Earth Science Curriculum

Developed by University of Utah Mining Engineering students for the Utah Mining Association

Piloted and refined by Alpine School District teachers

Water and Its Effects

<table>
<thead>
<tr>
<th>Topic: The effects of water</th>
<th>Estimated Length (minutes): 45-60 minutes</th>
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<tbody>
<tr>
<td><strong>Standard: 1</strong>, Students will understand the structure of matter</td>
<td><strong>Objective: 3</strong>, Investigate the motion of particles</td>
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**Description:**
- Students will learn the impact of expansion and contraction of solid materials on the design of buildings, highways and other structures; including highwalls and mines.

**Required Materials/Resources:**
- **Expansion of Water - Ice can really do that?**
  - A one-liter bottle should be filled to the top with water
  - A one-liter bottle filled with water and frozen
Introduction:

- Water affects the design and strength of highwalls
  - The goal is to keep water out of mines
  - Water in mines and highwalls can lead to serious problems, including collapses or failures
  - If water is in a highwall and then freezes, it expands and causes problems
  - A highwall is the portion of a surface coal mine that is the undisturbed material
  - In other words, part of the slope that material has been removed from any portion of a surface mine that has not been excavated
  - A cliff, or highwall, is formed when material is being removed from the mine
  - This area contains either a coal seam in the highwall or underneath it
  - There are many safety concerns when it comes to highwalls
  - Some rules include: do not stand between equipment and a highwall, do not turn your back on a highwall, and you must be at least 30ft away from a highwall if not more.
  - When highwalls fail there are usually signs of warning.
  - These signs include small rocks starting to slide down, then larger rocks, and even cracking noises. When these happen, the highwall is about to fail

What would happen if water got into either of these areas?
The Results
**Discussion:** (Length: 20 minutes)

- What is a highwall (utilize information from the introduction)
- Teach what a highwall is.
  - When the material from a mine is removed, a cliff (highwall) is left
- Water should be kept away from these areas as much as possible
- Water in or around highwalls is very dangerous
- Water reduces the strength of structures that hold the cliff together
- Occasionally water flows out of the highwall, but when water stops it means there is a backup of water, which can weaken the highwall
- When water is backed up and ice forms, the water cannot exit the highwall and there is a water pressure built up; this causes a highwall to fail

**Activity: Ice can really do that?** (Length: 10 minutes)

- Procedure:
  - The day before class, fill up a one-liter bottle to the top with water and freeze it
  - Have another liter bottle filled with water than is unfrozen
  - Discuss the difference between the frozen bottle and the unfrozen bottle
  - Show that the frozen bottle has expanded and caused damage to the bottle
  - Explain why this happened
  - Calculate the density of the ice in the different phases. Compare the densities in the different phases.
  - Explain the possible dangers of frozen water and its expansion
- Watch the “Ground Rules-Chapter 4” Video

**Real World Application:** (Length: 10 minutes)

What is a highwall?
A highwall is the portion of the mine that has not been excavated
When material is removed from the mine, a cliff is left
Highwalls contain coal seams in them or beneath them
Highwalls are the areas that are about to be mined
These areas hold the important material

Rules for Highwalls

- Do not stand between equipment and a highwall
- Do not turn your back on a highwall
- You must be at least 30ft away from a highwall, if not more

Signs of Failing

- When highwalls fail there are usually signs of warning
- Small rocks begin to fall down the highwall
- Then larger rocks begin to fall
- Cracking sounds can be heard coming from the wall
- Then the whole highwall fails