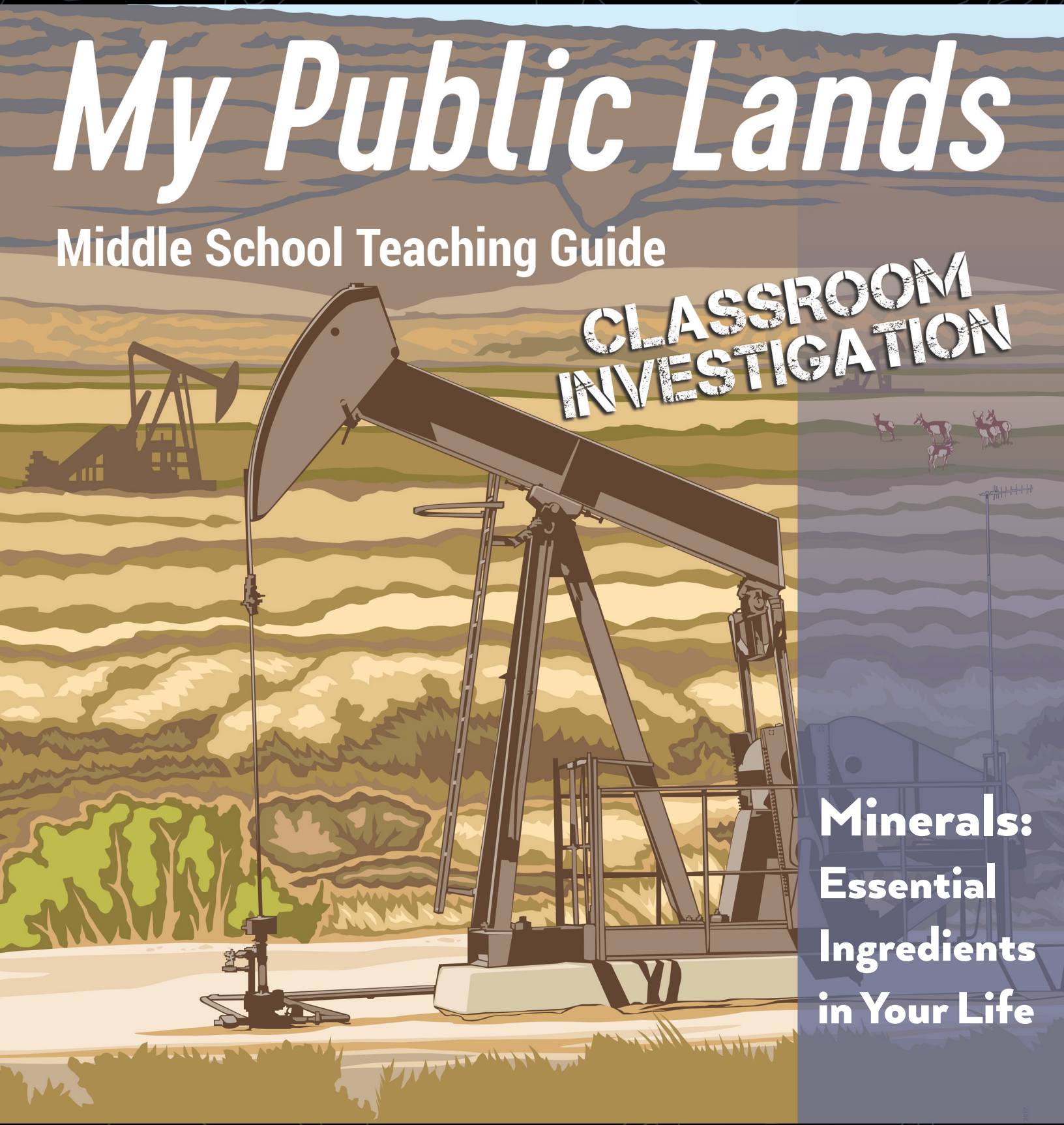
U.S. Department of the Interior
Bureau of Land Management

My Public Lands

Middle School Teaching Guide

CLASSROOM INVESTIGATION



Minerals: Essential Ingredients in Your Life

Dear Teacher,

Welcome to this Classroom Investigation Series unit about the importance of minerals. Its main aim is for students to understand the sources of the minerals that go into products they use every day.

Through this teaching guide, students learn to identify the various minerals that are used to make all sorts of products, from personal care items and cell phones to kitchen tools and hybrid cars. They also explore one mineral, cobalt, and determine whether it is necessary for the United States to mine it domestically. By weighing different considerations about cobalt mining, students learn how land managers apply the principle of multiple use and sustained yield. As students begin to understand the complexity of multiple-use management, they gain an appreciation of diverse views and avoid the simplistic sloganeering that can bedevil land use decision making. They discover how BLM land managers balance minerals development, recreation, respect for American Indian tribes and Alaska Natives, grazing, and habitat protection. Once they understand the BLM's complex multiple-use mission, students may become well-informed, lifelong allies of public lands.

Although designed for middle school students, the unit can be adapted for high school and upper elementary levels. Civics teachers who are covering public participation or environmental issues may find the unit especially useful, as may science teachers who want to illustrate how minerals show up in everyday life.

The unit supports innovative strategies in education, such as:

Social and emotional learning: Students participate in small groups in which they work together, listen and speak to one another, and collaborate.

Interdisciplinary instruction: As they progress through the unit, students examine science topics, such as the uses and availability of minerals and elements, as well as civic issues, including the tradeoffs facing land managers when they decide whether to allow mining for minerals.

Each activity takes 45 minutes to conduct, and one of them includes an extension idea. The activities work best as a collective unit that progresses from introducing the uses of minerals to the variables involved in deciding whether to mine cobalt domestically.

Curriculum Connections

This unit addresses the following Next Generation Science Standards:

- MS-ESS3-1: Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.
- MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

This unit also supports standard D2.Civ.3.6-8 of the "College, Career, & Civic Life C3 Framework for Social Studies State Standards," published by the National Council for the Social Studies: Examine the origins, purposes, and impact of constitutions, laws, treaties, and international agreements.

