NVMA Nevada Mining Association EST. 1913

Sustainability and Mining

Level: Grades 3–5
Facilitator Guide

LESSON DETAILS

Objective: Students will investigate how sustainability concerns can be addressed by mining operations.

Standards

NVACSS and NGSS

- **5-ESS1-1:** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
- **3-LS4-4:** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
- **3-5-ETS1-1:** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
- **DCI:** Natural Resources; Biodiversity and Humans
- **SEP:** Asking Questions and Defining Problems; Systems and System Models
- **CCC:** Influence of Engineering, Technology, and Science on Society and the Natural World

Career Readiness

- **1.2.5:** Demonstrate lifelong-learning skills by continually acquiring new industry-related information and improving professional skills.

Materials

- computer with internet access, a projector, and speakers
- model mine for each group (shallow bin or baking pan, black beans, sand, spoon or similar tool, 2 small bowls or cups, timer)
- printouts of the handouts with select SDG tiles and their descriptions
- toy plants and/or animals, blue paper (optional)
- poster paper (optional)

Lesson Summary

Students begin by exploring mineral extraction utilizing satellite models of a mine in Nevada to consider how it has changed the environment. Students then use a hands-on model to "work at a mine" and see what it is like to balance mineral extraction with environmental effects. An introduction to the UN Sustainable Development Goals (SDGs) will then help students relate mining to sustainability concerns. Students then return to the physical model to apply what they have learned about sustainability as it relates to mining. The lesson concludes with students using critical thinking skills from their observations to communicate their understanding of the challenges and concerns associated with mineral extraction.

Preparation

- Set up the model for **Explore** before class. Consider how different or similar you want each groups' model to be and how this might affect the discussion of their results (e.g., using less mineral at some sites to discuss that not all mineral sources are profitable).
- The models will need to be reset before **Elaborate**. You may want the models to be identical to how they were during Explore, or you may want each group to now have the same model setup, so they can compare the strategies they implement to meet their chosen SDG.
- As students work through **Explain,** start researching Targets and Indicators (Step 9) so you are prepared to share specific examples as students identify which SDG they will focus on.

Engage

1. Show students an overhead view of Goldstrike Mine, the largest gold mine in Nevada (and the United States!).
    a. If needed, you may want to start with overhead images of other locations that students are more familiar to them to help familiarize students with viewing places from this orientation (e.g., show an overhead image of their community, and identify the school or other buildings they know).
    b. If possible, it is also helpful to locate the **Goldstrike Mine** on Google Maps and zoom in to the area to give students a sense of the size of the mine, as well as more information on what the surrounding environment is like.
2. Have students describe how they know where the mine is by comparing it to the appearance of the surrounding environment.
    a. Show the **NASA Earth Observatory** image of Goldstrike Mine with some components of the mine labeled. You may want to talk through some of the information on this site with students.
3. Have students describe how they think this mine has changed and affected the environment of the area. Have them discuss specific parts of the images as evidence of this change.
4. Ask students, "*Why do you think people mine for gold?" and "What might be the benefits and consequences of gold mining?*"
5. Discuss the uses of **gold**.
6. Discuss the benefits.

Explore Mining Processes *

Adapted from* ***Resource Extraction* *by TeachEngineering*

1. Fill a shallow baking pan halfway with sand.

2. Mix a cup of black beans into the sand so they are unevenly distributed.

3. Optionally, arrange toy plants and animals on one area of the model as a terrestrial habitat. You may also want to place blue paper in at least one spot to indicate an aquatic ecosystem or water source.

4. Have students work in groups to plan how to most efficiently extract the mineral from their mine site. Provide a spoon or other tool for "excavation." Provide a "waste bowl" for sand that is dug up.

