Land Subsidence: Support

"The Open Cut" is an easily viewable example of a surface mine in the Black Hills. It was the original site of the Homestake gold mine, which during its lifespan operated as the most productive gold mine in North America.

Watch a Homestake Mining Company video clip below about the history of the original 1876 claim, the acquisition of the claim by George Hearst in 1877 and the history of the Open Cut surface mine in Lead. The video clip also introduces the issue of land subsidence in Lead which was due to poor backfilling and stabilization practices. The subsidence caused topographical changes and lead to the relocation of many buildings/homes.

Viewing Formats: (Digital Learning Library / Watch PBS)
During this activity your students will learn about the history of the Open Cut surface mine in Lead, SD. Your students will also learn about the issue of land subsidence in Lead which was due to poor backfilling/stabilization practices during the mining of gold. Then your students will complete an activity in which they will use materials like sand and coffee grounds to understand the importance of backfilling and stabilization.

Process:

- Introduce the activity by showing the “The Open Cut - Lead” video (Formats: DLL / Watch PBS) and by viewing the photos on the following website.

- Discuss the history of mining in South Dakota and current practices. Below are many websites with information about mining in South Dakota.
  - Dakota Pathways: Mining Booms and Busts
  - South Dakotas Mineral and Mining website
    - New Interactive Construction Aggregate Map with 519 licenses (view your area today)
  - Mining in SD (SD Historical Society)
    - Hard Rock Mining in the Black Hills
  - USGS Arsenic Contamination - Whitewood Creek - Belle Fourche River - Cheyenne River System, Western South Dakota

- Discuss land subsidence in Lead which was caused by poor backfilling and stabilization practices during the mining of gold. Below are many resources with information about subsidence.
  - Homestake Subsidence
  - What is Mine Subsidence?
  - Illustrated Effects of Mine Subsidence
  - USGS Mine Subsidence
  - Video - Understanding Risk: Karst Topography, Mine/Land Subsidence, Landslide
  - Video – Examples of Mine Subsidence Hazards in Colorado
  - Examples of Damage Caused by Mine Subsidence
• Have your students complete the following lab activity. Your students will test the strengths of cups with and without structural fill to better understand the importance of granular materials like sand/rock. (The principal strength of granular materials.)

  o Gather the materials below:
    ▪ Bathroom cups
    ▪ Fill (examples below)
      • Sand
      • Coffee grounds
      • Flax seed
      • Salt
    ▪ Boards to represent surface (1/2” plywood shown)

• Your students should hypothesize how many cups it would take to support their weight. (Individual cups could/should be tested to establish the weight at which they fail.)

• Test the hypothesis. Increase the number of cups if a fail occurs. If a fail does not occur, then reduce the number of cups to establish fail.
The Open Cut - Lead

Teaching Tip

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- Your students should select a fill material. If time allows - they could compare all of the fill types provided. (Alternative – your students could hypothesize the best type of fill and provide their own.)

- Your students should hypothesize how many cups it would take to support their weight. (Individual cups could/should be tested to establish the weight at which they fail.)

- Test the hypothesis. Increase the number of cups if a fail occurs. If a fail does not occur, then reduce the number of cups to establish fail. (Note: The reduction in the number of cups is surprising.)

Taking it to the Next Level:
- Try this activity from Elmhurst College: [How heavy is a gold bar?](#)