The activities address the following essential understandings:

- Minerals are essential to all of the products used in everyday life.
- There are tradeoffs involved in mining minerals in the United States and in relying on imports of minerals.
- Public land managers must balance tradeoffs as they make decisions about mineral mining projects.

About the Bureau of Land Management

The Bureau of Land Management (BLM) manages more than 245 million acres of public land located primarily in 12 western states, including Alaska. The BLM also administers 700 million acres of subsurface mineral estate throughout the nation. The agency's mission is to sustain the health, diversity, and productivity of America's public lands for the use and enjoyment of present and future generations. Diverse activities authorized on these lands generated $96 billion in sales of goods and services throughout the American economy in fiscal year 2017—more than any other agency in the Department of the Interior (DOI). These activities supported more than 468,000 jobs.

The DOI and the BLM carry out their overlapping missions by encouraging the responsible development of energy and minerals on public lands; working as good neighbors with partners and communities to promote multiple-use on public lands; supporting working landscapes to boost employment; and providing access to hunting, fishing, camping, hiking, and other recreational opportunities. Making BLM-managed lands accessible for recreation benefits visitors' health and enhances visitor appreciation for America's public lands. As visitors gain appreciation for public lands, they deepen their understanding of shared conservation stewardship, habitat preservation, and multiple-use management.

The BLM, along with other DOI agencies, relies heavily on volunteers. Youth and families who are inspired to volunteer on public lands will see, firsthand, that multiple-use land management balances energy and mineral development, recreation, respect for American Indian tribes and Alaska Natives, grazing, and habitat protection. Recreation and volunteer experiences on public lands can turn casual visitors into well-informed, lifelong allies of public lands who understand the BLM's mission.

The Importance of Minerals

The U.S. Geological Survey (USGS), an agency within the DOI, introduces the importance of minerals as follows on its website *(https://minerals.usgs.gov/granted.html)*:

> Did you know that the average automobile contains more than a ton of iron and steel, 240 lbs of aluminum, 50 lbs of carbon, 42 lbs of copper, 41 lbs of silicon, 22 lbs of zinc, and more than thirty other mineral commodities, including titanium, platinum, and gold? Do you know the cost of a pound of copper or an ounce of platinum? Though you are constantly reminded of the importance of gasoline, and its cost, to keep the car running, do you ever think about the importance and cost of the mineral materials that make up the car? Do we take minerals for granted?
>
> When the power goes out, few of us give a second thought about the copper and aluminum needed to carry electricity from the power plant to our homes or offices. When the battery dies, you do not automatically think about the lead, nickel, cadmium, or lithium used to make the batteries that store power for our cell phones, MP3 players, or hybrid cars, because you do not buy minerals, you buy products that have been manufactured using mineral materials. But without these nonfuel mineral commodities, many things that we take for granted would not work.
>
> Minerals in the environment and products manufactured from mineral materials are all

around us and we use and encounter them every day. They impact our way of life and the health of all that lives. Minerals are critical to the Nation's economy and knowing where future mineral resources will come from is important for sustaining the Nation's economy and national security.

Many of the minerals that are used throughout the economy are mined on BLM-managed public lands. Such mining is conducted in compliance with the BLM's surface management regulations and other environmental laws. The BLM website describes the BLM Energy and Minerals Program in part as follows:

> The [1872] Mining Law, as amended, opened the public lands of the United States to mineral acquisition by the location and maintenance of mining claims. Mineral deposits subject to acquisition in this manner are generally referred to as "locatable minerals." Locatable minerals include both metallic minerals (gold, silver, lead, copper, zinc, nickel, etc.) and nonmetallic minerals (fluorspar, mica, certain limestones and gypsum, tantalum, heavy minerals in placer form, and gemstones).

Starting in 1873, the DOI began defining locatable minerals as minerals that:

- are recognized as a mineral by the standard experts
- are not subject to disposal under some other law
- make the land more valuable for mining than for farming

For more information about how the BLM applies multiple-use principles to land use dilemmas, visit *https://www.blm.gov*.

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Activity 1: Minerals in Everyday Life

Time Estimate

45 minutes

For the Teacher

This activity addresses the following essential understanding:

- Minerals are crucial components of countless products used by people every day.

Learning Objectives

Students will be able to (1) identify products in the home that are composed of minerals, and (2) describe the minerals used in cell phones and the geographic origins of those minerals.

Overview

This activity introduces students to:

- The minerals that go into numerous consumer products.
- The geographic areas where these minerals are found and mined.
- The extent to which cell phone features depend on minerals.

Teacher Preparation

1. Make enough copies of the handout "Minerals in Our Environment" (rooms 1–4) so that each student has a handout for one of the rooms.
2. Make enough of the seven mineral handouts for every student in each small group to have a handout about one mineral.[1]
3. Read "A World of Minerals in Your Mobile Device," from the USGS.

Procedure

1. Let students know they will explore the minerals in products they use every day, from routine household goods to complex cell phones.
2. Divide the class into four groups of roughly equal size. Assign each group a different "room," and distribute "Minerals in Our Environment, Room 1" to group 1, "Minerals in Our Environment, Room 2" to group 2, and so forth. From the handout, ask groups to identify at least three products that are made from petroleum, and have each group select a spokesperson.

[1] Mining locations on the handouts are listed in order of the most productive sources.

Procedure, continued

3. Reconvene the class into one unit. Ask each spokesperson to share the items that depend on petroleum. Point out that public lands provided more than $59 billion worth of oil and gas in fiscal year 2017, supporting 284,000 jobs. Note that non-energy minerals also come from public lands, including some that are essential in constructing cell phones.

4. Divide the class into seven groups of roughly equal size. Provide the wolframite handout to one group, the tetrahedrite handout to another group, and so forth until each of the seven groups has its own mineral handout. Explain to students that they will be working in two different groups: a learning group and a teaching group. In the learning group, they will read and talk about a mineral. Doing so will prepare them to become an "expert" in the teaching group about how that mineral is used in cell phones.