5. Give each student group a timer, as they will work in 30-second intervals to extract their mineral. One student, the "extractor," will work for a 30-second interval that represents one workday. Determine how many workdays the students will do (10-15 are recommended).

   a. On each workday, they have two tasks:

   - To extract as much mineral as they can. They can collect minerals using only their forefinger and thumb, and they can only pick up one piece of mineral at a time. An additional "extractor" can be added when there are 10 or more mineral pieces visible. They will need to keep track of how many mineral pieces they extract each workday, so extracted mineral should be placed into a bowl or other designated location.

   - To excavate (dig), as needed, to locate more of the mineral. When they are digging, they cannot extract minerals. Any mineral that gets dug out with their tool has to go into a separate waste pile (cup or bowl) with the sand they remove from the mine site, it cannot go into the extracted pile. (This will hopefully prevent them from digging too quickly.)

   b. After students have completed the determined number of workdays, they should make a bar graph showing how much mineral they collected.

   c. Discuss their results:

   ▸ *Compare the data from each group. Are there any trends in the data?*

   ▸ *Do you think you improved in finding and extracting minerals over time? How do you think this affected how much mineral you found?*

   ▸ *Why wasn't the mineral found evenly throughout the site?*

   ▸ *Did you consider the environment as you mined? How might this have affected how much mineral you were able to extract?*

Explain

1. Ask students to describe concerns they have about mining based on the activity they completed in **Explore**. Record their answers on the board or on poster paper, so students can see the responses.

2. Introduce the UN Sustainable Development Goals (SDGs) by having students watch the beginning of "**What are SDGs?**" (0:00-2:08).

3. Ask students if any of their concerns about mining match or are related to the concerns addressed by the SDGs.

4. Place printouts of eight of the SDG tiles around the room (SDG 6, 7, 8, 9, 11, 12, 13, and 15). Tell students that these SDGs have been identified by geoscientists as being very closely linked to earth science knowledge and mining.

    a. Repeat the section of the video that shows each of the goals again (0:45-1:57). As students watch, they should move to the SDG tile that they think is the biggest concern related to mining.

    b. Another option is to have students list their concerns and then you can discuss them to determine which SDG each concern fits with.

5. Have students at each SDG tile read a paragraph on the SDG, then discuss how they think this concern is related to mining.

    a. Allow students to change groups at any time before step 6.

    b. Remind students that there is no right answer. They may want to choose multiple SDGs as concerns, but it can be very difficult to tackle too many challenges at once.

    c. If any of the groups are very large, it may help to break them up into smaller groups or hold a full class discussion about their SDG.

6. Have each group present their argument on how the SDG they chose is related to mining and why it is a concern.

7. Once every group has presented their argument, have students vote on which SDG they would like to explore further.

8. For the SDG with the most votes, watch the section of "**What are the SDGs?**" that explains more about that SDG (these explanations start at 4:45 and continue through the end of the video.

9. Review a couple specific Targets and/or Indicators from the SDG the students chose to give them a better idea of the specific goals people are working toward.

    a. Go to a specific SDG at: **https://sdgs.un.org/#goal_section**

b. Click on "Targets and Indicators"

c. Read through the Targets and decide on a couple that are most relatable to mining or to issues students brought up in discussion.

d. Click on each Target to reveal the Indicators, which are more specific goals related to a Target.

e. Choose Indicators to share with students, as they apply.

Elaborate

1. Have students return to their model mining site. Have groups discuss how they will try to extract mineral resources while working to meet the SDG chosen by the class.

2. Have students discuss their mining plan before they begin. They will do this as needed before each workday to consider the chosen SDG.

3. Students should follow the same mining rules as in **Explore**.

4. Once the specific number of workdays has been completed, have students graph their data.

5. Discuss as a class how the process of mining changed by considering one of the SDGs. Include a discussion on other changes they want to make but may not have been able to (e.g., access to other tools that did less damage to the environment or shorter workdays to extract the resource more slowly).

