

# The Mining Process

Level: K-2  
Facilitator Guide

## LESSON DETAILS

**Objective:** Students will investigate the monetary and environmental costs of mining by mimicking the mining process and assessing ore samples.

### Standards

#### NVACSS and NGSS

- **K-ESS3-3:** Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
- **2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- **2-PS1-2:** Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
- **DCI:** Natural Resources; Human Impacts on Earth Systems;
- **SEP:** Asking Questions and Defining Problems; Constructing Explanations and Designing Solutions
- **CCC:** Cause and Effect

#### Career Readiness

- **1.2.6:** Demonstrate lifelong learning skills by continually acquiring new industry-related information and improving professional skills.
- **1.2.8:** Demonstrate time, task, and resource management skills by organizing and implementing a productive plan of work.

### Materials

- item sold in single-serve packs versus in bulk (e.g., candy, chips)
- four bowls
- chocolate chip cookies (2 per student)
- copy of the Mining Products and Wastes handout
- computer with internet access and projector (or image printouts)
- short pieces of steel and copper wire
- pliers (optional)

### Lesson Summary

Students begin by making observations of the amount of waste created from single serve versus bulk items to understand how waste production is associated with use of resources. Students then look at images of rock waste from mines and consider how it might be used. Then, student groups break apart a cookie as analogy to mining to examine relative amounts of “mineral” versus “waste rock.” The class then discusses mining by analyzing segments of a video on the mining process. The lesson concludes with students comparing mineral samples to determine which would produce the most mineral versus rock waste.



## Preparation

- In **Engage**, be sure to use bowls large enough to hold all of the product. They do not need to be large enough to hold all of the waste (excess can “spill over”). When choosing the products to use, consider food allergies of your students.
- In **Explain**, you may want to have tools, such as toothpicks or tweezers, available for students to use as part of their plan to create less “rock waste.”
- Before **Elaborate**, set up a model of a “landscape” that has a potential mineral resource buried within it. Fill a clear container with at least three layers of different color sand (or similar materials), with one layer being thinner and representing the mineral of interest. It is best if the mineral layer is not even throughout the container (i.e., you can see it through the clear walls of one side of the model, but not the other). Place construction paper (or other opaque covering) around the outside that can easily be removed.

## Engage

1. Conduct a demonstration in which you compare the amount of product and waste from an item sold in single-serve packs versus in bulk (e.g., popcorn, candy).
  - a. Have four equal -sized bowls, two to fill with product and two for waste.
  - b. Open the bulk item and pour the product into one bowl, then place the packaging (the waste) in the other bowl.
  - c. Have students make predictions of how the volume of product and waste from the bulk container will compare to the volume of those from the single serve items.
  - d. Repeat step 1b with the single-serve items, placing the product in one bowl and the packaging in the other.
2. Have students make observations of the two product bowls, then the two waste bowls.
3. Discuss:
  - ▶ *Which product would you rather buy and why?*
  - ▶ *How might the cost of the items influence your decision?* Share the costs of each product with students.
  - ▶ *How might the waste produced affect the environment?*
4. Relate the activity in steps 1-3 to mining by telling students they will now look at another process that similarly provides a useful product, while at the same time creating waste.



5. Show students images of surface mines and discuss the questions for each:

**a. Nevada Mine**

- ▶ *What do you think is happening in this picture?*
- ▶ *What do you think they are digging for?* You may want to point out that digging occurred where each “step” is located, so there is likely something there that is useful.
- ▶ *Where do you think the waste product is in this picture?*

**b. Barrick Gold Mine, Nevada**

**c. Copper Mine, Arizona**

- ▶ *How do these image compare?*
- ▶ *Why do you think the rocks in these pictures are different colors (red, black, grey, and tan)?* Discuss how different rocks are made up of different minerals. You may want to show some samples of minerals and rocks to show the differences between them.

6. Show images of waste rock piles and ask students how they might affect the environment:

- **Powder River Basin, Wyoming**
- **Oregon**
- **Butte, Montana**

## Explore

1. Give each student a chocolate chip cookie.
  - a. Tell them that the chocolate chips represent minerals that people need to make products.
  - b. The cookie represents the surrounding rock that is not needed by people.
2. Provide students with the Mining Products and Wastes handout. Have students place the cookie in the “Unmined Rock” circle. Ask students to break apart the cookie to remove the chocolate chips. They should make two piles within the labeled circles: chocolate chips within “mineral,” broken cookie pieces in “rock waste,” as they mine their cookie. Leave any unbroken parts of cookie (if any) in “Unmined Rock”.



