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Goals and Materials

Goals

Kit users will:

- Learn what mining is and the various mining practices used in South Dakota,
- Become familiar with historical events and figures in South Dakota mining.
- Understand and demonstrate mining techniques such as panning and strip mining.
- Recognize the significance of mining in the development of South Dakota.

Materials

This kit includes:

1 Teacher's Resource binder
1 drill bit
1 mining deed
2 stock certificates
1 claim map
1 blasting cap tin
2 panning pans
1 5-ft blasting cap
1 12-ft blasting cap
1 core sample
1 trowel
1 feldspar sample
1 rose quartz sample
2 Sioux quartzite samples
2 prairie agate samples
1 gold ore sample
1 mica sample
1 bottle of 24k gold
1 miner's helmet
1 balance scale
1 container of iron pyrite (fool's gold)
1 carbide lamp
1 mining pick
1 blasting simulator
1 bottle of BBs
21 photographs (in Teacher Resource binder)
5 transparencies (in Teacher Resource binder)

Teacher Resource

What is mining?

Mining is the extraction of minerals, metals, and fossil fuels from the earth. These have provided building materials, currency, jewelry, and fuel supplies to people all over the world. The Egyptians mined limestone for the outer layers of the pyramids. The Aztecs mined gold to make ritual masks and jewelry. People mine for what they need. Granite is used for construction, copper for electrical wires, gravel for roads, and diamonds for laser beams and jewelry. Gold and silver, once used as currency, are used today in jewelry. Topaz, emeralds, rubies, and other precious stones are also used in jewelry. Oil and coal provide everything from charcoal to gasoline.

Types of Mining

There are four main types of mining:

1) Quarrying requires digging a large hole in the earth from which minerals and rocks can be extracted. This technique is used when the mined material is abundant and relatively close to the earth's surface. Granite and limestone are quarried.

2) Strip-mining is the process of reaching a specific layer of rock and minerals by removing all the layers above the target layer. This technique is used when a mineral can be found at a specific depth below the surface. Coal, which forms in distinct layers, is often strip-mined.

3) Placer mining is a surface mining method used to find precious materials lying on top of or near the earth's surface. Panning for gold is an example of placer mining. Placer mining is useful for finding small quantities of precious materials. One individual or a large group using relatively simple tools can do it. Other types of mining require more advanced technology.

4) Hard-rock mining is simply mining underground. Shafts and tunnels are built to follow a *vein* or mineral deposit between definite boundaries, but not at any specific depth. Gold forms in underground veins and is frequently mined using this method.

Prospecting

Prospecting is the act of searching for surface minerals to placer mine. It is also used to determine locations for hard-rock mines. Although it has been practiced since ancient times, not much is known about early prospecting. Early prospectors needed to protect their discoveries from raiders so they rarely shared the secrets of their trade with anyone other than fellow prospectors. Many of the methods used by prospectors in the American West were likely similar to those used by ancient prospectors. [1]

Most of the prospectors in South Dakota were searching for gold and silver so they developed techniques for finding these two minerals. They looked for igneous rock, formed when molten rock below the earth's surface rises and cools. Granite is one such rock. Gold can be found in granite.

Prospectors also looked for *mineralization*, the presence of certain minerals, in an area. Quartz and bright-colored rock both indicated an area's mineralization. Prospectors specifically looked for green, blue, or rusty stains on rocks. The green or blue stain caused by copper chlorides and carbonates could indicate silver. Rusty brown stains came from hematite, a 'signpost of gold'. Most prospectors avoided metallic yellow because it usually signified iron pyrite, commonly known as fool's gold. Fool's gold can easily be told from real gold because a hammer tap will flatten real gold but will shatter fool's gold into dust.[2]

[1] Western Mining. Young, Otis E. Jr. (1970) University of Oklahoma Press: Norman, Oklahoma Pg. 3-5
[2] Young, Pg. 18-20

Prospectors also used a crude chemical test to determine the presence of silver in a mineral sample. Otis Young describes the process:

> The prospector collected sufficient particles to fill a spoon, dried them, and scraped them into a small cavity cut in a charcoal block. He covered the sample with a layer of bicarbonate of soda (baking soda), and then used a blowpipe and candle flame to smelt the batch. . . . This chemically reduced the mineral by driving off sulphur, chlorine, or carbonate, leaving a small metallic bead or button behind. . . . A white metal bead could be rolled in slightly dampened salt, and then exposed to the sun to show black streaks symptomatic of silver.[3]

The presence of other minerals such as iron, lead, copper, and nickel could also be determined by looking at the color of the bead.

Once a likely area for gold was found, prospectors searched for the *lode*, or vein of gold. If they could locate the lode, they would have the ore *assayed*, or chemically tested for gold content. If the location looked to be profitable, the prospector filed a legal claim and then tried to sell it to a mining company. Sometimes prospectors tried to increase a claim's value by "salting" it with gold from another source. Gold shavings off coins or purchased gold dust could be added to the assay samples, making a claim appear more valuable.[4]

Quarrying

One of the most fundamental and practical forms of mining is quarrying. This process is defined as an open, or surface, excavation of rock that is used for a variety of purposes.[5] Quarrying has been practiced for centuries. The Romans quarried stone to construct their famous road system. The Egyptians quarried materials for the pyramids and the Sphinx. Much of the stone for the Giza pyramids was quarried on the Giza plateau itself.[6]

Quarrying has been practiced in South Dakota since before it was a state. Stone quarried in the Black Hills helped rebuild Deadwood after a fire destroyed the town in 1879. Quarrying in eastern South Dakota is still profitable today. Mining Sioux quartzite is a multimillion dollar industry in Minnehaha County. Sioux quartzite is valuable because of its hardness, uniformity, and attractive pink appearance.[7] It has been used for buildings and as crushed rock for paving South Dakota roads. The crushed quartzite gives South Dakota its many pink highways. The Dakota Granite Company in Milbank mines granite for use in construction.

Strip Mining

Strip mining involves removing layers of earth and rock in order to expose the minerals underneath. The material that is removed is called *overburden*. In strip mining, the disruption of the soil from its natural formation may adversely affect vegetation and the water table. Steps can be taken to minimize such dangers. Workers are now more careful in replacing the overburden during reclamation.

Like quarrying, strip mining is a form of surface mining. Although never huge industries, both coal and uranium have been strip-mined in South Dakota. Black Hills lignite coal was hard to mine

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[3] Young, Pg. 24
[4] Young, Pg. 46
[5] *Columbia Electronic Encyclopedia*, 6th ed. "quarrying." (Columbia: Columbia University Press, 2003), 02 June 2004. http://www.infoplease.com/ce6/sci/A0840729.html.
[6] Padwe, Alice. "The Egyptian Pyramid." (Washington, D.C.: Smithsonian Institution, 1999), 02 June 2004. http://www.si.edu/resource/faq/nmnh/pyramid.htm.
[7] Fanebust, Pg. 272.

profitably, in the Hills and elsewhere in the state. The Firesteel Coal Company in the Timber Lake area did operate for several decades but ceased operation in 1969. Uranium mining began in South Dakota in 1957 with mines in Harding and Fall River counties. 69,632 tons of uranium ore were mined that year. Processed uranium was used in nuclear weapons and fuel reactors. By 1973, mining uranium in the state stopped being profitable and production stopped.

Placer Mining

Mining in South Dakota often brings to mind the Black Hills Gold Rush. Placer mining and hard-rock mining were common in the rush. Placer gold was found on bedrock, and tons of dirt and rock had to be moved to reach it in some cases. Gold was separated from this waste by panning or sluicing. Panning is often shown in the movies and television shows about the gold rush. The men with the long hair and beards standing in shallow streams with metal pans were placer miners. Panning is an essential part of placer mining once gold is found.[8] Watson Parker describes the process as follows:

> The gravel to be washed was put into the pan, which was immersed in water. The prospector shook the pan and kneaded its contents, washing off the light dirt and throwing away the stones. The gold, if any, settled to the bottom along with any heavy metallic sands from the gravel. With a final dexterous twist of the pan, the miner would spread its contents in a broad crescent across its bottom. At the convex edge appeared the flecks and flakes of gold, which could then be removed with either a matchstick or a fingernail.[9]

Hard-rock mining

Hard-rock mining required more men, greater personal risk, advanced equipment, and more capital to start the operation. Wealthy organizations or partnerships often funded hard-rock mining operations. George Hearst and his partners at the Homestake Gold Mine in Lead are an example. Both placer and hard-rock mining went on simultaneously in the Black Hills. Hard-rock mines stayed profitable over longer periods compared to placer mines, whose gold often played out more quickly.

Transportation and communication facilities in the Black Hills improved as hard-rock mines developed making it easier for workers to get to the area. These advancements provided young towns like Lead and Deadwood with a valuable infrastructure.

Value of Gold

What makes gold so valuable? In ancient times gold was primarily used for decoration. Civilizations adorned religious and culturally significant structures with the metal. Gold has been used for jewelry since the Sumeric civilization of around 3,000 B.C., and has been used for wedding rings since the 9th century.[10] It became a form of currency after the 9th century. Today, gold's chemical properties make it valuable. Gold is extremely malleable and can be pounded into flat sheets. It can be drawn into fine wire, and is very reflective. These properties make gold extremely useful in the technological world. Buildings and space satellites use it to reflect heat. Medicines and dental work take advantage of gold's unique properties. Computers and other high-tech equipment use tiny gold wires in their circuits.