Evaluate

1. Have students write a mock letter about what they have learned about the SDG the class focused on. It may be helpful for students to:

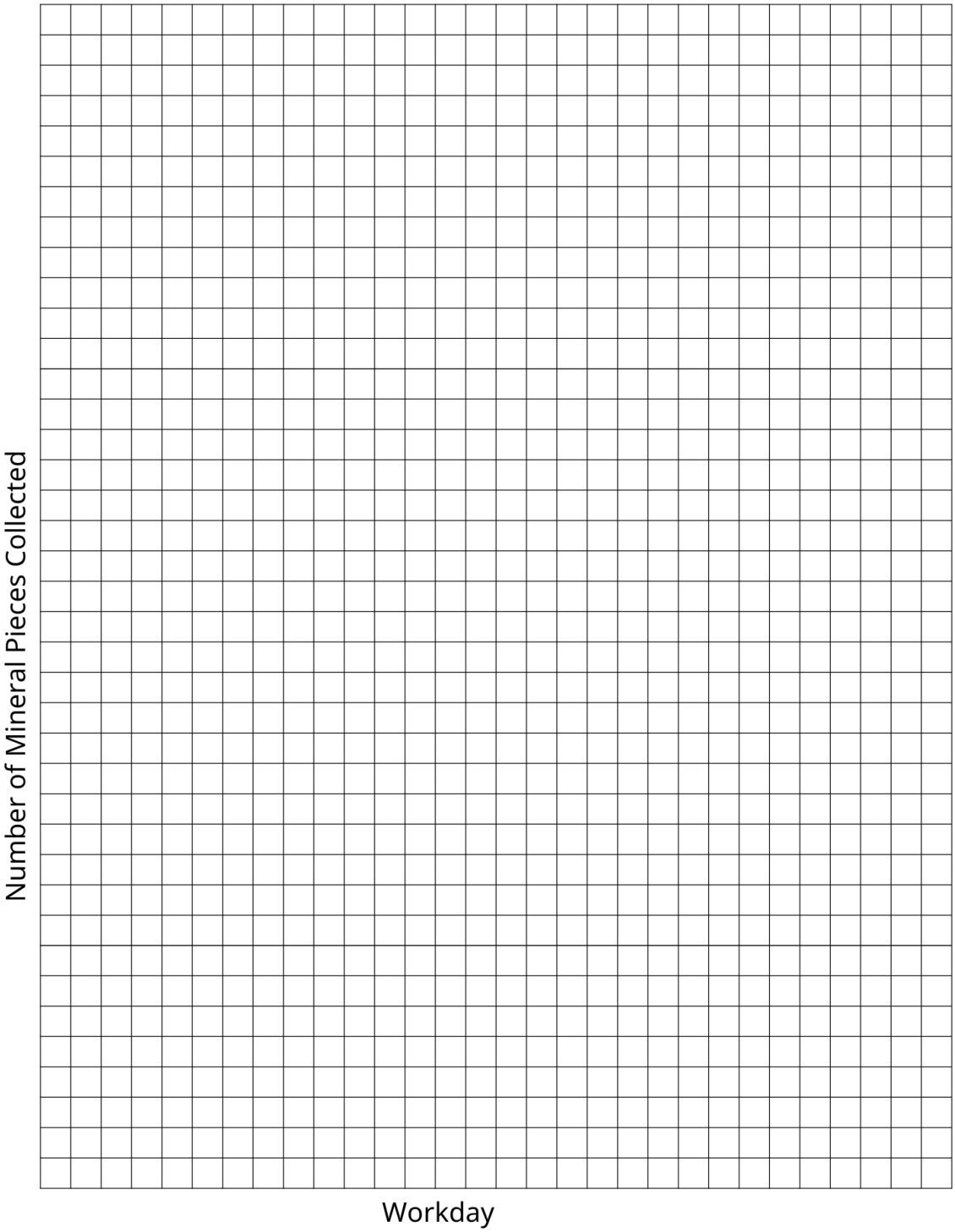
   a. Identify the specific audience of their letter so they can include relevant details about what they learned. For example, if they choose to write to a mining company, it may include advice on how to mine more sustainably, but if it is to a family member, they may need to start with a description of mining before discussing the SDGs.

   b. Use the dictate function in a word processing program to speak their letter out loud and then edit it.

