these explosions throughout the galaxies until they condensed into the solar system and planets where we now live. Because the core of the earth was hot and molten when the planet formed, almost all of the gold sank into the earth's core where we cannot reach it. The gold that humans now find on the surface of the earth came from asteroids that hit the earth billions of years ago.

Gold originally acquired importance to humans because of its appearance. In societies from India to Egypt, gold was used to make decorative objects and jewelry. Unlike silver and some other metals, gold does not lose its brilliance or tarnish when it is exposed to water or air. Gold is also exceptionally resistant to the effects of acid and does not corrode easily. Like other metals, gold is highly conductive of electricity. It can be used in electronics, but because it is so expensive it is rarely used. There are only two metals that are more conductive than gold, based on volume: copper and silver.

Gold is present in the planet's oceans, with significant amounts of the metal in and below the water. It is estimated that in all of the earth's seawater there are approximately 15,000 tons of gold. Although many people have tried to extract gold from the oceans, no one has been successful at recovering gold from seawater.

When it is unmixed with other metals, gold is actually quite soft and malleable. This flexibility makes it easy to use gold in many different ways. A single gram of gold can be hammered into a thin sheet that is one square meter. You can even hammer gold leaf until it is so thin, it becomes transparent.

Because gold is so soft, it is often combined with other metals to make an alloy. The rose gold or white gold that is often found in contemporary jewelry is made by combining gold with other metals including copper, silver, nickel and palladium. Pure gold is measured by weight. Scientists use another term, *karat*, to express how much gold is present when it is combined with another metal.

In these circumstances, pure gold is described as 24 karat gold. When gold is mixed with other metals, it becomes 22 karat, 18 karat, 14 karat or 10 karat gold.

Historically, gold was especially easy to melt and work with because it was often found in pure nuggets. Most other metals are only found in ore-bodies—mixes of rock and metals that are more difficult to separate. Gold is also found in ore, distributed in small particles or bands inside rock. When the rock breaks down naturally, for example, due to a river or stream passing over it, the gold particles are released into the debris. In the case of the river, this means that tiny gold nuggets can be found in the sand on the riverbank. There are other nuggets and rocks that look similar to gold, most notably pyrite (also known as "Fool's Gold"). Pyrite is an iron sulfide that looks like gold and may have very small amounts of gold in it. In addition to iron, gold is often found in metal solid solutions with silver or with quartz. A total of 174,100 tons of gold have been mined throughout human history and over three-fourths of this gold has been extracted since 1910.

Most of the gold currently sold in the world comes from mining. South Africa has one of the largest gold mining economies in the world. While this has brought wealth to the country, it has also caused some problems with pollution; mine waste releases harmful acid into the environment. As mines near the surface run out of gold, miners burrow deeper under the ground. Some gold mines are as deep as three miles under the earth's surface. Once a mine is dug, the gold must be extracted from the ground, separated from the ore, and then refined into pure gold. Only at that point can it be poured into bars for investment or made into fine jewelry. It may seem like a lot of work, but a single ounce of gold is worth as much as $1,300. It doesn't look like gold mining will stop any time soon.

Gold has impacted, and will continue to impact, human society and history. Whether used as jewelry or currency, gold carries value. Its properties—weight, durability, malleability, rarity, and beauty—combine to make it a natural symbol of wealth and prosperity. People want gold. Its pursuit has driven economic and technological development across the ages, all over the globe, from South Africa to California and beyond. But not without cost: the pursuit of gold has negative impacts, both environmental and social. Nevertheless, this precious mineral formed in space continues to inspire us. We, like the ancient peoples who first discovered it, are touched by the allure of gold.

The Elements of Jewelry

By ReadWorks

Stroll by a jewelry store on any day, and you'll see cases full of shiny items. Light glints off of gold rings, and silver necklaces sparkle against velvet backgrounds. The jeweler who owns the shop and makes the jewelry has to consider both beauty and science. Someone who earns their living by making beautiful things has to know a lot more than you might think. A jeweler makes beautiful rings, bracelets, and necklaces, but he or she also must know about many different stones and metals. Before a ring ever slips onto a finger, before a necklace ever drapes a neck, a series of decisions must be made about everything regarding the jewelry.