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[8] Parker, Watson. *Gold in the Black Hills*. (Pierre, S.D.: South Dakota State Historical Society Press, 2003), Pg. 56.
[9] Ibid.
[10] Newmont. "What has gold been used for in the past." (Waihi, N.Z.: Martha Mine Education Centre, 2002), 03 June 2004. http://www.marthamine.co.nz/schools/gold_sch.html.

Cyanide Process

Finding and extracting gold from the earth is only half of the mining equation. While some gold is pure, most is combined with other metals or broken up into small particles and spread throughout a mixture of minerals and metals. The gold particles may be so fine they cannot be seen with the naked eye. Gold ore was sent to mills where the gold could be extracted.

Refractory ore contains complex combinations of minerals and metals that make gold recovery difficult. There are two types of refractory ore: red ore and blue ore. Red ore is refractory ore that has been *oxidized*, or exposed to oxygen. It turns red because of the iron it contains. Blue ore is unoxidized refractory ore. It is found deep in the earth where it is not exposed to oxygen so it retains a blue color.[11] Both of these ores were challenging to mill and no efficient or affordable technique existed for extracting their gold. In 1885, John S. MacAurthur, William Forrest, and Robert W. Forrest developed an inexpensive solution to this extraction problem, the cyanide process.[12]

Not many solutions will dissolve gold. It even resists the corrosive acids in a person's mouth, which makes it good for dental work. Potassium cyanide does dissolve gold easily and separates it from other metals and minerals. Mills in the Black Hills started using the cyanide process to extract gold.

The cyanide process started by crushing the ore. The crushed ore was stored in large holding bins to be dumped into leaching tanks where the cyanide solution was added. As the gold (and silver) dissolved into the cyanide, waste materials sank to the bottom of the leaching tank. A vacuum pump removed the gold-and-silver-bearing cyanide solution from the tank, and the remaining waste was dumped into a nearby creek. Boxes containing zinc shavings were used to separate the gold and silver from the cyanide. The zinc attracted the gold and silver, pulling them out of the cyanide solution. The solution was drained from the boxes and reused in the leaching tanks. The gold-and-silver-coated zinc shavings went into a lead pan with sulfuric acid, which dissolved away the zinc and left a black powder which was melted down into gold-silver bullion.[13]

The cyanide solution worked well on red ore but blue ore contained very fine pyrites that interfered with the cyanide's ability to extract the gold.[14] Although techniques were developed for recovering gold from blue ore, they were not cost effective. The cyanide process revolutionized the mining industry in the Black Hills and worldwide.

Black Hills Gold Rush

There were rumors of gold in the Black Hills long before its official discovery. In 1874, Lt. Colonel George A. Custer led an expedition into the Black Hills in search of gold and possible fort sites. Horatio N. Ross, an expedition member, found gold at French Creek. Custer's expedition took place even though the Treaty of 1868 had established all of the land in western South Dakota, including the Black Hills, as a Sioux reservation.

Several pre-gold rush conditions stimulated the rush to the Hills. Grasshopper swarms, low commodity prices, and an unstable market were hurting farmers. The Panic of 1873 caused economic disaster and hardship as banks failed, railroads went bankrupt, and closing factories threw thousands out of work. Workers, including many blacks and Chinese, came to the Hills hoping for work, or perhaps a rich strike. The publicity about gold the Black Hills drew workers to the area.

Following the discovery of gold in 1874, towns such as Yankton, Bismarck, Cheyenne, and Sidney, Nebraska began supplying travelers to the Black Hills. Cheyenne and Sidney's Union Pacific

[11] Chasing the Glitter: Black Hills Milling 1874-1959. Clow, Richmond L. (2002) South Dakota State Historical Society Press: Pierre, South Dakota. Pg. 19
[12] Clow, Pg. 114-115
[13] Clow, Pg. 118-119
[14] Clow, Pg. 26

Railway lines made the Black Hills accessible.[15] As these towns competed, their newspapers advertised around the country about being the best place to get supplies. Newspapers publicized successful gold claims, often exaggerating to draw in business. Gold fever, the promise of wealth, was the biggest draw. Miners came from all over hoping they would strike it rich in the Hills.

Life in a Gold Rush Town

The rush of miners, suppliers, and others to the Black Hills brought with it disorder and violence. More than one hundred murders were committed in the first year of the rush. As time went on, veteran miners instilled in newcomers the unwritten law that each man's livelihood was not to be threatened. In the words of Watson Parker, "…a miner's claim, his tools, and his gold were inviolable, as safe when he went to town as if he'd remained to watch them."[16] In spite of the unwritten law, much theft and claim jumping occurred. There were no courts in the early days to prosecute criminals. Miners relied on miner's courts and the personal security that a gun and the will to use it provided. The area's justice system evolved from personal security and informal miner's courts into a system fully equipped with juries, judges, and plenty of lawyers.

Miners endured countless hardships including snow, rain, lice, and disease. Towns like Lead and Deadwood met the miner's needs. Deadwood was established on April 26, 1876, less than a year after gold was first discovered in Deadwood Gulch. The town provided room and board, baths, doctors, and entertainment. Businesses offered food, drink, gambling, stage shows, and prostitutes. Other businessmen opened bakeries and laundries. No matter what was being bought or sold, gold dust was the currency of choice. Business owners had scales on hand to determine the worth of gold dust brought in by miners.

Homestake

In April of 1876, Moses and Fred Manuel, along with Henry Harney and Alex Engh, located a promising claim near Lead, the Homestake.[17] The Manuels and their partners worked the claim, hoping to attract a buyer. In 1877, they sold Homestake to George Hearst and his two San Francisco business partners, James Ben Ali Haggin and Lloyd Tevis. It was the beginning of a legacy that lasted until the mine's closing in 2001.[18]

Hearst had long been active in the California mining communities and had the experience and expertise needed to develop the Homestake Mine. One of the first hurdles Hearst faced was securing control of the Homestake ore vein. Hearst was convinced that the Homestake vein was much larger than the original claim, and he set out to acquire all of the adjacent claims. He did this through purchase, lawsuits, and political pressure. Over the course of several years Hearst battled with one unwilling seller after another, buying several mines including the Golden Star, the Giant, the Highland, the Prince Oscar, the Old Abe, the Homestake No. 2, and the Deadwood-Terra Mine.[19]

The Father De Smet Mine eluded their grasp for a while until the partners bought enough Father De Smet stock to control the mine in 1881. The mine's owners had reportedly refused $700,000 for their claim. The Father De Smet, like the Homestake, was an extremely rich claim. The two companies became bitter rivals, fighting over anything that might be a possible advantage, including the "great water fight," a water rights dispute over the Whitewood Creek. Water is

[15] Parker, Pg. 40.
[16] Parker, Pg. 143.
[17] The Evolution of Homestake Mining Company. Smith, Duane A. (2001) Homestake Mining Company: Walnut Creek, California. Pg. 21
[18] Smith, Duane A. Pg. 22-23
[19] Smith, Duane A. Pg. 34

necessary for the smooth operation of mines and mills. After a lengthy legal and political battle, Homestake finally won control of the Whitewood Creek.[20]

Homestake went into the timber business so that it could internally provide the resources it needed for its mining operation. They built a small railroad to provide needed transportation. As Homestake prospered, its success became the financial basis for other Hearst mining operations in the western states.

As Homestake expanded, so did the town of Lead. This created a problem because Lead was built on mineralized land, a violation of federal mining law. Tensions rose as residents claimed land titles that legally belonged to Homestake. The company worried about mineral lodes and veins that might run beneath the town, and town residents worried that they might be evicted from their homes. In the early 1890s a compromise was reached. Homestake allowed residents surface rights to their homes and buildings, and would pay for any damage the company caused to those buildings during the mining process. They also agreed to give ninety-day notice if they needed a piece of land, and to pay for any damage they caused by removing any structure on the property. Homestake essentially became the landlord of Lead.[21]

Homestake was in many ways responsible for Lead's success. In addition to being the community's largest employer, the company also contributed to the community in a variety of other ways. Under the leadership of George Hearst and his wife Phoebe, the Homestake Mining Company provided many community resources including the first volunteer fire company and a company hospital for Homestake employees and their families. George Hearst also built the Brick Store, a department store that offered no-interest credit to miners and their families. Payments were deducted from the employee's wages.[22]

George Hearst had sound business reasons for his interest in the community's welfare, which centered on the efficient and smooth operation of the mine. His wife, Phoebe, took a personal interest in her contributions to the community. She was responsible for the building and maintenance of the Hearst Free Public Library, which opened in 1894. Phoebe also started and maintained the Hearst Free Kindergarten. She opened a recreational building, donated to local churches, and even sponsored a baseball team. After George's death in 1891, Phoebe maintained her interest in Lead and the Homestake until her death in 1919. The year Phoebe died the Hearst son, William Randolph Hearst, sold his share of the Homestake stock and ended the Hearst control of Homestake.

Homestake had its share of troubles through the years. It shut down temporarily during World War II, but devoted its surface departments to the war effort. [23] Homestake also weathered financial ups and downs and strikes. Increasing concern over environmental issues forced the company to change some of its practices. Over the years, Homestake closed many old mines and invested in new ones in the United States and around the world. It held claims in several U.S. states, Canada, Peru, and, most notably, a very successful mine in Australia. Homestake diversified and no longer mined purely for gold and silver. Catering to the needs of the modern industrial world, Homestake mined everything from lead and zinc to oil and uranium.