5. Learning Group: Depending on how large the class is, there might be four or five students in each of the seven learning groups. Students should read their group's handout and talk about how to explain the mineral's use in cell phones to other students. Once each learning group has finished discussing its mineral, have students within each group count off 1 through 4 or 5 (depending on how many are in the group). Then assign students to a teaching group by asking all the "1s" to form a group, all the "2s" to form a group, all the "3s" to form a group, and so forth.

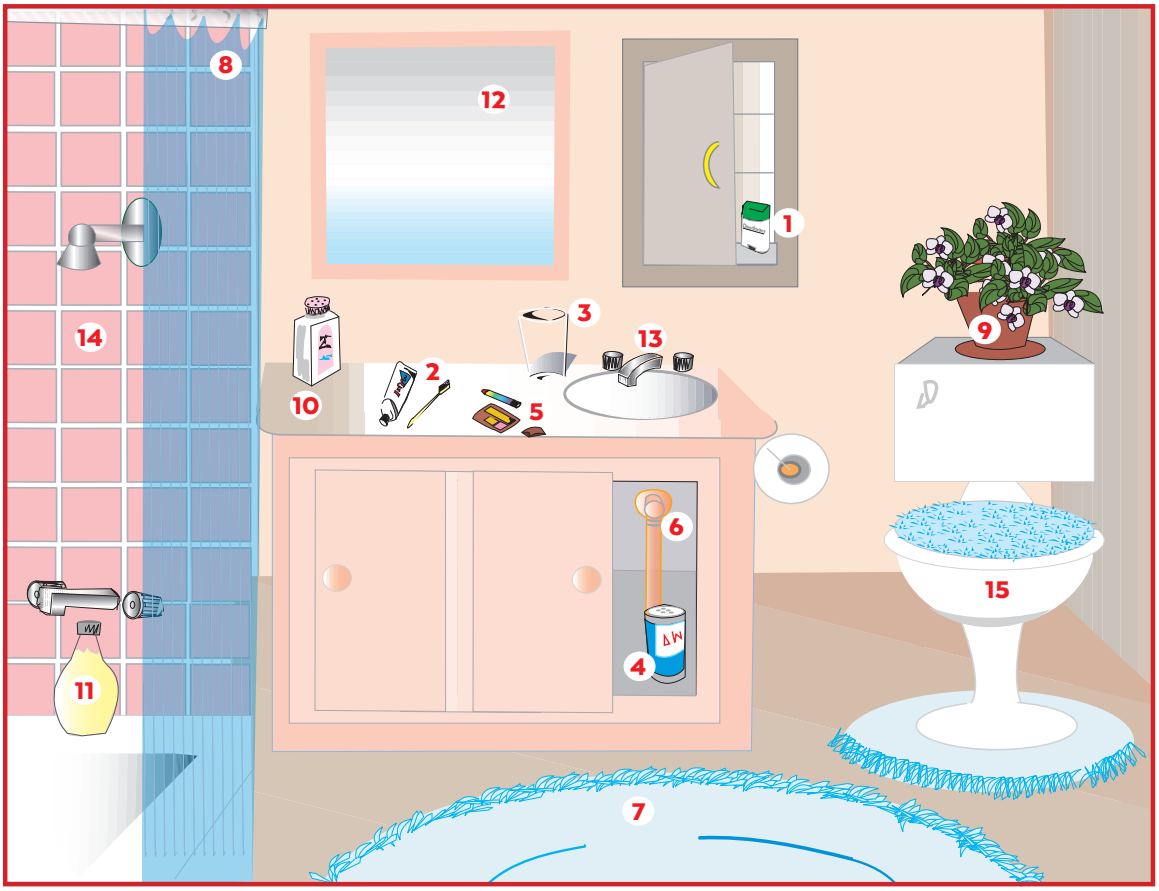
6. Teaching Group: Every teaching group should have seven students, one "expert" for each mineral. Each "expert" has 2 minutes to teach the other six members of the group about their mineral. First, the chalcopyrite "expert" explains how chalcopyrite is used to make cell phones. Then the tetrahedrite "expert" explains how tetrahedrite is used to make cell phones. Then the wolframite "expert" describes how wolframites are used to make cell phones, and so forth through all seven minerals. By the end of the teaching group, all the students will know about seven minerals and how they contribute to cell phones.

7. Discussion: Reconfigure the class into one unit and ask: What key functions of cell phones would be impossible without the minerals you explored today? Point out that public lands provided more than $13 billion worth of non-energy minerals in fiscal year 2017 for cell phones and numerous other products, supporting more than 48,000 jobs.

