

**Title:** Mining and Safety in Kentucky

**Level:** Secondary

**Day/Time:** One class period or Homework assignment

**KERA Goals:** 1.2, 2.6, 5.1, 6.1, and 2.20

**Background Information:**

Since the first commercial sale of coal in 1820, Kentucky has felt its impact. Mined from near the Green River in Muhlenberg County, this was considered by many the beginning of the coal mining industry in Kentucky.

As industrialization grew during the mid-1800's, the demand for coal also grew. Coal mines opened in the northern and southern regions of the state in response to this increased demand.

By the late 1800's, mining had extended into the rich coal fields of eastern and western Kentucky. Improved mechanization in the mines and the expansion of Kentucky; railway system enabled companies to move into these new regions. Railroads were not only a major means of transporting coal but coals largest user.

Many believe the first surface mining operation was started near Paradise, Kentucky. The stripping of overburden, the rock and material covering the coal, was done during the summer and the coal was mined during the winter. The overburden was removed by horse-drawn plows and scrapers. Then it was hauled away in wheelbarrows and carts.

In the late 1800s, steam power shovels were used to remove the material covering the coal; however, these shovels were small and were limited in their effectiveness. As a result, little coal was actually mined. By 1911, this began to change as larger surface mining equipment was finally introduced and the first coal mined from a surface mine was shipped by rail.

Coal mining was to continue to grow until 1990. In that year, Kentucky experienced a record production in excess of 179 million tons. Underground coal production currently exceeds surface coal production by more than 50 percent.

Today, coal mining and the economy of Kentucky, have a close relationship. Many communities would suffer greatly from the loss of this important industry. Kentucky continues to employ more coal miners than any other state in the U.S.

*What is Coal?*

Coal originated as ancient plants that grew in swamps millions of years ago. Geological processes over vast spans of time covered, compressed and altered the decaying plants, increasing the percentage of carbon (and hardness) and thus producing the **different ranks of coal**. **Lignite** is the lowest rank of coal, and the softest, characterized by high moisture and low heat value. **Subbituminous coal** is next in rank with much less moisture and

higher heat value. **Bituminous coal** – the primary type that occurs in Kentucky– contains very little moisture and has high heat value. **Anthracite** is the highest rank coal, and the hardest, with almost no moisture and very high heat value.

Along with carbon, coal contains hydrogen, oxygen, nitrogen and sulfur. In fact, coal contains small traces of almost every known mineral. Coal exists as layers, or seams, found between geologic rock layers. In Kentucky, the thickness of these coal layers may be less than an inch to more than ten feet. The coal seams presently mined in Kentucky are typically 2 to 7 feet thick.

### *Types of Mining in Kentucky*

#### Surface Mining

Surface mining is used when coal seams lie close to the surface. Today's surface mine operations are highly mechanized, moving huge volumes of earth in order to retrieve a relatively thin **coal seam**. In Kentucky, surface mine operations typically mine coal that is 25 to 150 feet below the surface. Below this depth, the cost of handling the rock and soil layers overlying the coal becomes prohibitive and the coal is too deep for most surface equipment.

With the passage of strict federal and state surface mining legislation in the late 1970s and early 1980s, coal companies are required to use mining procedures that protect the land and wildlife. Prior to mining, the area is surveyed and inventoried to determine the type and amount of vegetation and wildlife in the area. The mining company determines what conditions exist which must be addressed prior to, during and after mining. Following this pre-mining inventory and the issuance of a permit, mining operations begin.

The first step is clearing the land of all trees and vegetation. The **topsoil** and subsoil are then removed and set aside to be used later when reclaiming the land. The **overburden** – rock and other material covering the coal– is removed by **draglines** or large shovels to expose the bed of coal. If the overburden proves too hard, it is drilled and blasted. Smaller shovels load the coal onto large trucks.

Once the coal is removed, the area is reclaimed. First, the overburden is returned to the pit where the coal was removed. Next, the subsoil and topsoil are replaced. The area is restored as close to the original contour as possible. The reclaimed land is used in a variety of ways: crop land, wildlife habitats, pasture and wooded land, or recreation areas. These are only a few examples of the uses of reclaimed mine land.

#### Underground (Deep) Mining

Underground mines are developed when the coal is too deep for surface mining. Many of Kentucky's underground mines are less than 400 feet deep but some are as deep as 1,000 feet. Over 75 percent of the coal mined annually in Kentucky comes from underground mines.