After 125 years of production, the Homestake Mining Company closed the Lead mine in 2001. Homestake began reclamation, environmental restoration of land and dismantling of structures. On December 14, 2001, the last ton of gold ore was mined at Homestake. That last ton was taken from the 1400 level of the mine, almost directly under the Open Cut and the spot where the original Homestake gold strike occurred. The old Homestake mine is under consideration as a site for a high-tech underground research facility.

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[20] Smith, Duane A. Pg. 35-36
[21] Smith, Duane A. pg. 72
[22] Smith, Duane A. pg. 68-74
[23] Smith, Duane A. Pg. 114

Coal Mining in South Dakota

Although coal can be found in the Black Hills, it was never mined profitably. The Firesteel coal fields in the north-central part of the state did provide some profitable mines for a few years. These fields were estimated to contain as much as 137,580,000 tons of coal. The area showed such promise that the South Dakota Relief Agency started a strip-mining operation in a state-owned mine there in 1933. The mine proved ineffective as a state-owned investment and closed in 1934. Geographically, the South Dakota state coal mine had actually been located over the border in North Dakota. Private and commercial owners mined in the Firesteel area until 1969.

Native Americans may have used Firesteel coal for personal use early on, but Andrew Traversie and William Benoist did the first confirmed mining in the Firesteel coal fields in 1907. They mined coal for personal use, although some was eventually sold. The first significant commercial operations began around 1911 with the operation owned by Fred Hammersly and Charles Lindt. Lindt's mine was considered as a potential site for a state-owned coal mine in 1920. The largest mining operation in the area, the Firesteel Coal Company, formed in 1923. This company employed over 60 men and shipped coal as far away as Iowa. Production climbed to over 40,000 tons a year, peaking with 53,743 tons in 1942. The company was unable to maintain that production level and it fell to below 10,000 tons per year during the labor shortage created by World War II. Commercial coal mining in the area ceased permanently in 1969 and reclamation began in 1981.[24]

Current Mining in South Dakota

Mining remains an important part of the South Dakota economy. The only remaining large scale-gold mine left in the state is Wharf Resources. Wharf Resources produced 70,902 ounces of gold in 2003, over 11,000 ounces fewer than the production level of 2002.[25]Mining non-metallic industrial materials such as sand and gravel are exceedingly important to South Dakota's economy. Sand and gravel can be found in nearly every county in the state, and are used primarily for road construction. Sioux quartzite, mentioned above under quarrying, is also used for construction and is quarried in several locations in the southeastern part of the state. Pegmatite mining for mica, feldspar, and rose quartz still takes place in the southern Black Hills. Limestone, shale, and gypsum are mined and used by the South Dakota Cement Plant in mixing cement. The Dakota Granite Company near Milbank quarries granite. Milbank granite is used for both industrial and decorative purposes, and is often shipped to international markets.

Oil and gas wells can also be found within the state. As of October 1997, there were 147 oil wells and 58 gas wells in production. Oil was first discovered in Harding County in 1954. It has been found as far east as Dewey County and as far south as Fall River County. Although the state's petroleum levels are tiny compared to those in other areas, petroleum remains an area of potential development within the South Dakota mining economy.

[24] The information for this section was provided by the Timber Lake & Area Historical Society.
[25] Summary of the Mining Industry in South Dakota, 2003. www.state.sd.us/denr. Pg. ii.

South Dakota Minerals

Agate: Gem stones have become one of the fastest growing segments of South Dakota's mineral industry.[26] One of the most well-known gem stones in South Dakota is the agate, a form of chalcedony marked by colored bands that flow concentrically like the rings of a tree trunk. The official state gem stone is the Fairburn agate, a particularly beautiful variety. In Fairburn agate the bands are extremely sharp and run perfectly parallel to one another. Agates are found in the the Black Hills. In addition to being an attractive gemstone, agate is also used for items such as grinding tools.

Copper: Copper is found throughout the Black Hills and was a common by-product of gold mining. Copper's first use dates back as far as 10,000 years when it was used for tools and jewelry. Today it is used extensively in electric wiring and many types of transistors because of its conductivity and flexibility.[27] It is also used in jewelry, in important metal alloys, pipes, building material, and currency. The South Dakota State Capitol's dome is made out of copper.

Feldspar: Feldspar is an abundant group of rock-forming minerals that constitute 60% of the earth's crust.[28] It is a silicate found in all rock types and is an essential constituent in most igneous rocks. In South Dakota feldspar is found throughout the Black Hills in *pegmatites*, unique types of granite rock with large crystals. Feldspar comes in many varieties. Potassium or potash feldspars are used to make porcelain and glass. Labradorite and Amazon stone, known as plagioclase feldspars, are used for decorative purposes.

Gypsum: The name for gypsum comes from the Greek *gupsos*, which means chalk, plaster or cement. Gypsum is used in the production of all three materials. Gypsum was formed by the evaporation of ancient sea water. Gypsum is a common sulfate mineral found in many places and a variety of forms.[29] One form, alabaster, is used for ornamental vases and boxes. Satin spar is used for jewelry and ornaments. Plaster of Paris goes into gypsum lath, wall board, casts, and molds.[30] Gypsum is prevalent in the Black Hills.

Lead: Lead is an important industrial metal that can be found in some places in the Black Hills. It has been used to make everything from piping to paint. Some products that still contain lead are stained glass, lead shot, batteries, and roofing materials. Lead is a very dense metal that resists radiation well. The protective vests people wear when getting X-rays or radiation treatments are made with lead.[31] Pewter, a common alloy of lead, used to be popular for dinnerware. It has been determined that long exposure to lead ingestion can be toxic to humans. Since this discovery, other metals have slowly been replacing lead in many industrial products.

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[26] Hogan, Patrick E. and Erin Hogan Fouberg. *The Geography of South Dakota,* revised edition. (Sioux Falls, SD: Center for Western Studies, 1998), p116.

[27] http://www.phelpsdodge.com/products/copper/
[28] "Feldspar," *Columbia Encyclopedia*, 6th ed. 2004. http://www.encyclopedia.com/html/f1/feldspar.asp. Aug. 4, 2004.
[29] "Gypsum," *Columbia Encyclopedia*, 6th ed. 2004. http://www.encyclopedia.com/html/g1/gypsum.asp. Aug. 4, 2004.
[30] Ibid.
[31] http://www.webelements.com

Mica: Like feldspar, mica is also found in pegmatites. Mica is easily recognized by its shiny exterior and its perfect *cleavage*, or ability to be split or divided. Mica can be split into leaves that are thinner than a sheet of paper. It is a soft mineral and highly resistant to heat. It is used in things like gypsum wallboard, roofing, cement, paint, oil well mud, and rubber.[32] Mica mining is a delicate operation because of the need to keep the crystals intact. In the production of sheet mica, the mineral is stripped of rock and split two different times, once with a hammer and once with a knife. Sheet mica is used in insulating materials and as a resonating diaphragm in acoustic musical instruments.[33]

Silver: Silver, like gold, is a precious metal found in the Black Hills. It is commonly used in jewelry and other ornamental objects because of its beauty. Silver has qualities that make it useful in industry as well. It reflects 100% of the light that hits it, making it the perfect substance for mirror backings in telescopes and microscopes. Silver is also the best heat conductor of all metals, which makes it useful in solar panels. It has the highest conductivity and is used in batteries for hearing aids, pacemakers, and space equipment. Silver's most fascinating property is its ability to kill bacteria without injuring normal cells. Because of this property it is used in surgical tools and implants. Cotton gauze soaked in silver solution helps is used to treat burn victims. Silver compounds are also used to purify water.[34]

Uranium: Uranium can be found in South Dakota and was at one time mined in the state for industrial use. Uranium is a very dense, radioactive element. It is most commonly used in nuclear power plants as a fuel source. One ton of uranium produces as much electricity as 16,000 tons of coal. During the Cold War, uranium was used in nuclear weapons. Some uranium is still used in medical treatments. Because of its high density, uranium is not easy to mine and transport. For example, a one- gallon container of milk weighs about eight pounds. Fill that same gallon container with uranium and it would weigh about 150 pounds. Uranium is 1.6 times more dense than lead.[35]

[32] Hogan & Fouberg. 116.
[33] "Mica," *Columbia Encyclopedia*, 6th ed. 2004. http://www.encyclopedia.com/html/m1/mica.asp. Aug. 4, 2004.
[34] http://www.panamericansilver.com
[35] http://www.ne.doe.gov/uranium/facts.html

Did You Know?

Gold has the chemical symbol of *Au,* named after Aurora, the Roman goddess of dawn.

The largest pure lump of gold ever found weighed 156 pounds. It was found in Australia.

Sea water contains about one hundred times more gold than there is in human possession.

The world's deepest mine is the Western Deep Level Mine in Carletonville, South Africa. This mine is so far underground its miners work in temperatures of about 131° F.

The ancient Egyptians produced sheets of gold leaf so thin that a pile one inch high contained over 360,000 sheets.

Miners at the Comstock Lode in California had troubles with notorious "black sand" clogging their equipment. A few years later it was discovered that the "black sand" was actually silver granules.