Assessment

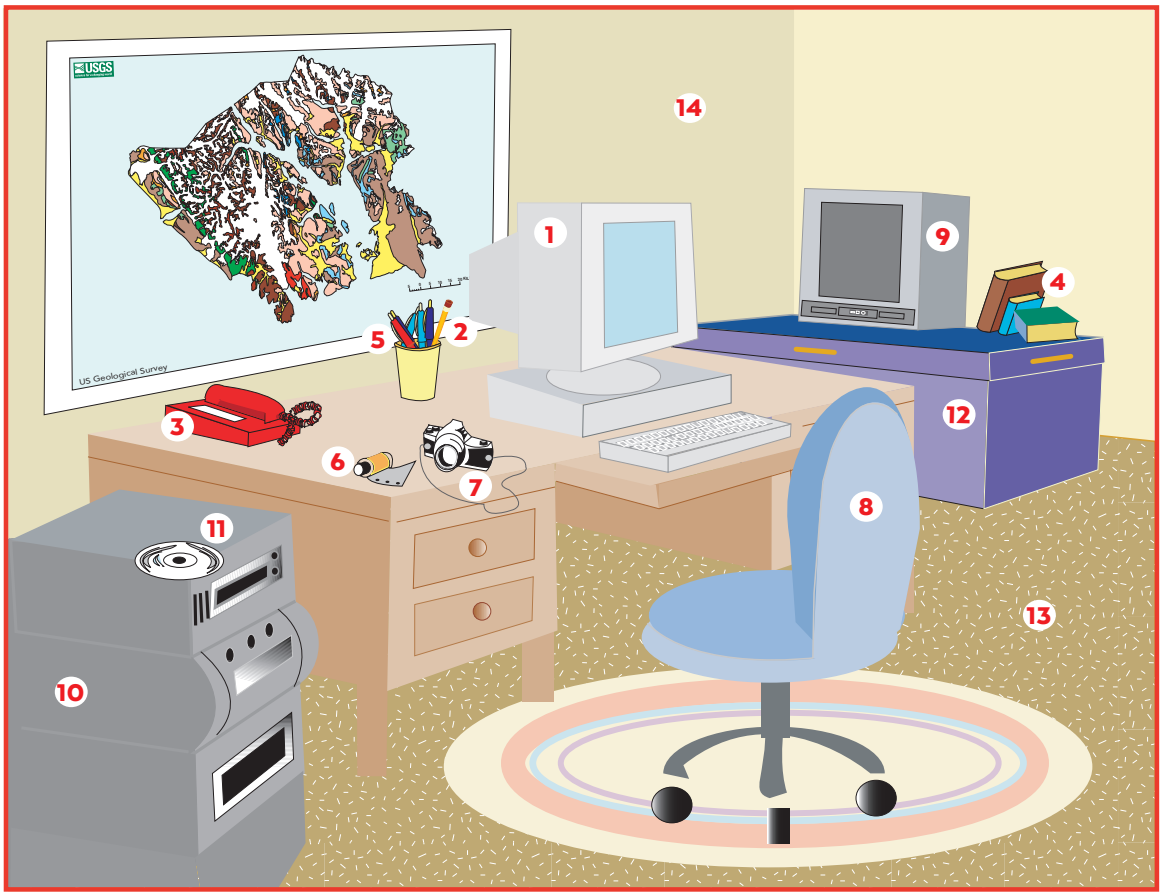
Circulate among groups to determine how well students understand and can teach the content on the handouts.

Minerals in Our Environment – Room 1



1. **Deodorant:** Includes aluminum and the container is made of petroleum products.
2. **Toothpaste:** Includes fluorite, barite and calcite. The container is made of petroleum products or aluminum.
3. **Drinking Glasses:** Includes feldspar, silica and soda ash.
4. **Abrasive Cleanser:** Includes silica or calcite.
5. **Lipstick And Makeup:** Includes clay, mica, talc, limestone and petroleum products.
6. **Plumbing:** Made of copper, clay and petroleum products.
7. **Rugs:** Includes limestone, petroleum products and selenium.
8. **Plastic Shower Curtains:** Contains petroleum products.
9. **Flower Pot:** Made of clays and metallic minerals for pigments in glaze.
10. **Talcum Powder:** Contains talc and mica.
11. **Dandruff Shampoo:** Includes coal tar, lithium clays and selenium. The container is made of petroleum products.
12. **Mirror:** Includes feldspar, silica and silver.
13. **Faucets:** Includes iron, nickel and chromium.
14. **Tiles:** Made of clay, feldspar, wollastonite or talc, mineral pigments.
15. **Toilet:** Includes clays, silica, copper, zinc, petroleum products and borates.