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There are three types of underground mines: **shaft**, **slope** and **drift**. The type of underground mine developed depends on the coal seam. If a coal seam **outcrops** (appears at the surface) or is exposed from a surface operation but is too deep to surface mine, a drift mine can be driven horizontally into the coal seam. When the coal seam is relatively close to the surface yet too deep to be recovered by surface mining, a slope mine can be built, with the mine entrance being a tunnel which slants down from the surface to the coal seam.

The most common type of underground mine is the shaft mine. Used to reach coal seams which are too deep for surface mining or the other two types of underground mines, a vertical shaft is dug down to the coal seam. The shafts are used by miners to enter and exit the mine. The coal is removed through shafts as well.

There are two methods of underground coal mining used in Kentucky:

**Room and Pillar:** The coal seam is mined in a carefully engineered pattern that keeps approximately half the coal in place to help support the roof of the active mining area. These large "pillars" of coal are left while "rooms" are mined out around the pillars. Coal is removed either by **continuous miner machines** or conventional methods.

In Kentucky, the greatest amount of coal is mined using a machine called a continuous miner. This machine has a large drum which has rows of bits or teeth. The drum is pressed against the wall of coal and the rotating drum breaks down the coal. Large gathering arms on the machine scoop the coal. A conveyor on the machine then moves the coal back to where it is loaded on waiting **shuttle cars**. Shuttle cars are machines that have large hoppers and are used to move the mined coal away from the seam.

In **conventional mining**, a machine resembling a large chain saw cuts into the coal. This gives the coal a place to expand into during blasting. Holes are drilled and explosives are placed into the holes. After the explosives are detonated, machines, called loaders, scoop the coal and load it onto shuttle cars. Another way of blasting the coal is to use compressed air. Long metal cylinders are placed into the holes and the compressed air is released, causing the coal to break.

**Longwall Mining:** Becoming increasingly more popular, longwall mining is different from room and pillar in that all the coal is removed. Mined by a large rotating shear or drum, the machine moves along the wall of coal, cutting the coal as it moves. The coal falls onto a conveyor belt and is taken from the mine. This wall of coal is several hundred feet wide which is why this type of mining gets its name " longwall

Since all the coal is removed, the miners must be protected from mine collapse by large steel shields that act as giant jacks to support the roof. After the coal is removed, the shields move forward with the mining operation, allowing the roof to collapse in the area just mined.

The collapsing roof will cause the surface to sink, which is called subsidence. Coal companies are required by federal and state laws to protect homes and property from subsidence and make repairs if damage occurs.

## What Factors Determine the Type of Mining Used?

- Location of area to be mined
- The amount and type of overburden
- Thickness of coal seam
- The type of mining that provides the safest and most profitable results, with the least impact on the environment.

### *Safety in Kentucky Coal Mines*

Protecting miners is a primary concern to the Kentucky coal industry. With both surface and underground mining, the safety of the workers is considered essential to the operation of a mine. Coal mining can be a hazardous occupation, and unless special precautions are taken, injury or death may result.

Over the past 20 years, the number of injuries and fatalities have notably decreased in Kentucky mines. It has been through the efforts of labor, management, and state and federal regulatory agencies that this has been achieved. The number one priority is to continue to provide a safe work environment for the Kentucky coal miner.

### *Underground Mine Safety*

*Ventilation:* Good, fresh air is the most important safety concern. The purpose of good ventilation is to provide workers with a safe and healthy workplace. To ventilate an area means to provide fresh air, control the air movement and also to remove dust and dilute gases generated by mining activities. If the mined area is not properly ventilated, safe mining would not be possible.

The larger the mine, the more effort is needed to move air in and out of the mine. In larger mines, it is difficult to ventilate are from the mine face and provide a fresh supply because the air must travel farther distances.

At the mine *face* – the heart of the mining operation where coal is being cut away from surrounding rocks – naturally occurring gases, predominately *methane*, are liberated from the mined coal. Air circulated through the mine is considered "fresh" or "intake air." After the air passes the mine face, it is directed out of the mine in passages labeled "return air flow."

The primary concern with methane is that its presence in sufficient amounts can create an explosion. Most mining equipment operates at the coal face, such as roof bolters and continuous miners, are equipped with methane monitors that will automatically trigger equipment shut down at high methane levels. Methane gases exist in any geologic formation that once consisted of organic materials, such as plants.