3. Discuss:

- ▶ *Why is rock waste produced during mining?*
  - ▶ *Why might people want to reduce rock waste?*
4. Give each student another cookie and have them plan how they will reduce the amount of waste they create. (e.g., not breaking apart pieces of the cookie that do not contain chocolate chips, or deciding to not extract chocolate chips that are buried deep within the cookie).
    - a. As needed, explain that breaking up the whole cookie is like digging up a large piece of land. Tell students to consider the plants, animals, people, or other organisms living in the area and what effects digging up all the land could have on them.
  5. Have them repeat steps 1-2 with their new cookie using their plan to reduce waste. Their mineral, waste, and unmined piles will fill the other three circles on the Mining Products and Wastes handout.
  6. Once students are done, have them compare their piles to those from their first cookie.
  7. Have some groups share their plans and whether or not they worked. You may also ask them to make suggestions about how they could improve their plans if they were to do them again (e.g., having access to tools that can help them dig out the mineral and not all the rock).
  8. Revisit the mine images from Engage to relate them to Explore.
    - a. For students that had “unmined rock” piles, have them share why they did not break apart those pieces of cookie.
    - b. Discuss which images show unmined areas and why people might choose to not mine there.
  9. Ask students to share ideas about what might be done with the rock waste from mines.

## Explain

1. Have students watch “**What is Mining?**” to learn about why minerals are mined.
2. Pause the video at:
  - a. 0:24 when they define mining. Revisit the images of mines from Explore to further explain the word “extracting” as the process of removing minerals from the ground.
  - b. 0:52 so students can study the image of the quartz sample. If possible, provide students with samples of quartz. Have them describe the mineral and try to use their descriptions to guess what part of a phone could be made up of this mineral. Continue playing the video to reveal the answer.



- c. 1:26 to allow students to give other examples of items they use that are made out of metal. If possible, have some steel wire and some copper wire to discuss differences in metals, such as color and strength. Demonstrate that it is more difficult to bend the steel wire (this may require pliers) than it is the copper wire, and so they are good for different purposes.
3. Skip from 1:26 to 2:15. Mute the video as it plays from 2:15-2:23.
  - a. Tell the students to watch the video and think about what the material is that they are seeing in terms of “product/mineral” and “waste”.
  - b. Ask students if they think this is the mineral being mined, or the rock waste produced during mining. Have some students share their reasoning.
4. Turn the sound back on and watch the video from 2:24-2:48, pausing as needed to describe terracing and backfill. Focus on how the rock waste is used to fill in older areas of the mine, which is helpful for rebuilding the area once mining is done.

## Elaborate

1. Have students view a model showing a buried mineral deposit (as described in [Preparation](#)).
2. Tell students that you are interested in collecting a specific mineral and tell them what color it is (based on the layer that represents the mineral in the model). As students observe the model from the top, ask:
  - ▶ *What can we see when looking at the surface?*
  - ▶ *How might miners know where to find materials that aren't visible on the surface?*
3. Uncover one side of the model so they can see the layers.
4. Have students share ideas about where they would like to dig to get the mineral out of the “ground.” Compare students’ ideas in terms of how each plan might affect the environment, relating back to rock waste and the overall landscape.
5. Uncover the other sides of the model so students can see that the mineral is not evenly spread through the layers. Have students discuss how they might modify their plans with a goal of minimizing waste and/or damage to other layers.
6. Show an image of how [underground mines](#) are constructed to dig out mineral layers. Discuss how this prevents the production of rock waste by not digging out the layers between mineral deposits.
7. Discuss why it is important to reduce human impact on the environment.