A prospector in the Black Hills named a promising claim after his neighbor's daughter, calling it "The Little Allie". The prospector's wife got angry because he had never named a claim after her and she demanded that the mine be renamed in her honor. The prospector agreed and renamed the mine "The Holy Terror" which is what it is still called today.

One corrupt prospector in California tried to fool a group of wealthy investors into purchasing a worthless mine by salting it with nuggets made from melted silver dollars. The scheme was exposed when a mine worker discovered "-ted States of" on the back of one of the fake silver nuggets.

The ancient Egyptians valued silver more than gold because it was more difficult to mine and extract.

Silver can absorb up to twenty times its own volume of oxygen. This process kills oxygen-loving bacteria. Many surgical tools are made of silver for this reason.

At one time the photography industry used one-third of the silver found worldwide. Before digital cameras, silver was used to make most types of film.

Paul Revere, famous for his midnight ride during the Revolutionary War, was also a well-known silversmith.

Miner Superstitions

Miners believed that accidents happened in threes.

Miners believed that a man was likely to fall if his work clothes fell off their hook on the wall.

Miners believed it was bad luck for a woman to enter a mine.

Miners believed it was dangerous to whistle underground.

Miners believed it was bad luck for a miner to drop his tools in a mine.

Miners believed that if a candle fell from the tunnel wall or went out three times, something was wrong at home.

Miners believed in Tommyknockers, two-foot creatures blamed whenever anything went wrong. Tommyknockers got the credit when things went well, too. Miners left the last bite of their lunch as food for the Tommyknockers.

Miners believed that rats had a keen sense of impending dangers such as cave-ins. If the miners saw them running out of the tunnels, they would race after them, giving rise to the term “rat race”.

Bibliography

Note: Libraries holding the books are listed by their South Dakota Library Network PALS code. Book summaries are also from the SDLN PALS database.

Biography

Calvert, Patricia. *American Frontier, The*. NewYork: Atheneum Books for Young Readers, 1997. *A collective biography of great figures in the history of the American frontier.* 388 p.
Libraries: SDD MPL

Non-Fiction

Angliss, Sarah. *Gold*. New York: Benchmark Books, 2000. Explores the history of the precious metal gold and explains its chemistry, how it reacts, its uses, and its importance in our lives. 32 p.
Libraries: SDD

Bates, Robert L. *Mineral Resources A-Z*. Hillside, NJ: Enslow Publishers, 1991. 128 p.
Libraries: SDS WAT

Cheney, Glenn Alan. *Mineral Resources*. New York: F. Watts, 1985. 62 p.
Libraries: SDS USD

Dineen, Jacqueline. *Coal*. Hillside, NJ: Enslow Publishers, 1988. 32 p.
Libraries: SDS HPL

Dineen, Jacqueline. *Metals and Minerals*. Hillside, NJ: Enslow Publishers, 1988. 23 p.
Libraries: SDS

Dineen, Jacqueline. *Oil and Gas*. Hillside, NJ: Enslow Publishers, 1988. 31 p.
Libraries: SDS

Gintzler, A.S. *Rough and Ready Prospectors*. Sante Fe, N.M.: J. Muir Publications : Emeryville, CA: Distributed to the book trade by Publishers Group West, 1996, c1994. 49 p.
Libraries: SDS

Hellman, Hal. *Story of Gold, The*. New York: Franklin Watts, 1996. Discusses the nature of gold and the value of this metal throughout history, as well as some of its uses and its role in the development of the science of chemistry. 63 p.
Libraries: RCP SDH STG

Lye, Keith. *Spotlight on Gold*. Vero Beach, FL: Rourke Enterprises Inc., 1988. 47 p.
Libraries: SDS SDD

Meltzer, Milton. *Gold: The True Story of why People Search for it, Mine it, Trade it, Steal it, Mint it, Hoard it, Shape it, Wear it, Fight and Kill for it*. New York: Harper Collins, 1993. 167 p.
Libraries: RCP SBR SDS SDW SDD MIT LVE HPL MPL YCL MHS MDM MVS

Mitgutsch, Ali. *From Swamp to Coal*. Minneapolis: Carolrhoda Books, Inc., 1985. 24 p.
Libraries: SDF SDS LVE CES

Sootin, Harry & Laura. *The Young Experimenter's Workbook*. New York: Norton, 1965. 59 p.
Libraries: SDS

Fiction

Almond, David. *Kit's Wilderness*. Thorndike, ME: Thorndike Press, 2000. Thirteen-year-old Kit goes to live with his grandfather in the decaying coal mining town of Stoneygate, England, and finds both the old man and the town haunted by ghosts of the past. 272 p.
Libraries: RCP SBR SDA SDF SDS SDW STG USD SDD AML FGH RPL WAT YCL DWD MHS MDM SHS CEB MVS HHS MPL CMS GDS HCP BHS CHS

Fleischman, Sid. *By the Great Horn Spoon!* Boston: Little Brown and Co., 1988. 193 p.
Libraries: SDD AML SGC MDM WBS SDS SDD MPL RPL MIT YCL TCM CES

Hamilton, Virginia. *M.C. Higgins, the Great*. New York: Simon & Schuster, 1999. As a slag heap, the result of strip mining, creeps closer to his house in the Ohio hills, fifteen-year-old M.C. is torn between trying to get his family away and fighting for the home they love. 232 p.
Libraries: RPL SDF MDM MDE TCM SDA LVE SPF KST TCH SDS CMS MIT TCS BHS WAT FGH SDD RCP USD GDS

Teacher Bibliography

Clow, Richmond L. *Chasing the Glitter: Black Hills Milling, 1874-1959*. Pierre, SD: South Dakota State Historical Society Press, 2002. 202 p.
Libraries: BHS DSU SDA SDB SDH SDS SDW STG USD SDD MIT LVE LEA HPL SPF WAT MPL

Lagal, Roy. *Gold Panning is Easy*. Dallas: Ram Publishing Co., c1986. 102p.
Libraries: SDS STG SDD AML MIT RCP

Parker, Watson. *Gold in the Black Hills*. Norman: University of Oklahoma Press, 1966. 259 p.
Libraries: BHS DSU NSU PRN RCP SBR SDA SDB SDF SDH SDS SDW SMT USD SDD AML MIT LVE RPL SPF WAT MPL YCL DWD MHS GDS SHS KST CEB LWS SDO SGC HCP WBS STG LEA HPL

Ransom, Jay Ellis. *The Gold Hunter's Field Book: How and Where to find gold in the United States and Canada*. New York: Harper & Row, Publishers, 1975. 367 p.
Libraries: SDS AML MIT

Smith, Duane A. *Staking a Claim in History: The Evolution of Homestake Mining Company*. Walnut Creek, CA: Homestake Mining Co., 2001. 215 p.
Libraries: BHS SDH SMT

Stone, Gregory V. *Prospecting for Lode Gold*. Philadelphia: Dorrance & Co., 1975. 50p.
Libraries: SDS

Tallent, Annie D. *The Black Hills; Or Last Hunting Grounds of the Dakotahs*, 1874-1876 Centennial Edition 1974-1976. Sioux Falls, SD, Brevet Press, 1974. 563 p.
Libraries: BHS DSU NSU PRN RCP SBR SDA SDB SDF SDH SDS SDW SMT USD SDD AML MIT SDO SGC FGH RPL SPF WAT YCL DWD CHS WTN GDS KST WBS STG HPL

Young, Jr., Otis E. *Western Mining*. Norman: University of Oklahoma Press, 1970. 342 p.
Libraries: BHS NSU SDB SDF SDS SMT STG USD

Websites

http://www.womeninmining.org/index.htm
This site is a good resource for teachers as it includes activities, games, publications, and educational links.

http://www.coaleducation.org/default.htm
A site with lesson plans, professional information, and fun and games for students.

http://www.dakotaexperience.org/cvfrontier/
This site is South Dakota specific as it has pictures and stories of the frontier days in the Dakotas.

http://www.mii.org/
Mineral Information Institute site containing lesson plans, homework help, environmental information, and classroom activities.

http://www.acf-coal.org/
This site is specific to coal mining. It contains lesson plans, information, and teacher access to useful teaching products.

http://www3.newberry.org/k12maps/
This site is very valuable because it supplements its lesson plans with historic maps.
Map 8, mining in South Dakota, should be of specific value.

