



UTAH OFFICE OF ENERGY DEVELOPMENT

Mining and Reclamation

Grade/Subject: 8th Science

Strand/Standard 8.4.3 Design a solution to monitor or mitigate the potential effects of the use of natural resources. Evaluate competing design solutions using a systematic process to determine how well each solution meets the criteria and constraints of the problem. Examples of uses of the natural environment could include agriculture, conservation efforts, recreation, solar energy, and water management. (ESS3.A, ESS3.C, ETS1.A, ETS1.B, ETS1.C)

Lesson Performance Expectations:

- The students will develop a plan to mitigate the effects of our extraction of natural resources through mining.
- They will develop a plan to make use of land in a way that encourages the restoration of the natural ecosystem.
- They will identify the effects to the environment caused by the mining and research how mining reclamation has been done in the past, including specific examples from Utah.

Materials:

- Computer or tablet for each student
- Poster paper (one per group)
- Markers
- List of minerals mined in Utah at end of lesson

Time:

Two 45 minute class periods

Teacher Background Information:

- **Types of mining in Utah:** There are several different kinds of mining that take place in Utah: underground mining (longwall mining and room and pillar mining), surface mining (strip mining and open pit mining). Most of the mines in Utah are underground mines. See History of Mining in Utah at [this link](#).
- **What is mining reclamation?** After mining for these resources, the mining company is responsible for reclamation of the land. In the past mine site reclamation was not a priority for mining companies; but today legislation and regulations are in place to address the effects of mining. A multitude of people have to work on reclamation. Mines have to factor in the costs of reclaiming the land when they initially permit to mine. This means the reclamation plan has to be in place before mining begins: they need to estimate how much reclamation will cost and then be able to factor those costs into how much they need to get out of the mine to make it cost-effective.
- **Jobs in the mining industry with an emphasis on environmental jobs:** There is a growing job demand in the mining industry in environmental assessment and remediation. Mining or Environmental Engineers and Biologists assess the factors of the original environment and develop plans to return the mine sites to those same conditions (or better) once mining is finished.

Student Background Knowledge:

- Students need to know that a natural resource is something found in nature that is used by man.
- [Article on natural resources from Britannica Kids](#)
- Students need to know that minerals are naturally occurring, inorganic solids with a specific atomic structure.
- [Article on what minerals are at geology.com](#)
- Mining plays a huge factor in Utahns daily lives: minerals are mined to provide the materials to make thousands of products that we have come to depend on daily. Mined coal provides energy for homes, schools, and businesses. Mining provides jobs to thousands of Utahns, along with other economic benefits to the state of Utah.

Teacher Step by Step: A 3-d lesson should insist students do the thinking. Provide time and space for the students to experience phenomenon and ask questions. The student sheet provided below provides guidance but is only an example of how students might respond.

1. Phenomenon: It's Mine!

Find pictures of an open pit mine and the land around it and show them to the students as you present the following:



Photo from <http://energy.utah.gov/category/non-fuel-minerals/>

[Other photos of open pit mines.](#)

The year is 2125. After being mined for nearly 200 years the ore in an open pit iron mine has been depleted and the mine is no longer profitable. The land is near a national park and so an investor has purchased the mine and is now deciding how to best make use of the land. The land is located in a pinyon-juniper high desert ecosystem.

Include photos that show the ecosystem of the area. Ask the students to record three questions they have about this situation and discuss these questions together as a class. Focus on questions that highlight potential ways the ecosystem

of the area has been affected and how it could affect future use of the site.

Explain to the students that they will create a proposal for future use of the land. Their proposal will design solutions to mitigate environmental impacts caused by mining. The land should be profitable for the investor and also safe for human use. The design should reduce pollution and contaminants (heavy metals etc.) in the soil, water, air, etc., repairing the surface of the land and restoring the natural ecosystem.

2. What are some of the effects of mining?

Show the students the [Rio Tinto movie](#) and pictures of other mines. Include several types of mines such as open pit, underground, strip mines, etc. Have students browse the [interactive Rio Tinto site](#). Discuss ways the land has been changed by the Bingham Canyon copper mine.

