



Utah Mining Association



Earth Science Curriculum

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

Piloted and refined by Alpine School District teachers

Expanding and Contracting Earth: Intro to Mining Methods

Topic: The expansion and contraction of certain materials	Estimated Length (minutes): 30-47
Standard: 1, Students will understand the structure of matter	Objective: 3e. Describe the impact of expansion and contraction of solid materials on the design of buildings, highways, and other structures. 2d. Describe the relationship between mass and volume as it relates to density.

Description:

- This lesson plan will describe some basic mining methods and tie in to the

expansion and contraction of certain materials that are mined.

- The different mining methods try to take advantage of the fact that materials expand or contract to help extract the desired material in the most efficient and safest way possible.

Required Materials/Resources:

The following videos are helpful for explaining and showing the different kinds of mining methods

- Mining method 1: Video from Caterpillar explaining the longwall mining method (approx. 3.5 min) <http://www.youtube.com/watch?v=bXORrVmxwbM>
- Mining method 2: Video explaining a bucket wheel excavator (approx. 2 min) <http://www.youtube.com/watch?v=oWlcqdPJEpg>
- Mining method 3: Video of various blasts in a mine (approx. 4 min) <http://www.youtube.com/watch?v=7fEJcyMNfII&feature=fvwp&NR=1>

Teacher Background:

- Everything in this world is made from materials that come from the earth. Some of these materials are non-renewable. These essential non-renewable resources must be extracted safely and efficiently in order for us to enjoy the wants and needs of our society.
- Different mining methods are used to extract different minerals around the world. The following methods in this outline are just a few.

Discussion: (Length: 15 minutes)

- Materials that are mined experience expansion and contraction
- Method 1: Underground Longwall mining
 - Uses machine called longwall to mine out large regions of coal or other soft rock minerals (see Longwall Video)
 - A machine called a continuous miner, or commonly known as a 'CM,' cuts out the entryways (rooms), and leaves the larger area (panel) for the longwall to mine.
 - As the longwall has finished mining out a panel (the 300-800ft by 2-3 mile area), the open space behind the shields caves in. This material is called the gob.
- Method 2: Surface Bucket Wheel Excavator mining

- Uses machine called Bucket Wheel Excavator to extract soft rock minerals.
 - Is one of the biggest, most efficient ways to mine in the world
- Method 3: Surface Mine Blasting
- Often times the volume of earth calculated to be in the rock is less when the same volume of rock is blasted and ready to be hauled away by truck and shovel. This is called 'swell factor.' Swell factor =
$$\frac{\text{Volume of material in the ground (bank material)}}{\text{Volume of material after blasting (loose material)}}$$
 Simply put, you often have a larger volume of material after blasting has taken place.
 - The swell factor is important when choosing how many and what kinds of trucks and shovels to use to gather and haul the material
 - Blasting is the most efficient form of breaking large rocks into smaller rocks (comminution). The difference between a good blast and a bad blast can be observed. If the blast goes straight up out of the hole, it is a bad blast. If the desired material was removed in a safe and non-chaotic way, it is a good blast. The associated video shows some good blasting examples and bad blasting examples.

Activity: (Length: 20 minutes)

- Dirt in 5-gallon bucket (*This activity needs a couple of days of preparation*)
- Step 1: Fill bucket about $\frac{1}{4}$ of the way with dirt.
- Step 2: Add a small amount of water to help dirt become as compact as possible. This may require some downward pressure on the dirt to facilitate the compaction process.
- Step 3: Fill bucket about $\frac{1}{2}$ of the way with dirt.
- Step 4: Repeat step 2.
- Step 5: Fill bucket about $\frac{3}{4}$ of the way with dirt.
- Step 6: Repeat step 2.
- Step 7: Finish filling the bucket with dirt.
- Step 8: Repeat step 2.
- Step 9: Calculate the density of the dirt.
- Take the bucket of dirt outside. Activity is done best on concrete. Have the students dump out the contents of the bucket. Then have students fill the bucket back up with the same dirt. Students will realize that compact materials will 'swell' and it will be very difficult to put back all of the dirt back into the bucket. Discuss what has happened to the density of the dirt and why this occurred.

Assessment: (Length: 15 minutes)

- Explain why the dirt did not all fit back in the original bucket (answer must relate to density)

Real World Application: (Length: 5-10 minutes)

- Some careers associated with mining:
 - Mining Engineer, Longwall crew member, survey crew member, continuous miner crew member, planning engineer, mechanical engineer, electrical engineer, geologist, geological engineer
- The longwall method is currently being used right now in Utah to mine coal
- Approximately 80% of electrical power in Utah comes from coal