Jewelry is made of metals and stones with different characteristics. Every material in the world has its own properties, and a jeweler must know the characteristics of the materials he or she works with inside and out. By understanding the properties of metals and stones, the jeweler knows how they react, mix, melt, and hold up to everyday use. Jewelers sometimes blend metals themselves, but they often purchase metals blended by goldsmiths and forgers. As these workers shape and form the metal combinations, they begin to create the jewelry people wear.

Gold and silver are two of the most common metals used for jewelry, but they are very different if you compare them. Scientists know gold by its chemical symbol *Au*. Gold is a soft but dense metal. It

is malleable, which means it can be shaped. It can be hammered out into thin sheets, it can be ground into a thin powder, and it becomes liquid when heated. It can also conduct electricity. Gold has a bright yellow color and luster that does not tarnish in air or water. A jeweler knows all of the properties of gold and can identify it based on these characteristics.

Because gold is soft, it needs other metals to support it so that it can stand up to the normal wear-and-tear of life when worn as jewelry. It must be able to endure hand-washing, sweating, and being worn while working. So if pure gold is used in a ring, it will be very soft and might wear away, scratch, or dull over time. For this reason, pure gold is combined with other metals to form alloys used in jewelry.

Silver is less valuable than gold. It is also slightly harder. Scientists refer to silver with the symbol *Ag*. Silver has the best ability to conduct electricity of any element. It can exist in pure form, or combined with other metals as an alloy. Silver shines brightly when polished. Since ancient times, it has been used as a precious metal to make coins, ornaments, and silverware. A buyer might choose silver instead of gold because of its price and durability.

Although gold and silver have captivated the minds of adventurers and conquerors, there is another metal that is actually even more valuable: platinum. Scientists use the symbol *Pt* to represent it. It is silver-white in color, lustrous, and malleable, although not as malleable as gold. Its strength makes it resistant to wear and tarnish, and it does not easily corrode or wear away. Platinum makes strong and lasting jewelry, and jewelers prize it for that.

In addition, platinum is not very likely to create a skin reaction. Sometimes, jewelry can react to sweat on the skin. A green band can appear on the skin underneath a ring or bracelet where the metal rubs it. This happens when metals mixed with gold react to the acidity in sweat on the skin. That reaction makes the metal corrode, which forms a salt compound that gets absorbed into the skin and turns it green in patches. The higher the percentage of gold in jewelry, the higher the quality, and the less likely it is to create the green-skin effect.

Before jewelers and other workers transform metals into liquid and shape them, they understand what temperatures the metals must be subjected to in order to melt. Because metals are chemical elements, their melting points are predictable. Silver turns to liquid at 1763.2 degrees Fahrenheit. Gold will always melt at 1947.5 degrees Fahrenheit, and platinum always melts at a much higher temperature of 3214.9 degrees Fahrenheit. If jewelers or scientists aren't sure what type of metal

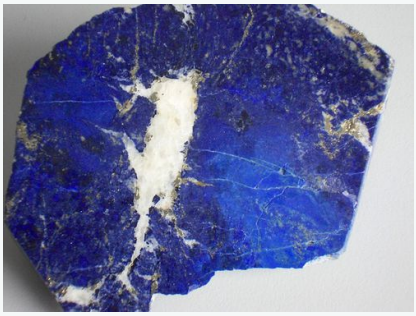
something is, they can subject it to high temperatures and determine its identity based on the minimum temperature needed to melt it.

What happens when a metal is melted? When a metal goes from solid to liquid, the change of state means the molecules change their behavior. Imagine that a solid piece of gold has molecules that are closely spaced and vibrate in position, but don't change their position in relation to other molecules. As temperatures rise and the state of gold changes to liquid, the molecules begin to move to other positions. They are in constant contact with one other.

Jewelers and goldsmiths are not the only people who make decisions about jewelry. The jewelry business employs many people who work with and assess precious metals and stones. Gemologists analyze the characteristics of gemstones and then certify their quality. They use microscopes and other tools to examine gemstones to check for purity and strength. Then, they write reports and documents that certify the quality of these items. There are also jewelry appraisers who carefully examine jewels and assess their value for pawnbrokers, jewelry stores, and insurance companies. Like jewelers, both appraisers and gemologists must understand the properties of the stones and metals they see every day.