With a partner the students will research two minerals from the list of minerals that are mined in Utah.. They will explore what the mineral is used for, where it is mined in Utah and what processes are used to mine the mineral. Then they will identify ways the environment could be affected through this mining process. What waste products might be released? What are the environmental impacts of mining?

Mining Reclamation

Discuss the students' findings as a class. List the environmental impacts that will have to be mitigated in order to reclaim the land. Discuss what mining reclamation is: when mining is complete, the mining company is required to reclaim the land by returning it to its original state as much as possible.

3. Propose a solution

The students will now develop their proposal for the repurposed pit mine. Their proposal must encourage the restoration of the original ecosystem (no paving the entire area for a parking lot!) They will first identify ways the area has been affected, design a solution to mitigate the problem and identify how they will encourage one plant and one animal from the ecosystem to return to live at the site.

The students will create a poster to present their solution and advertise their development plan.

Assessment of Student Learning.

The students will present their proposals to the class by displaying them in the classroom. The students will do a gallery walk to view the other proposals and evaluate the competing designs and vote on the best.

Standardized Test Preparation:

Mining and Reclamation

1. When are the criteria met for a mining reclamation project to be considered successful?
 - a. When the minerals have all been removed.
 - b. When the waste rock has been placed back where it came from.
 - c. When the opening to the mine has been blocked.
 - d. When the land looks similar to how it looked before the mine.*

2. What are constraints on a mining reclamation project? Choose all that apply.

- a. The available funding or costs of the project.*
- b. Whether the waste rock can be replaced in the mine.*
- c. Whether or not the public wants the mine to be reclaimed.
- d. How far the wastes have spread in the environment.*

3. How has mining benefited Utah? Choose all that apply.

- a. Created a variety of jobs.*
- b. Provided materials for manufacturing.*
- c. Allowed for development of energy sources.*
- d. Reclaimed all mining operations after their use.

Abandoned Mine



4. A shaft from a mine was drilled 150 years ago and the tailings were left at the opening. The company that created the mine has shut down. How should the public respond? Choose all that apply.

- a. The opening to the mine shaft should be sealed entirely by a public agency.*
- b. The public should not attempt to get into the mine.*
- c. The mine should be reopened as a tourist destination.
- d. The state should set aside funding to reclaim the tailings to prevent runoff.*

Extension of lesson and Career Connections:

Ask each student to research a career that would be involved in land reclamation. Career types include: Environmental Engineers, Geologists, Hydrogeologists, Ecologists, City Planner, Landscape Design, Construction. Find someone who works in this career and interview them.

Mining and Reclamation

Name: _____

Phenomenon: It's Mine!

Ask three questions about the phenomenon.	

Effects of Mining

Name of Mineral	
How do we use this mineral?	
Where is this mineral mined in Utah?	
Briefly explain how this mineral is mined. What kind of mine is it? What processes are used? What equipment is used?	
Identify 3 ways the environment is affected by the mining of this mineral.	

What is mining reclamation?
What has Rio Tinto done to reclaim former mining land and preserve the environment?
What are three other ways people have reclaimed land that has been mined in the past?

**Land Use Design Proposal
Planning Sheet**

Proposed use for the land:

What are three ways the land has been affected by mining? Has the groundwater been affected? The soil?	What do you propose to do to mitigate this problem?

What is one animal that lives in this ecosystem?	
How will you encourage this animal to return to the mine site?	
What is one plant that lives in this ecosystem?	
How will you encourage this plant to grow in this area again?	

Create a poster to advertise your proposed use for this land. Include the following:

- A name for your project.
- A slogan that will encourage people to come to your site.
- What has been done to reclaim the land?
- What has been done to help encourage one plant from the surrounding ecosystem to thrive at the site?

- What has been done to help encourage one animal from the surrounding ecosystem to return to the site?
- A drawing of what the site will look like once it has been developed.

As you complete the gallery walk, record how three other groups have proposed to use the land and what will be done to reclaim the land.

Proposed use for the site.	What will this group do to reclaim the land?	Do you feel like this is a good solution? Explain why or why not. How much will the ecosystem be restored with this proposal?