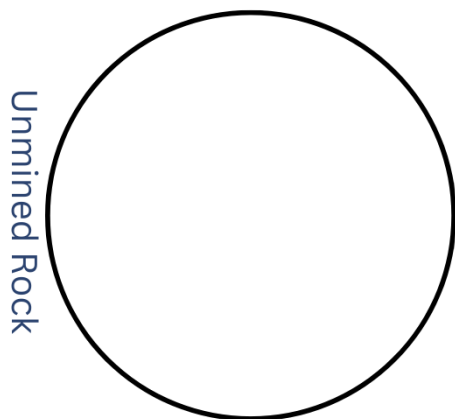
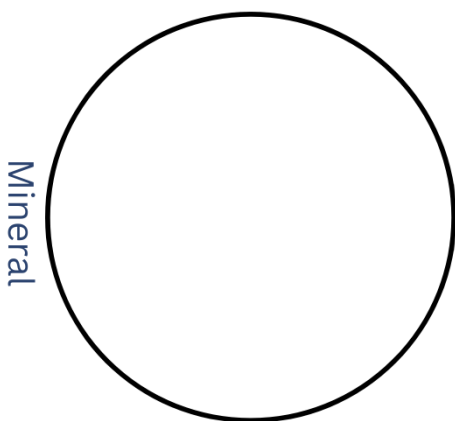
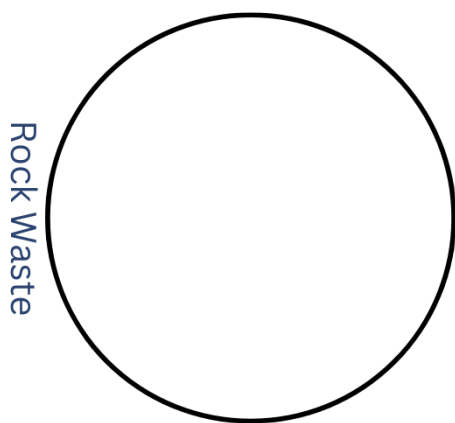
8. Optionally, return to the video and watch the part that was skipped in Explain Step 3. This section of the video discusses underground versus open pit mines.

## Evaluate

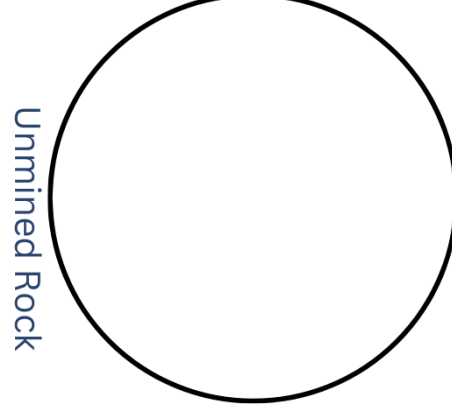
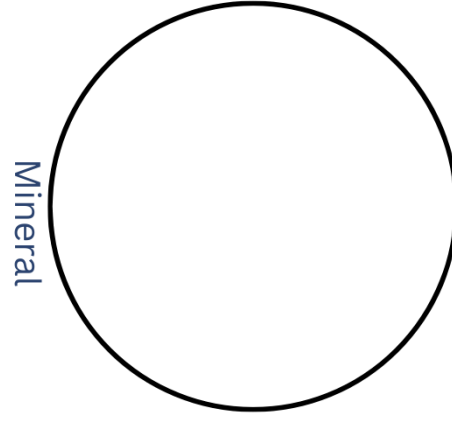
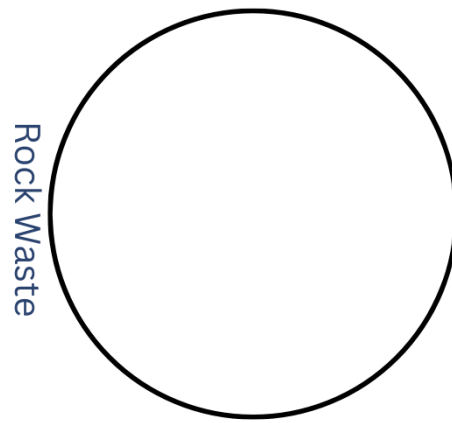
1. Provide samples or images of an ore to students and allow them to make observations without much prompting. Use samples/images in which it is easy to distinguish the rock waste from the mineral that would be extracted from it, such as:
  - a. **Gold in quartz**, Olinghouse Mine
  - b. **Gold**, Goldfield Nevada (called a Bonanza Ore because of the high amount of mineral)
  - c. **Gold Vein**, Goldfield Nevada (also a Bonanza Ore sample)
  - d. **Sleeper Rhyolite Gold Ore**
2. Discuss which sample they think would create the most rock waste compared to how much mineral could be extracted. Make comparisons to the activities in **Engage** and **Explore** to relate to relative amounts of product versus waste.

## HANDOUT

### Explore - Mining Products and Wastes



Cookie 2



Cookie 1