Another safety concern is dust created by mining activities. In addition to the application of dust suppressants on interior mine surfaces, mine workers are supplied with respirators to filter dust particles from the air they breath.

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*Lighting:* It is also important to provide proper lighting for underground mining operations to help prevent accidents from occurring. This includes lighting of the work area, travel routes and the machines. Another way to improve safety with lighting is to properly mark passages and exits. An underground mine can be very large. It contains many different rooms and roadways that have already been mined. In older mines, it could take a miner hours to get from the surface to the work area.

*Roof Support:* By using various roof support methods, the risk of the roof collapsing is greatly reduced. A good roof support plan includes constant checking of mine roof conditions, temporary support plans and permanent support plans. In order to support the roof of the mine, pillars and opening widths must be considered. Posts, jacks, bolts and beams are used to secure the walls and ceiling of the mine.

*Rock Dusting:* In a mine, the wall areas are covered with a white dust made of powdered limestone. The purpose of rock dusting the areas in the mine is to contain or minimize explosions, aid in the lighting of the mine and reduce health hazards.

### *Surface Mine Safety*

In surface mine, different safety considerations have to be made, including proper communications, proper use of heavy equipment and precautions against falling rock.

*Communications:* Communication is important in any mining situation. In surface mining, certain signals tell the miners when an area is to be blasted. Electrical safety is important in surface mine situations. Many high voltage lines are found throughout the mined area.

In surface mining, poor housekeeping is one of the leading causes of accidents. Good housekeeping includes proper storage of combustible materials. They must be kept away from electrical components. Miners must be aware of accumulation of coal or coal dust around belts or machinery, which could cause machinery to break down. Equipment and tools must be put in their proper place.

*Heavy Equipment:* At surface mines, large heavy equipment such as draglines, shovels, haulers, scrapers and bulldozers are used to mine the coal. Great care must be taken when working around large machines. Accidents are most likely to occur when miners get on and off their machines or walk between machines. They may not be seen by other equipment operators nearby.

### *Equipment Worn by the Miners*

Miners wear equipment that helps to keep them safe whether they work in a surface or underground mine. All miners must wear hard hats, steel-toed shoes and, at times, safety glasses. Underground miners are equipped with *self-rescuers* which allow them to breath in the event of a mine fire. Underground miners also carry gas detectors that are used to measure gases in the air. Some of these gases, such as methane, can be dangerous to the

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miner and can be explosive. Surface miners must also use hearing protection when working in high noise areas.

### *Safety Programs*

*Kentucky Department of Mines and Minerals* The Department of Mines and Minerals interprets the laws and makes decisions on many mining issues. The board also has the responsibility of certifying certain types of mining professions, such as mine examiners, mine managers, inspectors and hoisting engineers.

*Mine Rescue:* The Kentucky Department of Mines and Minerals, maintains mine rescue stations and teams throughout Kentucky. Mobile mine rescue units are equipped with every emergency rescue device and instrument that might be needed. These units are located at the mine rescue stations where trained professionals are on call 24 hours a day. Rescue teams are available for both underground and surface mines. Also, an Emergency Medical Technician (EMT) must be present when 30 or more individuals are working in a surface or underground mine. These EMTs must be available to provide care in the event of illness, injury or an emergency situation.

The Kentucky Mine Rescue Association hosts an annual mine rescue contest. The purpose of the contest is to simulate a portion of a mine where there has been a problem requiring the services of a rescue team. During the simulation, the rescue team will encounter situations similar to those found in underground mining. Each team will have to explore the mine, make gas checks, change ventilation and account for any miners who may have been trapped in the mine.

These practice contests sharpen the skills of rescue teams.

### **Discussion:**

1. Briefly describe the steps of surface mining.
2. List three facts about surface mining:
  - a.
  - b.
  - c.
3. Name the two methods of underground mining:
  - a.
  - b.
4. Which method of underground mining results in the recovery of more coal?

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5. List the four main areas of safety for underground mining and give a brief explanation of why each area is important:

- a.
- b.
- c.
- d.

6. How does safety differ between surface mining and underground mining?

7. What is the purpose of the Kentucky State Mining Board?

8. What function does the Kentucky Mine Rescue Association serve?

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