Utah Minerals

Alunite - A trigonal mineral formed from sulfuric acid acting on potassium feldspar in volcanic regions.

Beryl - One of the thirty recognized minerals of Beryllium. Occurs in a hexagonal crystal. Gem quality crystals are emerald and aquamarine.

Bertrandite - An important source of Beryllium mined in the Topaz Mountain region in western Utah.

Beryllium - A silver gray metal. 1/3 lighter than aluminum, it is the lightest of all metals. Alloyed with copper for electrical connectors and tools. The world's largest known beryllium resource is in Juab County.

Bertrandite ore (beryllium silicate) is found in volcanic tuff northwest of Delta. Utah continues to be the leading producer of beryllium metal in the United States. Uses include: nuclear reactors, aerospace applications, smartphones, and as an alloy for electrical and electronic equipment.

Building Stone - A general, non generic term for any rock suitable for use in construction.

Clay - An extremely fine-grained natural earthy material composed primarily of hydrous aluminum silicates.

Coal - A black substance used for fuel, composed of mineralized vegetable matter. Copper - A reddish metallic element that takes on a bright metallic luster and is malleable, ductile, and a good conductor of heat and electricity. The world's largest open-pit copper mine is at Bingham Canyon just southwest of Salt Lake City. The copper occurs in copper sulfide grains scattered through volcanic and intrusive rock and in high-grade veins and replacement bodies in the limestones around the intrusive rock. Copper has been produced from about 50 mining districts in Utah, most in the western part of the state. Some copper is associated with uranium and vanadium in sandstones in the Colorado Plateau. Uses include: building construction, electrical and electronic products, and industrial machinery.

Gold - A malleable ductile yellow metallic element. Much of Utah's gold production has been as a byproduct of copper-lead-zinc ore, especially from Bingham Canyon. North of Bingham Canyon, Barney's Canyon mine is currently the state's largest primary gold producer. Some of Utah's gold has been recovered from weathered near-surface veins. One large placer gold deposit was found in Bingham Canyon in 1864 and other smaller placers were found along the Colorado River and its tributaries. Utah usually ranks second or third in production of gold in the United States. Uses include: jewelry, art, electronics, dental, and coinage.

Gypsum - A hydrous calcium sulfate, colorless to white in crystals. Iron - A heavy malleable ductile magnetic silver-white metallic element. High-grade iron ore is found in many small deposits in the

Wasatch and Uinta Mountains, but large deposits are found only in southwestern Utah. For many years iron ore has been mined at the Iron Springs district in Iron County, where it occurs as magnetite and hematite replacements of limestone around a granitic intrusion. Uses include: pig-iron, steel making, and cement. Salt - A crystalline compound that consists of sodium chloride.

Silver - A white metallic element that is ductile and malleable. Many of the metalliferous or lode deposits in western Utah contain a mixture of silver, lead, and zinc, with lesser amounts of copper, gold, and other minor metals. These deposits are found where the fluids from igneous intrusions have reacted with the surrounding rock, especially carbonates, to precipitate metallic sulfides in fractures and voids. The most important lode production in Utah has come from mining districts within 50 miles of Salt Lake City. Uses include: photography, electrical and electronic products, silverware, and jewelry.

Potash - Potassium carbonate especially from wood ashes.

Uranium - A radioactive, silvery-white, metallic element. Uranium is produced first for its radium content, then for the vanadium associated with it. Thousands of occurrences have been found in southeastern Utah in the sandstones of the Colorado Plateau. Some occurrences have also been found with lode deposits related to volcanic activity and granitic intrusions. Uses include: munitions and power plants.

Vanadium - A gray or white, malleable, ductile, metallic element. Vanadium occurs with uranium in the Colorado Plateau (see Uranium). Uses include: hardens steel utilized in construction, machinery, and transportation.

Zinc - A bluish-white, lustrous metal. Zinc occurs with lode ores that are usually mined primarily for their silver and lead content (see Silver). Uses include: chemical, agricultural, rubber, and paint industries.