Minerals in Our Environment – Room 2

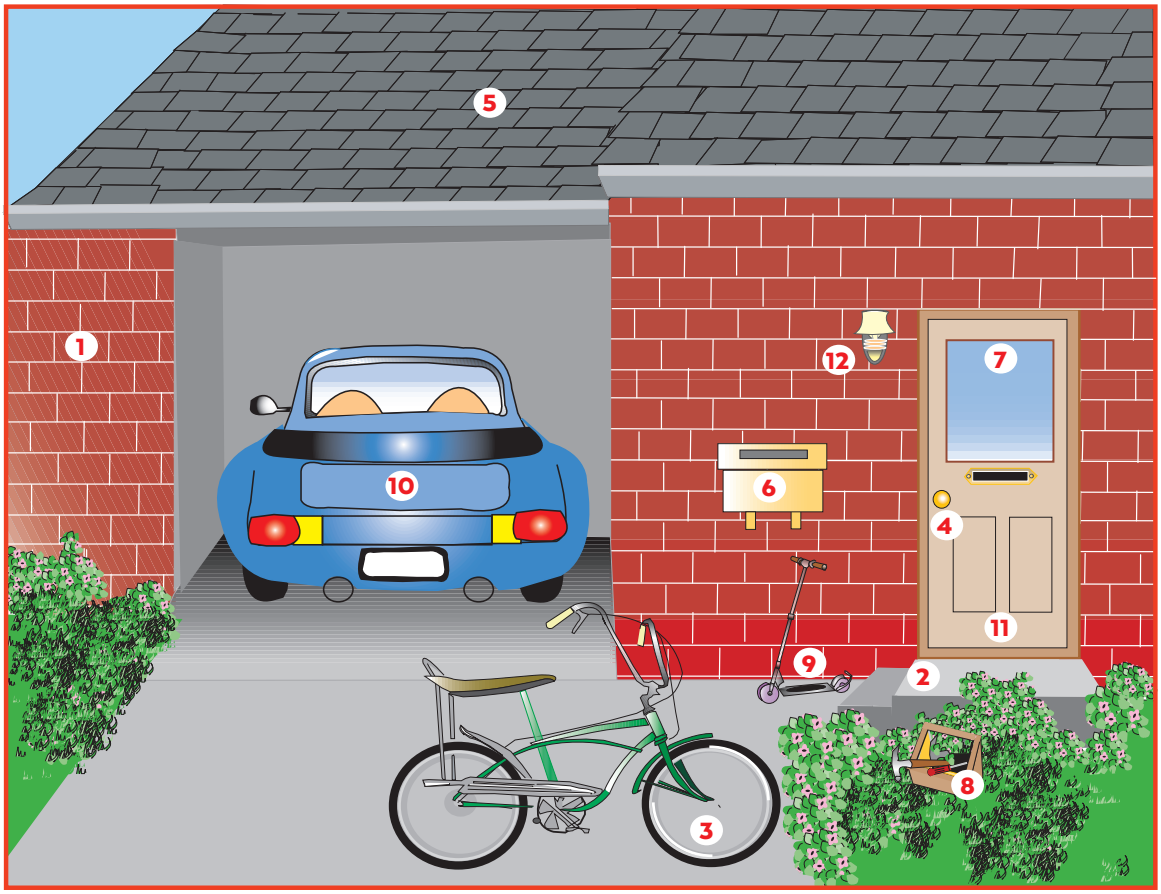


1. **Computer:** Includes gold, silica, nickel, aluminum, zinc, iron, petroleum products, and about thirty other minerals.
2. **Pencil:** Includes graphite and clays.
3. **Telephone:** Includes copper, gold and petroleum products.
4. **Books:** Includes limestone and clays.
5. **Pens:** Includes limestone, mica, petroleum products, clays, silica and talc.
6. **Film:** Includes petroleum products and silver.
7. **Camera:** Includes silica, zinc, copper, aluminum and petroleum products.
8. **Chair:** Includes aluminum and petroleum products.
9. **Television:** Includes aluminum, copper, iron, nickel, silica, rare earths, and strontium.
10. **Stereo:** Includes gold, iron, nickel, beryllium and petroleum products.
11. **Compact Disc:** Includes aluminum and petroleum products.
12. **Metal Chest:** Includes iron and nickel. The brass trim is made of copper and zinc.
13. **Carpet:** Includes limestone, petroleum products and selenium.
14. **Drywall:** Includes gypsum, clay, vermiculite, calcium carbonate and micas.

Minerals in Our Environment – Room 3

1. **Radio:** Includes aluminum, copper, gold, iron and petroleum products.
2. **Toaster:** Includes copper, iron, nickel, mica, chromium and petroleum products.
3. **Electrical Wiring:** Includes copper, aluminum and petroleum products.
4. **Microwave:** Includes copper, gold, iron, nickel and silica.
5. **Stove:** Includes aluminum, copper, iron, nickel and silica.
6. **Refrigerator:** Includes aluminum, copper, iron, nickel, petroleum products and zinc.
7. **Table Salt:** Includes halite; light salt can be made from sylvite. Most salt has added iodine.
8. **Plates:** Includes clays, silica and feldspar.
9. **Cutlery:** Includes iron, nickel, silver and chromium.
10. **Clock:** Includes iron, nickel, petroleum products and silica.
11. **Stainless Steel Sink:** Includes iron and nickel.
12. **Blackboard:** Includes clays. Chalk includes limestone or petroleum products.
13. **Magnet:** Includes cobalt.
14. **Dish Rack:** Made of petroleum products.

Minerals in Our Environment – Room 4



1. **Bricks:** Includes graphite, clays and silica.
2. **Concrete Step:** Includes gypsum, iron, limestone, clays and silica.
3. **Bike:** Includes barite, iron, nickel and petroleum products.
4. **Door Knob:** Includes copper and zinc, which make brass.
5. **Shingles:** Includes petroleum products and clays.
6. **Mail Box:** Includes copper and zinc, which make brass.
7. **Windows:** Includes silica, feldspar, soda ash, coal and salt.
8. **Tools:** Includes iron and nickel.
9. **Scooter:** Includes aluminum, calcite, mica, nickel, petroleum products, clays, silica and talc.
10. **Automobile:** Includes aluminum, barite, calcite, iron, lead, mica, nickel, petroleum products, clays, silica and zinc.
11. **Paint:** Includes titanium, gypsum, barite and sulfur.
12. **Light and Fixture:** Includes tungsten, molybdenum, aluminum, silica, copper and zinc.

Mineral Handouts: Activity 1, continued

Note: The elements on the chart show up in minute traces in the mineral. When enough of the mineral is mined, the element can be concentrated enough to be of value.

DISPLAY

- A mobile device's glass screen is very durable because glassmakers combine its main ingredient, **silica** (silicon dioxide or quartz) **sand**, with ceramic materials and then add potassium.
- Layers of indium-tin-oxide are used to create transparent circuits in the display. Tin is also the ingredient in circuit board solder, and **cassiterite** is a primary source of tin.
- Gallium provides light emitting diode (LED) backlighting. **Bauxite** is the primary source of this commodity.
- **Sphalerite** is the source of indium (used in the screen's conductive coating) and germanium (used in displays and LEDs).

ELECTRONICS and CIRCUITRY

- The content of copper in a mobile device far exceeds the amount of any other metal. Copper conducts electricity and heat and comes from the source mineral **chalcopyrite**.
- **Tetrahedrite** is a primary source of silver. Silver-based inks on composite boards create electrical pathways through a device.
- **Silicon**, very abundant in the Earth's crust, is produced from the source mineral quartz and is the basis of integrated circuits.
- **Arsenopyrite** is a source of arsenic, which is used in radio frequency and power amplifiers.
- Tantalum, from the source mineral **tantalite**, is added to capacitors to regulate voltage and improve the audio quality of a device.
- **Wolframite** is a source of tungsten, which acts as a heat sink and provides the mass for mobile phone vibration.

BATTERY

- **Spodumene** and subsurface brines are the sources of lithium used in cathodes of lithium-ion batteries.
- **Graphite** is used for the anodes of lithium-ion batteries because of its electrical and thermal conductivity.

SPEAKERS and VIBRATION

- **Bastnäesite** is a source of rare-earth elements used to produce magnets in speakers, microphones, and vibration motors.