Word Find

F Y G R A N I T E P T M B Z U
I P U X C W K D E A D W O O D
R R S R O Q L Y V N E P B R X
E O M Z A C C Y A N I D E Z E
S S Q U L N U K L I F G O L D
T P J O O C I S Z N T T B W M
E E N V R Y W U T G K P L Q B
E C O E U C H O M E S T A K E
L T F R W K L M I M R N C O L
P I Q B R T U V N W I X K Y Z
A N B U P L A C E R C N H D E
F G H R I J Q U A R T Z I T E
L E A D U K L N P O Q R L N S
T U Z E V S W G R A V E L X G
M N P N Q D H I O R B W S P S

HOMESTAKE **FIRESTEEL** **URANIUM** **GRANITE**

PLACER **CYANIDE** **BLACK HILLS** **MINE**

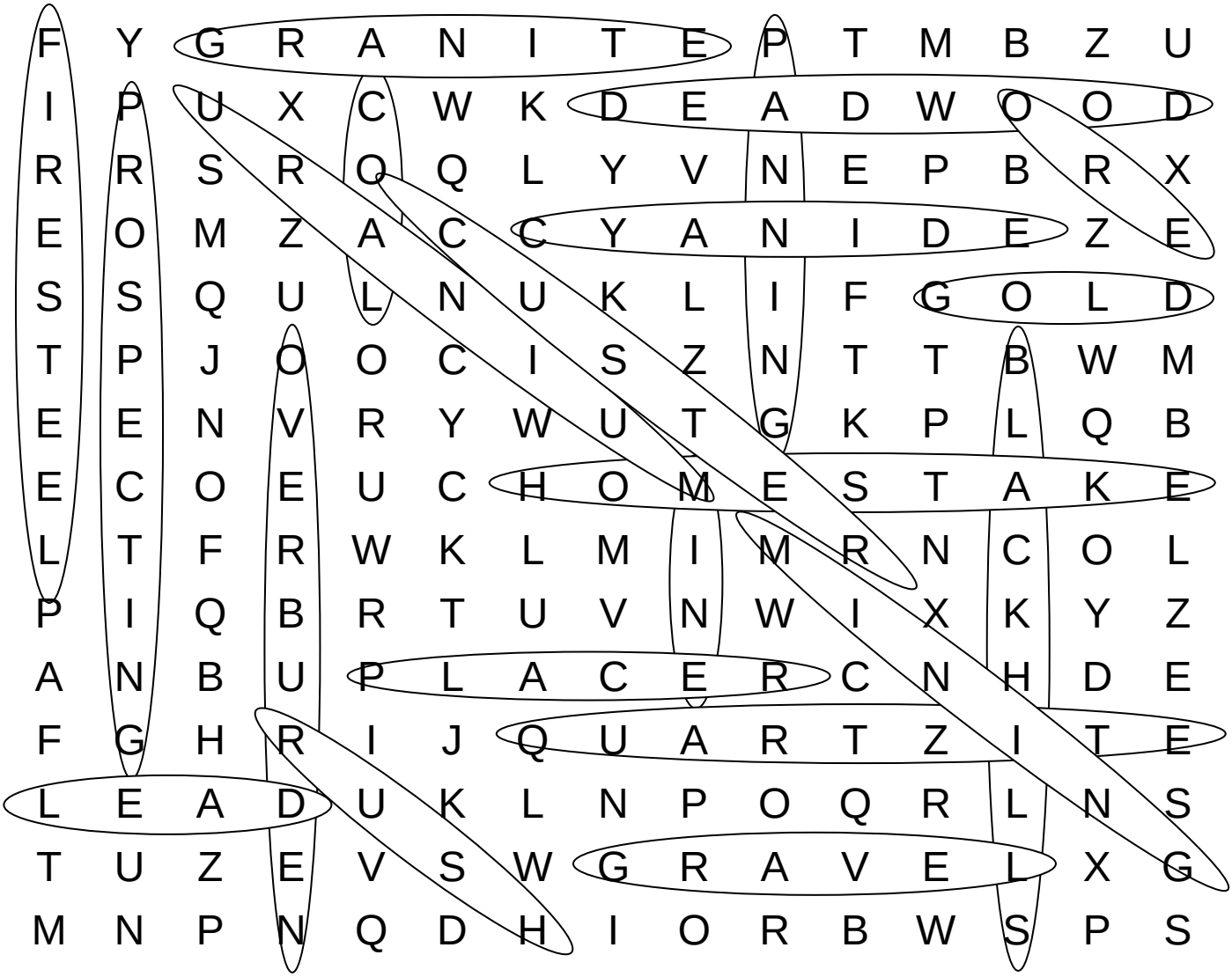
PROSPECTING **ORE** **PANNING** **QUARTZITE**

COAL **DEADWOOD** **CUSTER** **RUSH**

GRAVEL **MINING** **GOLD** **OVERBURDEN**

LEAD

Word Find Key



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GRAVEL **MINING** **GOLD** **OVERBURDEN**

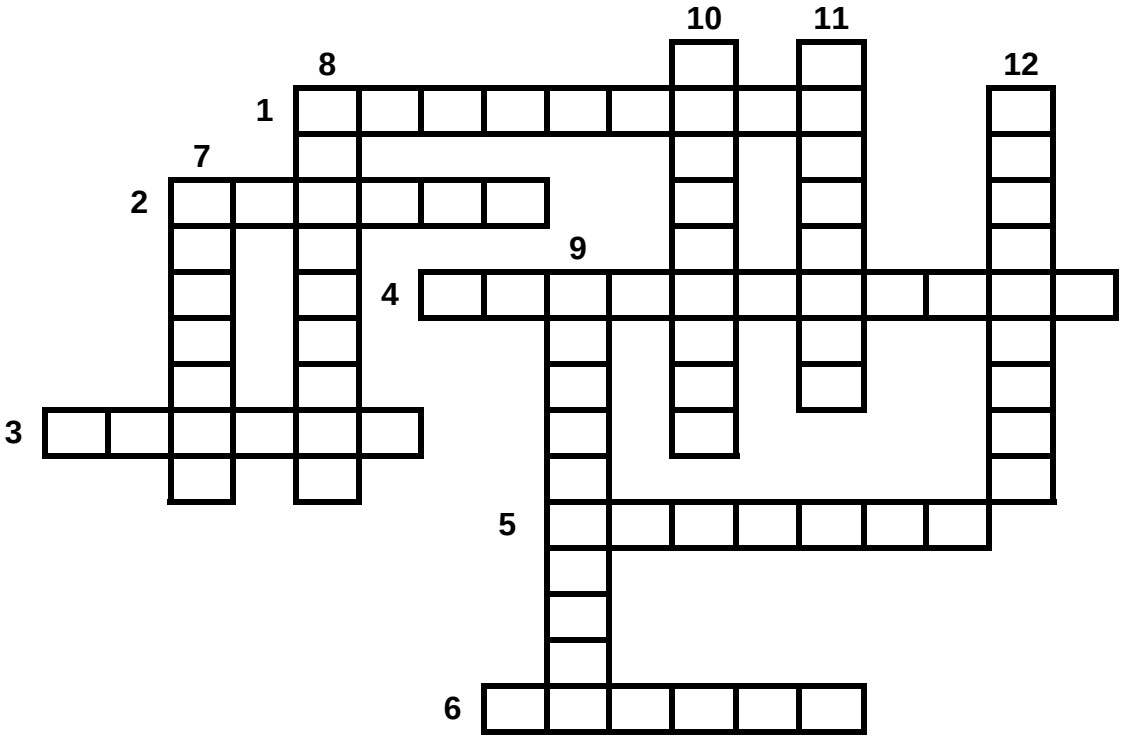
LEAD

Crossword Puzzle

Homestake	Deadwood	refractory	mining
Firesteel	cyanide	pyrite	Horatio Ross
panning	quartzite	placer	quarrying

ACROSS
1. Sioux _____ is used to build highways in South Dakota. It makes them pink!
2. Gold pans and sluice boxes are used in _____ mining.
3. Taking minerals, ores and fossil fuels from the earth is called _____.
4. _____ was the member of Custer's 1864 expedition who first found gold.
5. Gold can be removed from ore using the chemical _____.
6. "Fool's gold" is another name for iron _____.

DOWN
7. Standing in a creek, a miner would be _____ for gold.
8. _____is the process used to get Milbank granite and other building stone.
9. _____ore contains a mix of minerals and metals.
10. The coal field in central South Dakota near Timber Lake is called the _____ coal field.
11. The town of _____prospered during the Black Hills gold rush.
12. _____Gold Mine operated for 125 years in the town of Lead.



Crossword Puzzle Key

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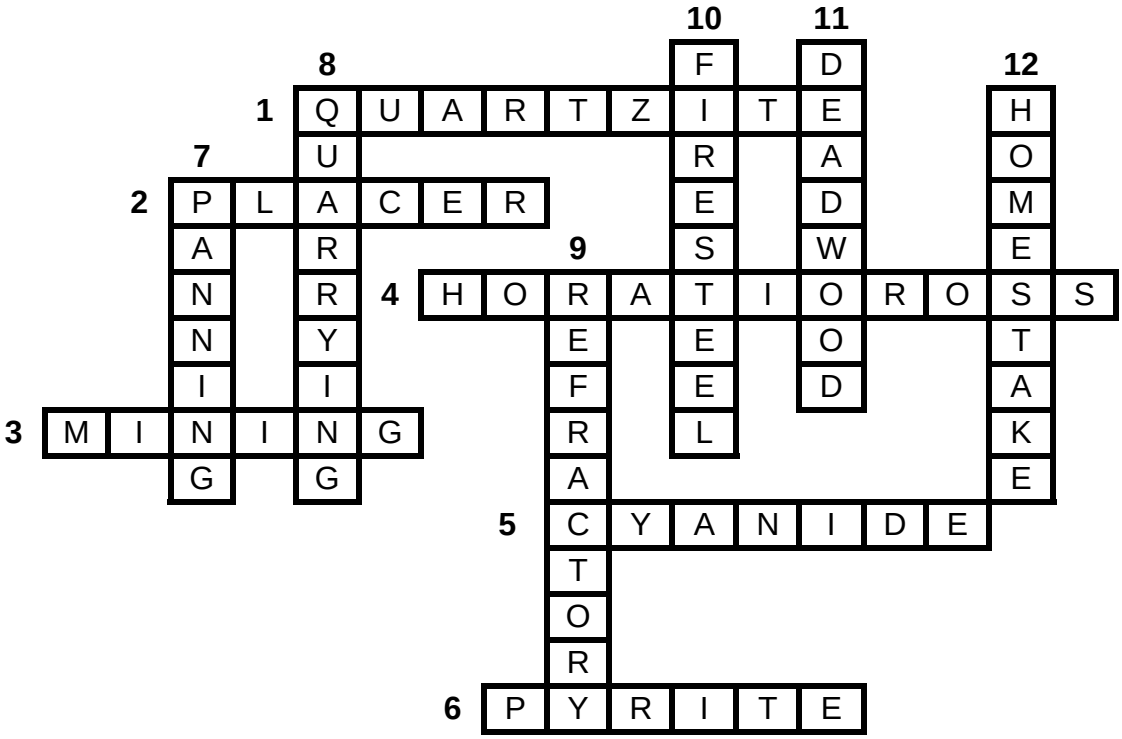