Where Did King Tut Get His Eyebrows?

By W.M. Akers



lapis lazuli

In 1922, English archaeologist Howard Carter discovered something spectacular. In Egypt's Valley of the Kings, an underground passage led to an empty room, long ago looted by grave robbers. But searching along the walls of the room, Carter's team found something strange: a secret panel that opened a hidden chamber. Inside was an array of ancient objects, but the most spectacular treasure was farther inside.

Working carefully, Carter and his team spent three weeks excavating the tomb. When they were finally ready, Carter opened the door to the burial chamber inside the tomb. He became the first person in 3,000 years to look upon the sarcophagus of Tutankhamen, an Egyptian pharaoh popularly known as King Tut.

Inside Tutankhamen's tomb were hundreds of artifacts. These included sculptures, gold, and four chariots. There were flowers that had been picked five centuries before the founding of Rome. When the air touched them, Carter watched them disintegrate. But of all the marvels inside Tutankhamen's tomb, none would become more famous than the mask of the pharaoh himself.

Tutankhamen was very young when he became king—only eight or nine years old. He spent his reign living as a child while his advisors made the decisions that affected the kingdom. After about a decade of rule, during a war with the neighboring kingdom of the Hittites, Tutankhamen died suddenly. No one knows how he died, but researchers have speculated that it could have been because of an inherited disease or because of an accidental fall, perhaps from a chariot.

Tutankhamen was mummified in the traditional fashion and buried in a sarcophagus inside his tomb. On top of the sarcophagus sits a mask made of 24 pounds of solid gold. It shows the boy king wearing an elaborate ceremonial headdress with a long fake beard attached to his chin. It is a beautiful piece of craftsmanship, and must have astonished Howard Carter and the other archaeologists when they discovered it.

Never had a pharaoh's tomb been so well-preserved. By inspecting all of the objects they found, the archaeologists were able to learn an incredible amount about a king who had been largely forgotten. The news of the discovery sparked a worldwide interest in Egyptian culture that affected fashion, architecture, and popular culture all over the Western world. And King Tut's mask was the symbol of the revival.

Of all the features of the mask, perhaps the most interesting are the pharaoh's eyebrows. These thick arches are bright blue, matching the stripes on the headdress, and are made of one of the rarest substances in the ancient world: a stone called "lapis lazuli," which has a history just as interesting as King Tut's tomb itself.

The ancient Egyptians were talented traders, sending caravans across the desert and boats over the sea. Although the area around the Nile River was rich in some materials, there were many that could not be found there and had to be sent for from far-off lands. Egyptian merchants traded for wood with Lebanon, copper with Cyprus, and incense with the kingdom of Punt. In return, they sent materials that Egypt had in abundance, such as papyrus (an early form of paper) and grain.

But of all the rare goods coveted by the Egyptian ruling classes, few were rarer, or came from farther away, than the stunning blue stone known as lapis lazuli. Its color was rich blue—so blue that the stone's name means "sky stone"—flecked with what appeared to be bits of gold. Across the ancient world, its beauty was prized. Unfortunately, it was very hard to get.

The stunning substance was found only in one place on Earth: the mines of Badakhshan, in what today is northeast Afghanistan. A rugged, mountainous country, it was difficult to extract the rocks, and once they had been mined, it was difficult to send them away. But the stone was valuable enough that traders would risk anything to bring it to market.

Two trade routes led from Badakhshan westward toward the Middle East and Egypt. One, the "northern route," led across the treacherous landscape on the upper border of what is today Iran.

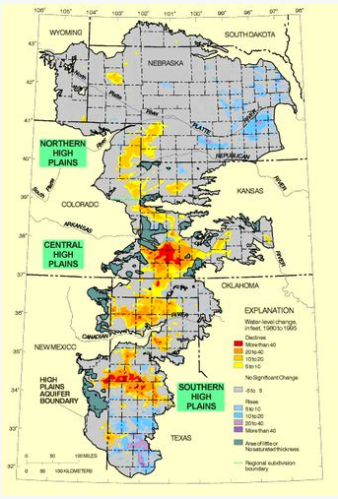
The second, the "southern route," began on the Helmand River, proceeding through ancient settlements into the lush land of Mesopotamia. From there, traders continued by land to Egypt, or made their way to the Red Sea to complete their journey by boat. In all, the trip took longer than 2,000 miles—a difficult journey today, but an unfathomable one in 1100 B.C.