Mineral Handouts: Activity 1, continued

Ore Mineral: Chalcopyrite

Source of: Copper, which is used more than any other metal in cell phones

Mined in: Arizona, Utah, New Mexico, Nevada, Montana, Michigan, and Missouri

Used for: Conducting electricity, data, and heat

Importance:

- Without copper to conduct electricity, the cell phone would not work.
- Chalcopyrite commonly is found with pyrite in high-sulfur coal seams.
- Copper wire was critical to the industrial, digital, and information revolutions.

Ore Mineral: Wolframite

Source of: Tungsten

Mined in: Currently there is no domestic production of ore (although some tungsten metal has been produced from tungsten concentrates and recycled scrap metal). The United States imports more than 50 percent of what it needs from China, Bolivia, Germany, and Canada.

Used for: Preventing the phone from overheating (acting as a heat sink) and enabling the phone to vibrate

Importance: Without tungsten and its high atomic weight, the cell phone would not vibrate.

Ore Mineral: Tetrahedrite

Source of: Silver

Mined in: Alaska, Nevada, Idaho, Montana, and Utah

Used for: Creating electrical pathways through the phone

Importance:

- Without silver to create electrical pathways, the cell phone would not work.
- Even though silver is known for use in jewelry, its primary use today is in electronics.

Ore Mineral: Spodumene

Source of: Lithium

Mined in: Nevada. The United States imports more than 50 percent of what it needs from Argentina, Chile, China, and Russia.

Used for: Used as cathodes (the electrode that allows current to leave a device) in lithium/cadmium batteries

Importance: Without lithium, the cell battery would not hold a charge for long.

Mineral Handouts: Activity 1, continued

Ore Rock: Bauxite

Source of: Gallium

Mined in: The United States imports more than 75 percent of what it needs from Jamaica, Brazil, Guinea, and Guyana.

Used for: Providing light emitting diode (LED) backlighting for the screen

Importance: Without gallium, the cell phone would not be backlit.

Ore Mineral: Bastnäesite

Source of: Rare earth elements

Mined in: California; however, concentrates from California are sent to China for processing. As a result, the United States imports 100 percent of what it needs from China, Estonia, France, and Japan.

Used for: Providing magnets for speakers and microphones

Importance: Without rare earth metals (minerals that are difficult to mine because they do not accumulate into ores), the cell phone's speakers and microphones would not work.

Ore Mineral: Sphalerite

Source of: Indium and Germanium

Mined in: Alaska, Tennessee, and Washington. The United States imports 100 percent of the indium it needs from China, Canada, the Republic of Korea, and Taiwan, and more than 50 percent of the germanium it needs from China, Belgium, Germany, and Russia.

Used for: Creating the screen's conductive coating

Importance: Without indium and germanium, the cell phone's touch screen would not work.

Activity 2: Cobalt Mining Considerations

Time Estimate

45 minutes

For the Teacher

This activity addresses the following essential understanding:

- There are tradeoffs involved in mining minerals in the United States and relying on imports of minerals.

Learning Objectives

Students will be able to (1) describe how cobalt is used in numerous consumer products, and (2) explain the benefits and costs of mining cobalt domestically.

Overview

In this activity, students consider diverse perspectives on the question of whether to mine cobalt domestically. They develop and share a list of talking points about whether cobalt should be mined in the United States.

This is the second of three activities that introduce students to minerals development on public lands.

Teacher Preparation

1. Read the "Background Information" from the USGS Minerals Resource Program.
2. Make enough copies of the "Talking Points" and "Background Information" handouts for each student.

Procedure

1. Introduce the lesson: Explain that students will be looking at whether cobalt should be mined in the United States based on the perspective of a group to which they are assigned and upon consideration of other viewpoints.
2. Form groups: Have students count off 1 through 10, and distribute the "Talking Points" handout to each student. Review the instructions and have all groups select a spokesperson.
3. Create talking points: Circulate among the groups and provide assistance as necessary while they discuss the questions on the handout and create their 2-minute talking points for their organization's president.
4. Present talking points: Provide each group 2 minutes to share its talking points. Encourage everyone else in the class to write down questions and suggestions for the spokespeople. After each presentation, invite students to ask their questions of, or share their suggestions with, the spokespeople.
5. Summarize the cobalt mining discussion: Conclude the class by asking students about:
   - Whether domestic cobalt mining would be good for U.S. businesses, and why.
   - Whether domestic cobalt mining would be good for the environment, and why.
   - Whether domestic cobalt mining would be good for nearby tourism businesses, and why.

Assessment

Students should address each talking point bullet in the handout. Make sure that students describe and support their viewpoint, mention who might oppose it and why, and conclude with a clear message.

Talking Points Handout

You are the media preparation team for one of the 10 organizations below, based on your group number.

Group 1: a maker of space rocket boosters

Group 2: a utility that wants to build a gas-powered electricity facility

Group 3: a maker of hybrid cars and trucks

Group 4: a maker of cell phones

Group 5: a maker of computers

Group 6: a county economic development office where the cobalt mine would be developed

Group 7: a homeowners' association near the proposed mine, which supplies homes with well water

Group 8: a company that takes tourists on fishing trips near the proposed mine

Group 9: a company that takes tourists on rafting trips near the proposed mine

Group 10: an organization that promotes conservation of animal habitat

Great news! Your organization's president has been invited to appear on TV's top-rated news show to talk about a proposed new cobalt mine. The president needs your team to give them 2 minutes' worth of TV talking points on these questions:

- What is our organization's position on whether a cobalt mine is needed in America, yes or no?
- What are our two strongest reasons?
- Which one of the other groups is most likely to disagree with our position?
- What is a reason that group would likely give for disagreeing with us?
- How should we answer them?
- **Conclusion:** What's the single most important point the TV viewer should remember?

To get started, read the "Background Information" and discuss questions 1–5. Then develop a 2-minute talking points document for your organization's leader to prepare them to appear on the TV news show.

Questions to discuss:

1. How do businesses use the "superalloys" that cobalt is used to make?
2. What are two uses for cobalt that help the environment?
3. What feature of cobalt makes it useful as part of the magnets used in computer disc drives and electric motors?
4. How much cobalt is mined in the United States?
5. Why might global supplies of cobalt become threatened?