Word Scramble

prospecting	lignite	assay	George Hearst
granite	iron pyrite	Custer	

1. Deciding where to mine for gold and other precious minerals.

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ tcppgiorsen
10 3

2. Chemical test done on an ore sample to show its mineral content.

___ ___ ___ ___ ___ ysasa
7

3. The type of soft coal found in the Firesteel coal field.

___ ___ ___ ___ ___ ___ ___ gietlni
4

4. He led an expedition into the Black Hills in 1874.

___ ___ ___ ___ ___ ___ trucse
1

5. This man developed the Homestake Gold Mine in Lead.

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ rggoee ahesrt
2

6. This stone is quarried near Milbank.

___ ___ ___ ___ ___ ___ ___ gtraien
5

7. Commonly called “fools gold.”

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ rino ytprei
9 11 8

8. Fill in the letters from the numbered spaces above to find the answer:
Putting the soil surface back after mining an area is called:

___ ___ ___ ___ ___ M ___ ___ ___ ___ ___
1 2 3 4 5 6 7 8 9 10 11

Word Scramble Key

prospecting	lignite	assay	George Hearst
granite	iron pyrite	Custer	

1. Deciding where to mine for gold and other precious minerals.

P R O S P E C T I N G (10, 3) tcppgiorsen

2. Chemical test done on an ore sample to show its mineral content.

A S S A Y (7) ysasa

3. The type of soft coal found in the Firesteel coal field.

L I G N I T E (4) gietlni

4. He led an expedition into the Black Hills in 1874.

C U S T E R (1) trucse

5. This man developed the Homestake Gold Mine in Lead.

G E O R G E H E A R S T (2) rggoee ahesrt

6. This stone is quarried near Milbank.

G R A N I T E (5) gtraien

7. Commonly called “fools gold.”

I R O N P Y R I T E (9, 11, 8) rino ytprei

8. Fill in the letters from the numbered spaces above to find the answer:
Putting the soil surface back after mining an area is called:

R E C L A M A T I O N
1 2 3 4 5 6 7 8 9 10 11

Reading an Object

Objectives:

- Participants will recognize the variety of information that can be learned by examining objects.
- Participants will inspect objects and draw conclusions from their observations.

South Dakota Social Studies Standards

K	1st	2nd	3rd	4th	5th	6th
K.E.1.1 K.E.1.3	1.E.1.1	2.US.1.2 2.E.1.1	3.E.1.1	4.US.1.1 4.E.1.1 4.E.1.2		6.E.1.1

South Dakota Communication Arts Standards

K	1st	2nd	3rd	4th	5th	6th
K.LVS.1.2 K.LVS.1.6	1.LVS.1.2 1.LVS.1.6	2.LVS.1.2 2.LVS.1.4 2.LVS.1.5 2.LVS.1.6	3.LVS.1.1 3.LVS.1.2 3.LVS.1.3 3.LVS.1.4	4.LVS.1.1 4.LVS.1.3	5.LVS.1.1 5.LVS.1.2 5.LVS.1.3	6.LVS.1.2 6.LVS.1.3

South Dakota Science Standards

K	1st	2nd	3rd	4th	5th	6th
K.P.1.1	1.E.1.2	2.P.1.1	3.P.1.1 3.E.1.2			

Timeframe: 30-60 minutes

Materials:

Included in kit
Kit artifacts
Object Identification Sheet

Background:

Every culture has used objects. These objects reflect the beliefs of the people who constructed, acquired, or used them. They also reflect the unique identity of the culture. If we study and/or teach only what's been written down about a culture, there are many things we miss. The same is true if we only look at cultural objects. When separated, written words and objects are both incomplete. When the two are studied together, a more complete cultural picture emerges. One of the main goals of this kit is to increase the participant's visual literacy skills and teach them how to learn from objects.

Activity Steps:

1. Arrange the participants so that it is easy to pass objects from one to another. Pass the objects around one at a time, allowing the participants to handle and examine them.
2. While the participants are examining the objects, use the points below to start discussion about the materials, construction, and history of the objects. Encourage the participants to share the visual and tactile information they get from the objects. You may ask each participant to consider a different aspect of the object (history, material, etc). Have the participants respond so the entire group can hear and enter into the discussion.
3. After an object has been examined, share the information found on the Object Identification Sheet with the group.

Materials & Construction:

What materials is the object made out of?
Is the material sturdy or delicate?
Is the object man made or is it a natural object?
If it is a natural object, has it been altered?
How would you describe the texture of the surface of the object?
What does its size tell you about the object?
Is it a complete piece or a fragment of a larger work?

History & Function:

What might be the purpose of the object?
Who might have used the object and what actions would they perform with it?
Where might it have been used?
Is this object still used today for the same or other purposes?
Is there writing on the object that might tell you something about it?
What questions do you have about the object?
Where could you find the answers to your questions?

Compare & Contrast:

Compare the two stock certificates. What is different about them? Can you learn something about the objects by comparing them to each other?

Object Identification Sheet (Kit 1)

T-2004-050

Trowel: A trowel is a good tool for moving dirt and rocks when prospecting or panning for gold.

T-2004-122

Mining pick: This miner's pick is a modern example of the tool that would have been used by both placer and hardrock miners to remove rock.

T-2004-076, 077

Gold Pans: This type of pan is used to pan for surface gold in streams. Water and gravel are swirled around, and the heavy gold sinks to the bottom of the pan.

T-2004-113

Balance Scale: During the gold rush, miners used gold dust to buy things in stores. Merchants needed accurate scales to measure out gold dust the miners used for money. Miners rarely carried their own scales because it was often easier to use the available ones in town. This modern, pocket-sized balance scale works the same as older scales. A known weight is put on one of the balance pans and then whatever one wants to weigh is put into the other pan until the scale balances.

T-2004-107

Miner's Helmet: This helmet provided head protection for miners in the Homestake mine. There is a clip on the front for attaching a light.

T-2004-109

Carbide Lamp: Miners attached lights like this to their helmets for working underground. To make a carbide lamp work, a powder called calcium carbide went into the bottom part of the lamp's cylinder. Water went into the top of the cylinder. Inside the cylinder the water slowly dripped onto the powder, making a flammable gas that came through the spout in the center of the light. Lighting the gas with the striker next to the spout created a flame, and gave light in a dark mine.

T-2004-054

Core Sample: A core sample is drilled from the rock where there may be gold. The core sample is *assayed,* or chemically tested, to see what minerals it contains. If pyrite or quartz are found, the core sample site may also contain gold.

T-2004-056

Drill Bit: Heavy, metal drill bits like this one were used on mechanized underground drills. Water was run through the hole in the center to keep the bit cool and lubricated as it cut into the rock. The water also kept the dust from the drilling down.

T-2004-058, 060

Blasting Caps: Blasting caps were used to set off explosions in the mine to remove ore for processing and to reveal more of the lode. Different sizes of blasting caps were used to time the detonations. 5-foot caps exploded sooner than 12-foot caps.

T-2004-072

Blasting Cap Tin: A tin used to hold DuPont blasting caps, a brand commonly used in mining. These caps were attached to fuses and used to set off explosions in the mine.

T-2004-062

Mining Deed: This 1885 deed transferred a mining claim from John Costello to William L. Smith. Documents like this provided a paper trail for a mine claim, making it possible to keep track of who owned the property.

T-2004-064

Homestake Stock Certificate #6220: This Homestake Company stock certificate gave the purchaser a share in the company in June 1888. The stamp and holes punched in the bottom of the certificate show that this stock was cancelled in August 1888.

T-2004-065

Conners Tin Production Company Stock Certificate # 51: This stock certificate for a share of the Conners Tin Production Company was never used.

T-2004-074

Ruby Basin Claim Map 1900-1918: This map shows the mining claims that made up The Golden Reward Mine, The Mogul Mining Company, and Lundberg Dorr and Wilson Mining and Milling Company.

T-2004-086

24k Gold: The flakes in this bottle are pure (24k) gold. Placer miners hoped to find flakes of gold when they panned in the streams of the Black Hills during the gold rush.

T-2004-115

Iron Pyrite: Iron pyrite is commonly known as “fool’s gold.” Real gold and fool’s gold can easily be told apart by tapping them with a hammer. Real gold is soft and will flatten while iron pyrite shatters into dust when hit.

T-2004-080, 083

Sioux Quartzite: These pieces of Sioux quartzite (one polished and one unpolished) came from quarries near Sioux Falls. Sioux quartzite is used as a decorative building stone, and for highway construction. This is the rock that makes so many of South Dakota’s highways look pink because of the stone’s color.

