# The Mining Process

Level: High School
Facilitator Guide

## LESSON DETAILS

**Objective:** Students will investigate the mining process to understand the value of reclamation of mining lands.

### Standards

#### NVACSS and NGSS

- **HS-ESS3-2:** Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- **DCI:** Natural Resources; Human Impacts on Earth Systems; Developing Possible Solutions
- **SEP:** Constructing Explanations and Designing Solutions; Using Mathematics and Computational Thinking
- **CCC:** Cause and Effect

#### Career Readiness

- **1.2.3:** Demonstrate critical-thinking and problem-solving skills by analyzing and resolving problems that arise in completing assigned tasks.
- **1.2.8:** Demonstrate time, task, and resource management skills by organizing and implementing a productive plan of work.

### Materials

- wild bird seed (commercial mix)
- shallow pans or trays
- paper plates or bowls
- small beads (~2mm; blue, gold and silver)
- medium beads (~4-6mm, white)
- copies of handouts

### Lesson Summary

Students begin by assessing Landsat images of a mine in West Virigina to describe how it has changed over time, with a focus on environmental effects. Students will then conduct a hands-on activity to mimic the mining process and consider both the monetary and environmental costs of mining. Students then learn more about the West Viriginia mine and their efforts to reclaim the land after mining ceased. They will then assess mines in Nevada that have won awards for their reclamation efforts. The lesson concludes with student groups presenting on a mine they researched and why their reclamation work won the mine an award.

### Preparation

For **Explore**, set up a model mining site for each student group. Pour approximately 1-1/2 pounds of birdseed into each pan. In each model add 2 gold beads, 4 silver beads, 8 blue beads, which can be mixed into the birdseed. Then, shape the birdseed into a "landscape" with a hill at one end of the pan, a low spot near the foot of the hill that represents a lake, with the rest of the area being flat. Gently push 3 white beads into the flat area of the pan, being sure to cover up any divots you may have made.

## Engage

1. Have students watch a time lapse of Landsat images of **Hobet Coal Mine** (West Virigina). Have students make observations. You may need to replay the video or click through the images several times.

2. Discuss:

   - *Were all the images taken at the same time of year? How can you tell?*
   - *What do you notice about the mine over time?*
   - *How can you tell what areas are being actively mined and which areas of the mine are being reclaimed?*
   - *Focus near the center of the image (the area that starts being mined in 1988). What do you notice about the topography of this area between 1986-1996 (and even to the end of the video).*

## Explore

1. Divide students into groups. Assign each group a number or have the students decide on a name for their mining "company".

2. Describe the setup of the "mining sites" that you have set up. Tell students that the birdseed represents rock, and there are beads buried within it that are valuable minerals. Also tell them that the low area represents a pond that is a water source for a nearby town. Do not tell them where the white beads have beads have been placed or that they are strategically located only in the flat area.

3. Tell students what each component represents and the relative amounts they will earn for extracting each:

   a. Gold beads = Gold = $5.00 each

   b. Silver beads = Silver = $4.00 each

   c. Blue beads = Copper = $3.00 each

   d. Birdseed = Rock (Waste) = $0.00

   e. White beads = Reclamation incentive = -$2.00 each (Rebates that will be deducted from the cost of reclamation. In the mining world, these might represent the refund of a portion of a reclamation bond as a result of concurrent reclamation or a cost reduction for some type of environmental mitigation service performed by the company.)

4. Have one student from each group assume one of the following roles:

5. **Miner(s):** Search for beads (resources) in the birdseed. There can be more than one of these if there are more than 4 students in a group.

6. **Recorder:** Completes the spreadsheet with values for beads found.

7. **Environmental Monitor:** Assign a $1-3 "fine" to cover costs for "environmental damage" (see “Birdseed Mining Costs and Earnings Report” for categories of damage to look for).

8. **Accountant:** Calculates totals and profits using the spreadsheet.

9. Students search through the seed mixture and remove the beads they find to a bowl or plate. A second bowl or plate should be used for rock waste that is produced. Allow 5 minutes for the mining activity (less for larger groups with more miners).

    a. You may want to act as an additional “monitor” and circulate through the groups to ensure students are following mining laws and recording accurate data.

    b. Giving students a shorter time for mining may cause them to risk environmental damages in order to locate resources in time, which could lead to a productive discussion.