Talking Points Handout

Background Information, from the Minerals Resource Program of the U.S. Geological Survey

(https://pubs.usgs.gov/fs/2011/3081/pdf/fs2011-3081.pdf)

Cobalt is a shiny, gray, brittle metal that is best known for creating an intense blue color in glass and paints. It is frequently used in the manufacture of rechargeable batteries and to create alloys that maintain their strength at high temperatures. [An alloy is a metal made when two or more metallic elements are combined.] Cobalt is an important component in many aerospace, defense, and medical applications and is a key element in many clean energy technologies.

… The Swedish chemist Georg Brandt isolated metallic cobalt—the first new metal to be discovered since ancient times—in about 1735 and identified some of its valuable properties.

[Since 2010 much of the cobalt used in the United States has helped make] … superalloys, which are corrosion-resistant alloys that retain their strength at very high temperatures. Gas turbine engines and other components used in aircraft and space vehicles, chemical and petroleum plants, and powerplants depend on the high-temperature strength of superalloys. Cobalt also has impressive magnetic properties that it retains at temperatures as high as 1,121 °C. Cobalt is an important component of the magnets used in computer disc drives and in electric motors; it helps them operate more efficiently at a wide range of temperatures.

Globally, the leading use of cobalt is in rechargeable batteries to help increase battery life and stability and to reduce corrosion. Mobile phones, portable computers, and hybrid and electric vehicles all depend on the energy produced by chemical reactions in these rechargeable batteries….

Cobalt is not a rare element even though pure cobalt is not found in nature. … Most cobalt is produced as a byproduct of the processing of copper and nickel ores. Cobalt is obtained from … ore deposits … [including] copper deposits, such as those in the central African copperbelt in the Democratic Republic of the Congo (DRC)….

… Only negligible [very small] amounts of cobalt were mined in the United States in 2010….[2] Almost one-half the world's known reserves of cobalt—some 3.4 million metric tons—are located in the DRC.

… The supply of cobalt is at risk of disruption for the following reasons: the global market is relatively small; there are limited sources of production; and, because most cobalt is a byproduct of copper or nickel mining, the supply is dependent on the markets for these more abundant metals.

Websites

https://www.encyclopedia.com/places/united-states-and-canada/canadian-political-geography/cobalt

https://www.idahostatesman.com/news/local/news-columns-blogs/letters-from-the-west/article205031074.html

[2] A new cobalt mine near Salmon, Idaho, however, is likely to produce 1,500 tons, or 2% of world output, of cobalt per year starting in 2019 or 2020.

Activity 3: Should the BLM Approve a Cobalt Mine?

Time Estimate

45 minutes

Learning Objectives

Students will be able to (1) describe factors considered by planners when making public land use decisions; (2) take and defend positions on hypothetical but realistic land use planning questions; and (3) explain the costs and benefits of land use choices.

For the Teacher

This activity addresses the following essential understanding:

- Public land managers must balance tradeoffs as they make decisions about mineral mining projects.

Overview

This activity introduces students to minerals development on public lands by encouraging them to grapple with the decisions that public land managers face when balancing the need for domestic sources of cobalt with preservation of cultural resources, recreational sites, wildlife habitat, and scenic quality. The choice in the activity is whether to approve a cobalt mine on BLM-managed lands. Small groups of students examine various aspects of approving a mine and discuss how the BLM's multiple-use mission affects the balance among competing uses, such as heritage areas, scenery, recreation tourism, and habitat for endangered birds.

Teacher Preparation

1. Make a copy of the "Considerations Handout" for each student.
2. Read the "Background Information" to become familiar with some of the choices that face public land managers and the diverse views about what they should do.

Background Information

BLM lands are managed for diverse uses, such as supplying natural resources (coal, natural gas, oil, renewable energy, minerals) and providing habitat for plants and animals. They also provide open spaces where people can enjoy recreation and learn about America's cultural and natural treasures through exploring ghost towns and the remains of American Indian dwellings.

Public land managers must balance recreational, cultural, conservation, and economic values when deciding on a land use question, and they listen to diverse voices representing a wide range of interests. People who depend on the hospitality industry want to attract tourists and often recommend decisions that promote recreation. Outdoor enthusiasts who enjoy hiking in scenic areas, rock climbing, and mountain biking also usually want decisions to accommodate recreation.

Alternatively, tribal leaders, historic preservationists, and conservationists often speak for minimizing human impact on the land, even if that means limiting tourism and certain other economic activity. This view may be seconded by farmers, ranchers, and others in agriculture, who often depend on healthy plant communities to filter water and to support grazing animals and pollinators of food crops.

Many minerals mined on public lands, such as coal, uranium, and oil, are essential for our country's energy supply. Other minerals, such as gravel and ores, are used in making an array of products. Questions about how to preserve biodiversity, promote economic growth, maintain balanced habitats, attract visitors to public lands, and ensure that future generations can enjoy cultural and recreational resources are knotty dilemmas for land use planners.

Cobalt Flats is the fictional parcel of land at the heart of this activity, but the issues and perspectives are representative of those faced by public land managers. This land parcel includes evidence of American Indian dwellings, is famous for backcountry recreation, and hosts the endangered southwestern willow flycatcher.[3] It would also be a good candidate for a cobalt mine.

It is essential that students understand there is no right answer for the dilemma in the activity. They should appreciate the tradeoffs that land managers face when weighing aspects of different choices that may partially satisfy most or all stakeholders but are certain not to satisfy everyone fully.

Procedure

1. Hook: Ask students to think about decisions made by young people that have long-lasting effects versus ones that do not. Ask for a show of hands for which of these choices do have long-term consequences: whether to go to a movie or stay in, whether to stay in school

[3] Although the BLM must consider the presence of paleontological resources when evaluating mining applications, cobalt does not occur in the same kinds of rocks where fossils may be found.

or drop out, whether to have pizza or salad, whether to take college preparation courses or not. Note that mayors, presidents, and other public officials are often called upon to make long-lasting decisions, including whether to open a new school or send the military overseas. These are decisions about which many smart and sincere people may disagree, often making the choices difficult.

