LEARNING ACTIVITY:

Determining Mineral Reserves

Grade Level: 6-12

Materials

- Cardboard boxes (similar to those that a ream of copy paper comes in)
- Plaster cloth sheets
- 2-3 bags of clean, dry sand (or "play sand," #400)
- 1 box of plastic sipping straws

Figure 1. *Box without sand. Note irregular bottom surface of empty box.*

Figure 2. *Box with sand added and five straws used to estimate volume of sand in box.*

Source: Minerals Education Coalition. Adapted with permission.

Common things we use every day, like roads, sidewalks, schools, hospitals and homes—to name just a few—are made up of rocks and minerals. As a resource, they are called mineral reserves and include materials like sand, gravel, limestone, granite, and other aggregate and construction materials.

These important resources are located underground, requiring technicians and scientists to utilize various tools to determine the quantity and quality of these materials. This activity explores the physical testing, calculations and scientific methods commonly used to determine the quantity of mineral reserves.

Procedure

1. Work in groups of two or three students per box.
2. Place plaster cloth sheets in your box to simulate a rolling, undulating surface. This represents the surface of solid bedrock. Use wadded paper or other materials to create an irregularly shaped contour. Use duct tape to close openings between plaster cloth and box sides.
3. Fill the box with sand, and spread a level surface approximately 2-3" below the box top. Trade your box with another group.
4. Calculate the volume of aggregate (sand) in the box above the bedrock. You cannot take the sand out to measure its true volume until the very end.
5. To calculate, "drill" five holes throughout your territory and measure the depth of each drill hole. You may use straws or a ruler to drill, mark, and measure where you drill. Create a diagram, like a map, and mark these locations. Consider: Why are you choosing these locations? How will you use your measurements to calculate a volume? You will use this strategy after you take measurements.
6. "Drill" into your drill sites and record the measured depth at each location. Use your strategy to calculate the volume of aggregate that you decided on in the previous step.
7. Once you have "estimated" as closely as possible using your system of measuring volume, measure the volume using large beakers or measuring cups.
8. Calculate the accuracy of your results. Use the following equation:

$$\text{Percent error} = \frac{[\text{your value} - \text{actual value}] \times 100}{\text{Actual value}}$$

Consider: What were your sources of error? What would you do differently to decrease the percent error? Would a different "drill pattern" give more accurate results? Would more "drill holes" help? In the real world, each "drill hole" costs money. Do you think your method was cost-effective?

Extension: Build your own shoebox-size model of real geologic structures such as faults, folds, and plateaus. Cover them with sand. Let others try to identify the structures using the straw method.

NGSS Connections

- Science and engineering practice—Developing and using models, Using mathematics and computational thinking
- Crosscutting Concepts—Systems and system models
- Disciplinary Core Ideas—Natural Resources

This activity was adapted with permission from the Ohio Mining & Mineral Education Program (OMMEP) of the Ohio Aggregates & Industrial Minerals Association (OAIMA) in partnership with Wright State University.