2. Optionally, have students exhange letters and write responses to each other's letters.

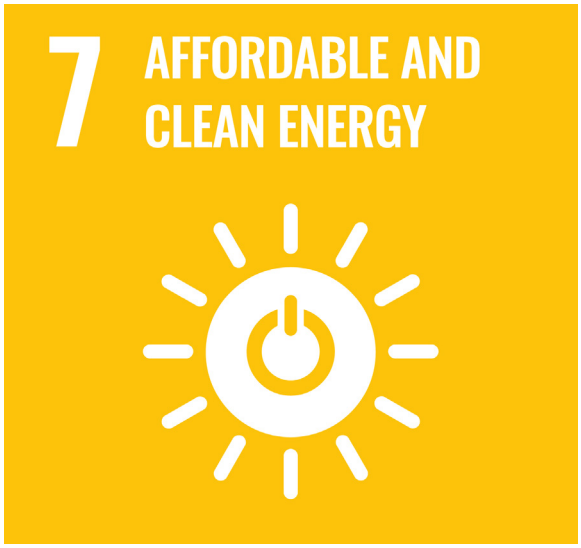
HANDOUTS

Explore

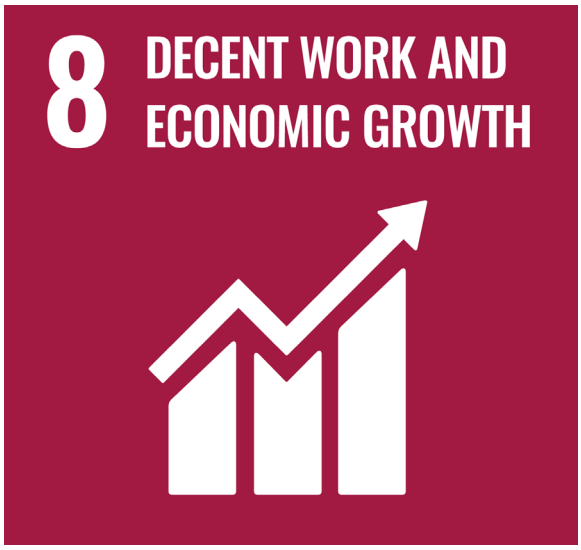


Explain

SDG 6: Clean Water and Sanitation -- SDG 6 is about making sure everyone has clean water to drink and use for other purposes, like washing clothing. When we take care of our water and keep it clean, we help people and animals stay healthy.



SDG 7: Affordable and Clean Energy -- SDG 7 is about using energy like sunlight, wind, or water to make electricity. When we use these kinds of energy, it helps our air stay clean and means we can have power without using up all our resources.



SDG 8: Decent Work and Economic Growth -- SDG 8 is about making sure grown-ups have good jobs that pay fair wages and care about workers' safety. When people have good jobs, they can take care of their families and help their communities grow stronger.

SDG 9: Industry, Innovation, and Infrastructure -- SDG 9 is about using new ideas and tools to save time and money. When we build better roads, bridges, and technology, it helps us travel and communicate easier and safer.

SDG 11: Sustainable Cities and Communities -- SDG 11 is about making our neighborhoods and cities nice places to live, with parks, clean air, and safe homes. When we take care of our cities, everyone can enjoy living there for a long time.

SDG 12: Responsible Consumption and Production -- SDG 12 is about using things wisely so we don't waste them. When we recycle, reuse, and don't use too much of something, we help protect our Earth and make sure there's enough for everyone.

SDG 13: Climate Action -- SDG 13 is about stopping rapid changes in climate that make the Earth too warm. When we protect our planet from getting too hot, we keep animals, plants, and people safe.

SDG 15: Life on Land -- SDG 15 is about taking care of forests, animals, and plants on the land. When we protect forests and make sure animals have homes, we keep our planet healthy and full of life.