T-2004-089, 092

Prairie Agate: These agates (one polished and one unpolished) are used as decorative pieces, mineral specimens, and gemstones. Agates are also used in items like grinding tools. A specific variety of agate, Fairburn agate, was designated South Dakota’s state gemstone in 1966. They can be found in the southwestern part of the state.

T-2004-095

Feldspar: Feldspar is an abundant group of rock-forming minerals that make up 60% of the earth’s crust. It is found in the Black Hills of South Dakota. Some varieties are used to make porcelain and glass.

T-2004-098

Rose quartz: Rose quartz is South Dakota's State Mineral. Although not particularly rare, it is found in only two other places in the world besides South Dakota, Maine and Brazil. Rose quartz is used for jewelry and as a tourist item.

T-2004-101

Ore: Ore is rock that contains valuable minerals. Iron pyrite, or fool's gold, and areas of color or *mineralization* can be seen in the ore. This mineralization can be an indicator of gold, but the ore would need to be *assayed*, or chemically tested, to find out if any gold is present.

T-2004-104

Mica: Mica is common in the Black Hills. It forms in thin layers that flake apart easily. When the thin flakes rub against hard stones around them, the flakes get ground into powder. This powder sparkled in the light and fooled many inexperienced prospectors into thinking they had found gold, much like iron pyrite did.

The blasting simulator (T-2004-111) and BBs are used for kit activities.

Preparing for the Rush

Objectives:

- Participants will determine the weight of gold samples using a scale.
- Participants will select products for a prospective gold rush within a specified budget.
- Participants will justify their selections based on usefulness and necessity.

South Dakota Social Studies Standards

K	1st	2nd	3rd	4th	5th	6th
K.E.1.1 K.E.1.2 K.E.1.3	1.E.1.1 1.E.1.2	2.US.1.2 2.E.1.1 2.E.1.2	3.US.1.1 3.W.1.1 3.W.2.1 3.E.1.1 3.E.1.2	4.US.2.1 4.G.2.1 4.E.1.1 4.E.1.2	5.G.2.1 5.E.1.1	6.E.1.1

South Dakota Mathematics Standards

K	1st	2nd	3rd	4th	5th	6th
K.A.2.1	1.A.3.1 1.M.1.3 1.N.3.1	2.A.3.1 2.M.1.4 2.N.3.1	3.M.1.4 3.N.2.1	4.A.1.3 4.M.1.2	5.M.1.2 5.M.1.3 5.N.3.1	6.A.3.2 6.M.1.1

South Dakota Communication Arts Standards

K	1st	2nd	3rd	4th	5th	6th
K.LVS.1.6	1.LVS.1.6	2.LVS.1.4 2.LVS.1.6	3.LVS.1.1 3.LVS.1.2	4.LVS.1.1 4.LVS.1.3	5.LVS.1.1 5.LVS.1.3	6.LVS.1.3

Timeframe: 60-90 minutes

Materials:

Included in kit
Preparing for the Rush supply list master
Preparing for the Rush worksheet master
Iron pyrite
Balance scale

Provided by instructor or participant
Pencil or pen
Paper
Paper bag(s)

Background Information:

Miners flocked to the Black Hills in the Gold Rush of 1874. They quickly realized when they reached the Hills that gold dust was the currency of choice. The paper money that the miners had used before had less value because gold dust could only be converted to paper money at a discount.[36] Disagreements developed between miners and store owners about what the value of gold dust should be. Originally set at $20.00 an ounce, business owners and miners reached an agreement in 1879 to establish the value of gold dust based on its source. Deadwood dust brought $17.10 per ounce, while purer gold from Rapid and Castle creeks brought $18.25 an ounce.[37]

[36] Parker, Pg. 149.
[37] Parker, Pg. 150.

The worth of gold dust was important to miners because they used it to buy things needed to survive. Miners brought salt pork, flour, sugar, tea, and coffee with them, but when those supplies ran out they had to buy more from local merchants. The miners bought food, mining tools, and other necessities. They also spent money in casinos and dance halls. A miner's success depended not only on how much gold he found, but on how wisely he spent it.

Activity Steps:

1. Make a copy of the Preparing for the Rush Supply List and Worksheet for each participant. This activity may be done individually or working in small groups.
2. Share the background information with the group and discuss how gold dust was used as money. Although store owners late in the Gold Rush based the value of gold on its source, for this activity gold has one value, $20.00 an ounce.
3. Put the small pieces of iron pyrite(fool's gold) from the kit into a paper bag and have each participant or group pick two pieces from the bag.
4. Have the participant weigh the sample on the balance scale. NOTE: The bar of the balance scale screws into the small metal circle in the scale case and the case serves as the base for the scale. The scale weighs in grams, so multiply the gram weight by .0353 to convert the weight to ounces. Round up or down to the nearest ounce. Since the scale and the pyrite samples are small, multiply the number of ounces by 4 to get the total ounces for the activity, and then multiply by $20.00/oz to get the value of the sample.
Example: 31 grams x .0353 = 1.09 ounces x 4 = 4.37 oz (rounded to 4 oz) x $20.00 = $80.00 value.
Repeat this procedure with each participant or group.
5. Have participants imagine they are miners during the Black Hills Gold Rush. They must decide which goods to purchase from the Supply List in order to be successful. Participants can choose as many items as they can afford within their given budget. Each participant should keep a running total of their purchases on the Preparing for the Rush Worksheet. Have them think about *wants* versus *needs* in their purchases.
6. When each individual or group has completed their purchases, discuss as a class what choices people made, and why. Have participants think about their spending habits today, and how they decide what to purchase. Do they have unlimited funds? Do they need to make choices? How do they decide?

Preparing for the Rush
Supply List

Personal needs (choose at least 10)	Housing (choose 1)
Rubber ground sheet- $3.00	Boarding house with meals provided - $56.00 a month
Rubber hip boots- $4.00	Two or three- room cabin- $30.00 a month
2 woolen blankets- $5.00	Boarding house with no meals - $28.00 a week
rifle- $15.00	
pistol- $5.00	
Ammunition- $4.75	
2 tin plates- $1.00	**Food (choose at least 4)**
dipper- $0.75	4 lbs. of Flour 10¢ a pound
knife- $0.50	3 lbs. of Bacon- 25¢ a pound
fork- $0.50	2 lbs. of Butter- 40¢ a pound
large spoon- $0.75	2 dozen Eggs- 35¢ per dozen
4 towels- $4.00	1 lb. of Salted pork- 50¢ a pound
1 box of matches- $0.15	4 lbs. Coffee- 20¢ a pound

Tools and Cookware (choose at least 5)	Luxuries and Amenities (optional)
Round-pointed steel shovel- $2.25	Hotels- $3.00 a day
Miner's pick- $2.25	Restaurants and dining rooms-$1.50 a day
Dutch oven- $20.00	Calico wallpaper- $7.50 for 5 sq. yards
Frying pan- $1.50	
Tin pail- $1.00	**Medicine (choose at least 1)**
Handsaw- $2.50	Swayne's Tar- 1 can - $1.00
Tent- $10.00	Sarsparilla Pills - 1 box - $0.85
Ax- $1.25	
Rocker- $4.00	**Entertainment (optional)**
Mercury- $1.00	Opera House Ticket - $1.50
Gold pan- $2.00	Gambling - $10.00
	Dance Hall Admission- $0.75

NAME _____

Preparing for the Rush
Worksheet

Item	Cost	Budget $_____
		-
		-
		-
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		-
		-
		-
		-
		-
		-

Remainder: _____

Mining in South Dakota: A Living Timeline

Objectives:

- Participants will prepare a timeline including historic mining dates in South Dakota.
- Participants will demonstrate knowledge of events through speech.
- Participants will determine connections between local and national events in history.

South Dakota Social Studies Standards

K	1st	2nd	3rd	4th	5th	6th
US History Indicator 2 K.E.1.1	US History Indicator 2 1.US.1.1	2.US.1.1 2.US.1.3 2.E.1.1	3.US.1.1 3.US.2.2 3.W.1.1 3.W.2.1 3.E.1.1	4.US.1.1 4.US.2.1 4.US.2.2 4.W.1.1 4.G.1.2 4.G.2.1 4.E.1.1 4.E.1.2	5.US.1.2 5.US.1.4 5.W.2.1 5.G.2.1 5.G.2.2 5.C.2.1 5.E.1.3	6.E.1.1 6.E.1.3

South Dakota Communication Arts Standards

K	1st	2nd	3rd	4th	5th	6th
K.LVS.1.6	1.LVS.1.6	2.R.2.2 2.LVS.1.4 2.LVS.1.6	3.R.2.2 3.LVS.1.3 3.LVS.1.4	4.LVS.1.1 4.LVS.1.3 4.LVS.1.4	5.LVS.1.1 5.LVS.1.2 5.LVS.1.4	6.LVS.1.2 6.LVS.1.3

Timeframe: Two 45-50 minute periods

Materials:

Included in kit
Living Timeline Characters master
Historical Events master
All kit materials