Lapis lazuli had many uses for the Egyptians. It was considered a sacred symbol of several gods and goddesses and would be given as an offering to them by those who sought their favor. Judges wore it as a pendant around their neck to symbolize that their power came from Maat, the goddess of truth and balance. And most famously, it was ground into a powder to use as eye shadow and to draw the sacred Eye of Horus. This may be the reason that, when it came time to craft a death mask for Tutankhamen, lapis lazuli was used around the eyes.

The material was so rare that when it came time to make the blue stripes on Tutankhamen's headdress, less-expensive imitation lapis lazuli was used. But for the eyebrows, nothing else would do. Today, you can see the mask on display at the Egyptian Museum in Cairo, Egypt. The eyebrows are as vibrantly blue as they were when Howard Carter discovered them in 1922—and most likely as blue as they were when they were pulled from the earth in Afghanistan, more than 3,000 years ago.

High and Dry

By Kirsten Weir



changes in the Ogallala aquifer from 1980 to 1995

High Plains residents are draining their hidden water supply.

The state of Nebraska gets its name from the Native American word for the "flat water" that flows across its plains. Today we call that water the Platte River. Turns out the state name is more fitting than those early Nebraskans imagined. The state sits atop a vast pool of underground H2O known as the High Plains *aquifer*.

An aquifer is an underground layer of rocks or soil that holds significant amounts of water. The High Plains aquifer, also called the Ogallala aquifer, is one of the largest groundwater reservoirs in the world. It lies under nearly the entire state of Nebraska, as well as parts of Colorado, Kansas, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming.

For decades, residents of those states have been extracting water from the aquifer. But all that pumping has taken a big toll. Could the huge store of groundwater be tapped dry one day?

Major Pileup

The High Plains aquifer was born from the action of wind, water, and a really big crash. About 65

million years ago, two *tectonic plates* began to collide along the western edge of North America, slowly pushing the Rocky Mountains high into the sky. Tectonic plates are enormous sections of Earth's rigid shell. Even as the mountains were being pushed skyward, wind and water began *weathering* (gradually breaking down) the peaks and carrying away the *sediment* (bits of sand and rock), says James Goeke. Goeke is a *hydrologist* at the University of Nebraska in Lincoln. A hydrologist is a scientist who studies water on or below Earth's surface.

Rivers and streams carried sediment from the mountains eastward, where it slowly built up to form the High Plains in the western-central United States. In the process, water was trapped underground. That all happened between 5 million and 20 million years ago, says Goeke, and the aquifer has existed ever since.

The thickness of the High Plains aquifer varies from place to place. In some spots, it's a few feet thick. In others, it's 1,000 feet. In some areas, the aquifer is largely gravel, with a lot of room for water between the rocks. In others, the aquifer is essentially tightly packed sand that holds less water.

Since the 1940s, when pumping began, 88 trillion gallons of water have been extracted from the aquifer, estimates Virginia McGuire, a U.S. Geological Survey scientist. Enough water to equal the volume contained by 18 Colorado Rivers is sucked from the aquifer every year.

America's Breadbasket

Where does all that water go? "Over 95 percent of the water that's pumped is for irrigation," McGuire says. Nineteen percent of the country's wheat, 19 percent of its cotton, and 15 percent of its corn are grown in fields overlying the aquifer. The High Plains states make up the heart of "America's breadbasket," the Midwestern region whose grains feed millions of people. Without irrigation, the High Plains crops would wither and die.

Already, farmers are feeling the pinch of the dwindling groundwater. In parts of Texas and Kansas, water levels have dropped more than 45 meters (150 feet). Farmers in those areas have to dig more and deeper wells to extract enough water for their fields, Goeke says. "As the water levels drop, you have to pull the water from ever-greater depths," he says. "It's more expensive to irrigate." In some places, farmers have abandoned their wells altogether.