2. Introduction: Explain that public land managers make long-lasting decisions just as mayors and presidents do. They must consider the diverse views of many smart and sincere people before making decisions that can have consequences lasting decades or even centuries. Let students know they will get into small groups to look at and make choices about a land use issue just as public land managers would, considering various views and being aware that there is no one right answer.

3. Group instructions: Distribute the student handout to everyone, have them read the scenario, and explain that their job in the group is to choose an option by consensus. Divide students into groups of four or five and ask the groups to select a spokesperson. Provide about 20 minutes for the groups to consider the arguments and decide whether to approve a cobalt mine. Answer any clarification questions they may have, emphasize that there is no right answer, and discourage them from introducing factors that are outside the context of the activity.

4. Report out: Ask the spokesperson from each group to report out the decisions they reached. Keep a tally to show which groups made which choices. Ask spokespeople to identify which arguments were most persuasive and why, and to describe how difficult it was to decide. If any groups did not reach consensus, ask them why they were unable to do so. For those that did reach consensus, ask which variables were most important as they made the choice.

5. Conclusion: Reconfigure the class into one unit and ask for a show of hands for which factor was the most important: promoting economic development, protecting cultural resources, accommodating recreation, preserving native heritage, or conserving habitat. Ask students to comment on which tradeoff was most difficult, and ask if anyone changed their view from the beginning of Activity 2 to the end of Activity 3.

Assessment

Rove among groups as they are discussing the cobalt mine issue, and listen for whether students are on topic and respectfully discussing the tradeoffs.

Extension Ideas

Have students identify a land use issue in the community, research and gather information about it, and explore and debate possible solutions.

Invite a land manager to talk with students about a recent difficult land use decision that they had to make.

Considerations Handout

Should the BLM Approve a Cobalt Mine?

Instructions

Read the scenario about an application to open a cobalt mine in Colbalt Flats, a fictional parcel of public land. Then read the reasons to approve or reject the mine. Discuss whether the BLM should approve the application. Your group needs to agree on a decision, yes or no. Select a spokesperson for the group who will explain your group's choice to the rest of the class, including: (1) your decision, (2) the main reasons you made that choice, (3) how difficult it was to decide, and (4) the key tradeoffs you discussed.

Scenario

The BLM's Cobalt Flats land managers have two options: approve an application to establish an underground cobalt mine, or reject the application. Cobalt is essential in powering cell phones, other consumer electronics, and even electric cars. The U.S. Geological Survey says cobalt is a critical mineral because it has "important uses and no viable substitutes, yet face(s) potential disruption in supply." If the United States does not mine its cobalt, companies will have to import cobalt from other countries, some of which use children as miners. Some groups oppose mining cobalt in Cobalt Flats because of the area's cultural resources, world-class recreational opportunities, and habitat for an endangered bird species. Other groups support the proposal for a mine to create jobs and secure a domestic source for cobalt.

Reasons To Approve the Cobalt Mine

Approving the cobalt mine would …

- Bring many jobs into the community
- Provide a U.S.-based source of a mineral that is needed in ecofriendly products, such as electric or hybrid cars, as well as in cell phones and other electronics
- Allow U.S. companies to be sure that their cobalt is mined by adult miners who are paid and treated fairly, not by children who are exploited.

This excerpt from a CNN report (see *https://money.cnn.com/2016/01/18/technology/smartphone-child-labor-cobalt/index.html*) describes how children are abused as miners in some other countries:

Major tech companies could be buying electronic components made from minerals mined by children, according to a report from Amnesty International….

Researchers of the report found that dozens of firms, including Apple…, Microsoft…, and Samsung, may have links to at least one company which sources its cobalt supply to "artisanal" or subsistence mines in the Democratic Republic of Congo (DRC).

Cobalt is a key element used in lithium-ion batteries. Most consumer devices—from smartphones and laptops, to self-balancing scooters and Tesla's home battery—use this kind of power source. The DRC supplies much of the world's cobalt.

Considerations Handout, continued

"We found that traders are buying cobalt without asking questions about how and where it was mined," Emmanuel Umpula said in a statement…. Umpula is executive director of African Resources Watch, an NGO [non-governmental organization] that worked with Amnesty International on the report.

In April and May 2015, investigators from the two groups interviewed 87 people, including 17 children, who work or have worked in five artisanal mines.

They found children as young as 7 collecting, sorting and cleaning mineral ores for 10 to 24 hours straight. In the process, they expose themselves to particles that can lead to lung-related illnesses, and risk getting beaten or exploited financially.

"There is lots of dust, it is very easy to catch colds, and we hurt all over," a 15-year-old named Dany told researchers.

Reasons To Reject the Cobalt Mine

Approving the cobalt mine …

- May make the area less attractive to tourists and people who want to see awesome landscapes when they hike and bike, which would cost some jobs in the hospitality industry
- May threaten sites near recent discoveries of cultural artifacts showing how American Indians lived in the area in centuries past
- Would potentially disrupt the habitat of the endangered southwestern willow flycatcher and of three species of trout that many anglers love to fish

This excerpt from the website *zionnational-park.com* describes the birds in the area:

> Numerous birds are found in the [area] including the endangered California Condor, Peregrine Falcon and the Southwestern Willow Flycatcher as well as the threatened Bald Eagle. Some of the species of birds … that have been declining include the Burrowing Owl, Long-billed Curlew, Northern Goshawk, Blue Grosbeak Ferruginous and Swainson's Hawk.

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Notes:

Notes:

The BLM's Division of Education, Interpretation, and Partnerships produced this publication. The BLM's National Operations Center, Information and Publishing Services Section, provided production services.

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May 2019
BLM/WO/GI-19/014+1115
EE 2042g