10. Have groups count the number of each colored bead and record them in the proper spaces on the "Birdseed Mining Spreadsheet".

    a. Any environmental damage fine is subtracted from the earnings.

    b. Then reclamation costs are subtracted from the initial profit. It is possible that their reclamation costs are negative if they found enough incentive beads to cancel out reclamation costs.

    c. The Grand Total is the profit (+) or loss (-) made of the mining company.

11. List the group numbers or company names on the board and compare the results.

    a. Let students know how many total beads were in the birdseed mix and show them the maximum amount that could be made if all beads were found, and no environmental damage fines were incurred.

    b. Discuss with students that this model did not include many of the costs associated with mining, such as wages for employees, mining equipment, and management of environmental effects.

    c. Discuss techniques that students used to search through the birdseed how students could change their mining technique to reduce costs if they were to mine again.

## Explain

1. Have students return to the **Hobet Coal Mine** animation and read about the mining and reclamation processes below the video.

2. Have students work in groups to generate a list of ideas about steps the Hobet Mine took to reclaim the land. Discuss:

   ▸ *What considerations might differ from state-to-state and why?*

3. Then, have students add ideas to the list about other steps they think mines should take to successfully reclaim the land.

4. Have students share their ideas to make a class list of reclamation recommendations.

5. Compare the class list to the "Selection Criteria" for the Nevada Excellence in Mine Reclamation Awards.

   a. Have students indicate which Selection Criteria overlap with their list.

   b. Discuss the Selection Criteria they did not name.

## Elaborate

1. Use the list of winners of the **Nevada Excellence in Mine Reclamation Awards** to identify mines recognized for their work related to rock waste.

   a. Recommended mines to use:

   - **2020: KGHM Robinson Mine** – Lane City Waste Rock Facility Reclamation Project (**Additional resource on this project**)
   - **2019: Barrick Gold – Bullfrog Mine Partial Pit Backfill**
   - **2017: Comstock Mining, Inc. – Rebuilding of State Route 342 and Reclamation of Historic Mine Features**
   - **2016: Newmont Mining Corporation** – Bootstrap/Capstone Waste Rock Disposal Facility
   - **2001: Round Mountain Gold Corp. - Manhattan Mine Site**
   - **1993: Echo Bay Minerals - McCoy Mine**

2. Assign each group a different mine to research. In addition to the Selection Criteria used in **Explain**, provide students with this "Guidance Document" that mines use to report reclamation efforts, which can help students understand more about specific processes done during reclamation of a mine.

## Evaluate

1. Have students present information about their mine. They will act as the Bureau of Mining Regulation and Reclamation to report on the work of the mine they researched and why the efforts of that specific mine won an award.

2. Determine criteria for what students should include in their presentations, such as:

   a. A map of the mine's location,

   b. Images that show how the area of the mine was changed from before/during reclamation to after,

   c. A time frame in which mining and reclamation took place,

   d. Explanations of the benefits of the reclamation efforts of the mine they researched, and/or

   e. The length and style of the presentation.

# HANDOUTS

## Birdseed Mining Costs and Earnings Report

### Earnings:

| MINERALS (BEAD COLOR) | NUMBER EXTRACTED | UNIT PRICE | TOTAL EARNINGS PER BEAD |
|---|---|---|---|
| Gold (_____) | | $5 | |
| Silver (_____) | | $4 | |
| Copper (_____) | | $3 | |
| **Total Earnings:** | | | |

### Costs: Environmental Damage:

| DAMAGE CATEGORIES | COST PER CATEGORY | COSTS FOR ENVIRONMENTAL DAMAGE |
|---|---|---|
| Excessive rock waste outside mining area | $2 | |
| Rock waste mixed with extracted minerals | $1 | |
| Rock waste entering lake | $3 | |
| Other | (determined by environmental monitor, not to exceed $3) | |
| **Total Costs for Environmental Damage:** | | |

## Subtract your Costs for Environmental Damage from your Earnings to calculate your Profit:

**Earnings:** $_____

**Costs:** $_____

**Initial Profit:** = $_____

**Reclamation:**

| COST AND REBATES FOR RECLAMATION | COST PER CATEGORY | CALCULATED TOTAL |
|---|---|---|
| Rebuilding the land | Multiply your Profit by 10% | |
| Reclamation Rebates (# found: _____) | Multiply the number of incentives you found by -$2 | |
| **Total Reclamation Costs (can be positive or negative):** | | |

## Subtract your Reclamation Costs from your Initial Profit:

**Initial Profit:** $_____

**Reclamation Costs:** $_____

**Grand Total:** = $_____