Water does make its way back into the aquifer. Rain trickles into the soil and becomes groundwater. Surface water also helps restore the aquifer. In some places, water from rivers and streams seeps through layers of rock until it, too, joins up with the groundwater. But people are taking out water much faster than nature is able to replace it. If the pumping stopped today, it would take 6,000 years of rainfall to replace the water that has been removed. Meanwhile, the pumping continues.

High Plains farmers and researchers are looking for ways to save water. Some farmers have switched from corn, a very thirsty plant, to other crops, such as wheat and sunflowers, that don't need as much water. Plant researchers are trying to create new varieties of corn that thrive in drier conditions.

New irrigation systems also can reduce water consumption. Traditional irrigation systems spray water over an entire field, but much of it evaporates before the plants can soak it up. Newer drip irrigation systems supply water directly to the plants' roots so that less water is lost to evaporation.

The situation in the High Plains isn't unique. Aquifers are a source of water for billions of people around the globe. We need to conserve them, says Goeke. "In many cases, I don't think we use water as wisely or efficiently as we might be able to," he adds. "Water is so critical to our existence. We can't afford to waste it."

Blood Mineral

By Joshua Kors

War rages in Africa over a remarkable metal used to make cell phones and MP3 players.

Ever wonder where the metal inside your MP3 player comes from? Chances are the source is an impoverished country in the heart of Africa: the Democratic Republic of the Congo.

Though Congo's people are desperately poor, their land is stunningly rich in diamonds, gold, silver, tin, uranium, and a mineral called coltan. To the untrained eye, coltan looks worthless. But it contains one of the most valuable metals on Earth: tantalum. It's that metal that helps power cell phones, MP3 players, and video game consoles.

"Coltan is vital to the function of modern society," says Andrew Campbell, a professor of mineralogy at the New Mexico Institute of Mining and Technology. "It is an incredibly precious mineral."

Precious and rare. Sixty-four percent of the world's coltan is underground in Congo. In recent years, the demand for cell phones has skyrocketed—and with it, the value of Congo's coltan. That rise in demand has sparked a mad scramble among corrupt governments, violent militias, and wealthy companies, all struggling to get their hands on the mineral. The result has been one of the bloodiest wars in world history. Since 1996, 6 million people have been killed. The International Rescue Committee estimates that 45,000 Congolese are dying every month.

Keith Harmon Snow has witnessed that bloodshed. Snow is an investigator for the United Nations. He was living in Congo with a family of poor peasants when the entire family was killed by soldiers from the neighboring nation of Rwanda.

"That's the way it is there. The militias control the land. They'll take a 9-year-old boy, put a gun to his head, and force him to dig up the coltan and haul it away," says Snow. "It's a slavery situation. They make sure no one steps out of line."

The militias are brutalizing the girls they find in Congo's villages too. "It's a war tactic," says Maurice Carney, cofounder of the aid organization Friends of the Congo. "The idea is to terrorize

the communities that live on this resource-rich land, to move them off the land so the rebels can control it. Then they dig up the coltan and sell it to international corporations."

What Is Coltan?

Coltan is the informal name for *columbite-tantalite*, a dull black *mineral*. A mineral is a naturally occurring solid that forms geologically. It is classified on the basis of chemical makeup, crystal structure, and physical properties, such as hardness, color, and luster.

Coltan contains two precious metallic elements: niobium (once known as columbium) and tantalum. The two have similar chemical properties. For decades, scientists believed that they were the same element. Today niobium is used to make airplane engines, rockets, and some coins. Tantalum is a key component in handheld devices, such as cell phones and MP3 players.

What makes tantalum useful in cell phones and other gadgets? All metals heat up when given an electrical charge, and electrical circuits can break down if they overheat. But tantalum easily releases its heat, allowing the circuitry in cell phones to function smoothly.

Electronics companies use tantalum to create *capacitors*, components that store an electrical charge. Companies have long used aluminum capacitors for major appliances, such as refrigerators, washing machines, and air conditioners. But aluminum capacitors aren't perfect. They can leak a high amount of electrical charge. When placed in hot environments, the amount of electricity the capacitors can hold drops dramatically.

Tantalum capacitors, though, leak less and hold a large amount of electricity even after years in a tight, hot cell phone or MP3 player. "Many metals can be used to conduct electricity—iron, aluminum, copper—but the tantalum you find in coltan is best at dissipating heat, which makes it perfect for certain electronics," says Campbell. "The tantalum found in coltan is what makes cell phones, computers, and all our other gadgets possible."

Newscom

Coltan and other valuable minerals in Sud-Kivu province lie close to the surface and are easily extracted. The process of weathering (the breakdown of rocks by chemical, mechanical, and organic processes) has worn down softer rock, exposing the hardier metals, such as gold, tin, and coltan. In this photo, two boys search for gold in a stream.

Black Gold

The Congo war creates an obvious dilemma for consumers who need handheld devices but don't want to fund the militias who are brutalizing Congo's people. "It's hard to tell people, 'Don't buy a cell phone, an iPod, a computer.' But at least, people should know where those devices come from," says Snow.

Joe LeMonnier

Sud-Kivu province in Congo is rich in natural resources, such as coltan (niobium and tantalum), tin, gold, and uranium. It is an area of volcanism (volcanic activity). The process of volcanism brings magma (molten rock) to Earth's surface, where it cools and solidifies into igneous rock. Igneous rock is often rich in minerals containing valuable metals.

Congo is not the only place where coltan can be found. There are untapped reserves in Canada, Brazil, and Australia. The problem with those reserves, says Campbell, is that the coltan isn't nearly as easy to mine as it is in Congo.

Australia shut down its coltan mine in December 2008. The head of Australia's mining operation, Peter Robinson, says his mine just couldn't compete with the low price of Congo's coltan.

"When you dig, the metal you're looking for will always be a small percentage of what you dig up," says Campbell. "In a copper mine, for example, you'd be lucky if three-tenths of 1 percent of the rocks you dig up are copper. In a gold mine, it's way lower than that. And with coltan, the percentage is probably even lower."

That's why the abundant, highly concentrated coltan in Congo is so tantalizing to technology companies. "Coltan would be so much more expensive to mine in other countries," says Snow. "You'd have a lot more rock to sort through. And you wouldn't get the savings that come with slave labor."

Rebel Control

Even if Congo remains the center of the world's coltan operations, there are possibilities for reform there, Carney says. His group's mission is to help end the war and help Congo's people regain control of their nation's resources.

"The people of Congo deserve their fair share, but reform is tremendously difficult because politically the nation is so unstable," he says. "Militias control different coltan supply networks. They fight with each other. They trade with each other. Power shifts all the time. Then one person gets shot, and the whole network gets redefined."

Carney points out that while the violence and war crimes are horrific, the number of perpetrators is quite small. "Congo is a nation of 66 million people, and it is being held hostage by no more than 6,000 rebels," he says. "The only reason they have such firm control is because the people are so poor and the rebels are so well financed by companies outside the country who want access to their minerals."

For now the bloodshed and the rush to find more coltan continue. "This is what wars have been

fought over for all of history: religion and resources," says Campbell. "People aren't going to stop buying cell phones." So the person who has the metal to make them "is going to hold a lot of wealth and a lot of power."

Africa at War

Congo's history was bloody and chaotic long before the coltan war began. For decades, the country lived under the brutal reign of Belgium's King Leopold II. In 1960, the nation won its independence, but its new prime minister, Patrice Lumumba, was murdered several months later.

That left Congo in the hands of Mobutu Sese Seko, a corrupt general who ruled it for more than 30 years. Seko crushed opposition to his power, stole billions from state-owned companies, and purchased a fleet of luxury cars while his people lived in poverty.

In 1994, simmering tensions between two ethnic groups in Rwanda, the Hutu and the Tutsi, culminated in civil war. The Hutu slaughtered 800,000 Tutsi in fewer than four months.

Two years later, Rwanda and nearby Uganda invaded Congo. Their aim was to eliminate the Hutu responsible for the Rwandan *genocide* (mass murder) and who were hiding in Congo's eastern forests. The invasion pushed Seko, Congo's dictator, from power. He was replaced by a rebel leader, Laurent Kabila, who was soon assassinated.

That instability set the stage for a broader, even bloodier battle. By 1998, forces from eight different nations were at war—a fight fueled by ethnic tensions, a thirst for power, and a hunger for Congo's vast natural resources. The coltan, gold, diamonds, tin, uranium, and other minerals in Congo's soil are worth approximately $24 trillion, according to a recent report in *Africa Today.*