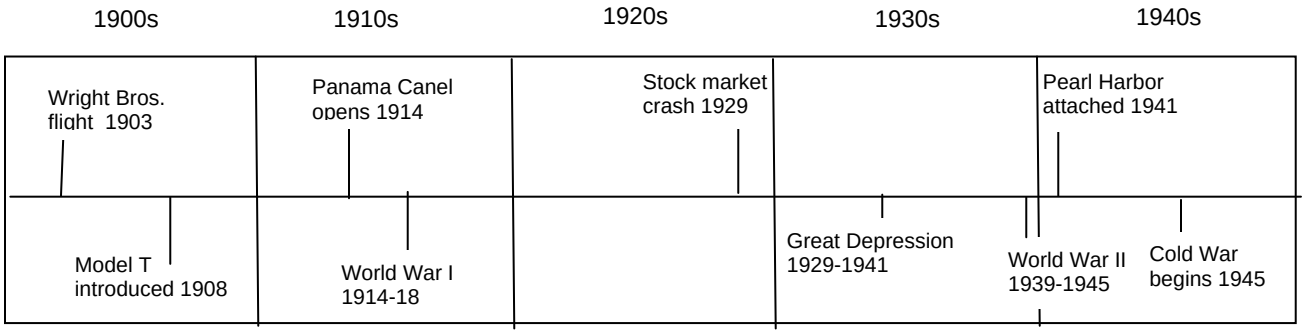
Provided by instructor or participants
Felt-tipped markers
Butcher paper or construction paper
Scissors
Rulers or yardsticks
Tape
Research materials (optional)
Costumes or props (optional)

Background Information:

The mining industry in South Dakota has had a large impact on the state's history. The Black Hills gold rush, for example, was caused not only by the discovery of gold but also by the economic situation of the time. The Panic of 1873 left many farmers and workers in poor financial shape and projects like the Transcontinental Railroad brought in a number of immigrants that needed work after the last spike was driven in May of 1869. In studying history, it is important to understand that local or statewide events are part of a broader national and international context. Actions in one part of the world or country can have an impact on people elsewhere. This activity will help participants learn about important events and people in the history of South Dakota mining and let them to place those events into a larger national context.

Activity Steps:

1. Organize the participants into five groups. Give each group a large sheet of paper, ruler or yardstick, and markers. Make a copy of the Historical Events Master for each group.
2. Each group will create one decade of a timeline for the classroom wall. Have them draw a horizontal line across the middle of their paper, and then draw five equal vertical sections. Each section will represent a decade. Label the decades, and then insert the events from the Historical Events Master.



Hang the timeline decades in order on the wall.

3. Make a copy of the Living Timeline Characters Master and cut the character profiles apart. Have each group choose three characters at random, or assign each group three characters. The groups should decide who from the group will read each character profile. Using the objects and photos from the kit as props, have each reader stand in front of their character's year on the timeline and read the profile to the group. Readers can also use costumes and other props if desired.
4. As each profile is completed, discuss what other events are taking place on the timeline around that time. What effect do those other events have on the character or on what they were doing? Do the events affect the mining industry? Discuss what kinds of events affect our lives today.
5. The participants may do further research on the events or the characters discussed and present their information to the class.

Historical Events Master

1800-1850

Louisiana Purchase-1803
Lewis and Clark Expedition-1804-1806
War of 1812-1812-1814
Morse invents telegraph-1832
Texas Revolution-1836
The Trail of Tears-1838
Mexican War-1845-1848
Gold Discovered in California-1848

1850-1900

Civil War-1861-1865
Emancipation Proclamation-1863
President Lincoln assassinated-1865
Alfred Nobel patents dynamite-1867
Transcontinental railroad completed-1869
South Dakota becomes a state-1889
Battle of Wounded Knee-1890
Spanish-American War-1898

1900-1950

Wright Bros. flight-1903
Henry Ford introduces Model T automobile-1908
Panama Canal opens-1914
World War I-1914-1918
Stock market crash-1929
Great Depression-1929-1941
World War II-1939-1945
Attack on Pearl Harbor-1941
Cold War begins-1945

1950-Present

Korean War-1950-1953
President Kennedy is assassinated-1963
Vietnam War-1965-1973
Moon Landing-1969
Fall of Berlin Wall-1989
Persian Gulf War-1991
World Trade Center bombings-2001
Iraq War-2003

Living Timeline Characters Master

"My name is Don Carlos de Hault de Lassus. I am the lieutenant governor of Louisiana. The year is **1804**. I have just received a letter from Régis Loisel saying that gold might be found in the Black Hills north of the Niobrara River."

I am a member of the Sioux tribe. Our home is located in the foothills of the sacred Black Hills. It is **1868**. We signed a treaty making the Black Hills and all of western South Dakota our land forever.

I am a woman member of the Sioux tribe. The year is **1875** and white miners looking for gold are starting to move into the Black Hills. They have broken the Treaty of 1868. 'Long Hair' and his men have fought our warriors. We are to join the Cheyenne under Sitting Bull to try to defeat them.

My name is Horatio Ross. I am a geologist traveling with Custer on an expedition to the Black Hills. It is **1874**. I have found gold in French Creek! There may be more gold in this area. We want to build forts here to keep an eye on the Sioux.

My name is Annie Tallent. I was the only woman on an expedition into the Black Hills led by John Gordon. We entered the Hills in December of **1874**, but were removed by the United States army the next year. The Black Hills still belonged to the Sioux under the Fort Laramie Treaty of 1868.

My name is Moses Manuel. My brother Fred and I came to the Black Hills after reading about Custer's trip. We discovered gold on the Homestake Ledge in **1876**! That year we built a mill and took out $5,000 worth of gold.

My name is George Hearst. My partners and I bought the Homestake Mine from the Manuel brothers in **1877**. I also bought other claims around the Homestake. I want to get as much gold as possible from the area so investors in my company will make a profit.

My name is Phoebe Apperson Hearst. The year is **1901.** The Hearst Free Kindergarten that I had built in Lead has just been dedicated. I have always been concerned with the welfare of the people of Lead and built a library in addition to the kindergarten.

My name is Julius Engle. I own the Blue Thunder Gold Mine in the Black Hills. The year is **1914**. My partner, Mr. Krupp, and I know that our gold mine is playing out. We found promising gold-bearing ore only a few months ago, but can't make enough money milling the ore to meet expenses.

My name is Sam Scherer. The year is **1934**. I am taking over the failed South Dakota state coal mine. The mine was supposed to provide coal for the state's needy residents during the Great Depression. It operated for less than a year before it was closed. One problem was that the mine was actually located in North Dakota, not South Dakota!

I am a worker at the Homestake Mine. The year is **1942**. I have worked at the mine for five years. I am joining the Army. I wanted to keep working at Homestake during the war, but the United State government has issued Order L-208. The Order stops the operation of all non-war-related mines.

The year is **1965**. I work at the Dakota Granite Works in Grant County, South Dakota. This company has been here since 1925. Our granite is made into monuments and used as building stone. It is popular because of its pretty color.

My name is Diana Mathisrud. The year is **1978**. I am one of the first female workers in the Homestake Gold Mine. It has taken a long time for women to get jobs in mines. People used to think it was bad luck to have a woman in a mine. Now, some of us are miners and some of us operate machinery.

I work at a gravel pit in Lyman County. The year is **2002**. Gravel and sand are found in almost every county in South Dakota. Our gravel is used mostly for building and maintaining Lyman County roads.

My name is Jack E. Thompson. I am the CEO for the Homestake mine. Today is December 14, **2001**. The last ton of gold ore has been taken out of the mine before it will close. The Homestake Mine operated for 125 years, ever since the Manuel brothers make their gold strike here in 1876.

Mining in a Nutshell

Objectives:

- Participants will demonstrate the steps used to find, extract, process, and use mineral resources.
- Participants will describe the steps in mining from discovering an ore deposit through using the product containing the mineral.
- Participants will generate ideas on ways to use waste products created by the mining process.

South Dakota Social Studies Standards

K	1st	2nd	3rd	4th	5th	6th
K.G.1.3 K.E.1.1	1.G.1.1 1.E.1.1	2.G.1.1 2.E.1.1	3.US.1.1 3.G.1.1 3.E.1.1	4.E.1.1 4.E.1.2	5.G.1.2	6.E.1.1

South Dakota Science Standards

K	1st	2nd	3rd	4th	5th	6th
		2.P.1.3	3.E.1.2 3.S.1.1		5.L.3.1 5.S.1.2	6.S.1.1

South Dakota Communication Arts Standards

K	1st	2nd	3rd	4th	5th	6th
K.LVS.1.6	1.LVS.1.6	2.LVS.1.4 2.LVS.1.6	3.LVS.1.1 3.LVS.1.2	4.LVS.1.1 4.LVS.1.3	5.LVS.1.1 5.LVS.1.3	6.LVS.1.3

Timeframe: 45-60 minutes

Materials:

Included in kit
Mining Phases Worksheet
Household Minerals Sheet (optional)

Provided by instructor or participants
1-2 pounds unshelled peanuts
Yellow, blue, red, black, and green markers
Graph paper or room map
Jar of Creamy Peanut Butter
Hammer
5 Ziploc bags
Plastic knives
Apple slices and crackers

Background Information:

There is more to mining then just digging a hole in the ground. There are six phases in the mining process - exploration, mining, processing, manufacturing, consumption, and recycling. This activity demonstrates those phases from finding ore to consuming products made with it. In the exploration phase, mining companies search for areas that might contain minerals and make detailed maps of locations where they may want to drill. They must know the exact location of where they want to mine so they can ask the proper authorities for permission. In the mining phase, companies extract the minerals from the ground. They may do this by strip mining, hardrock mining, or quarrying. The companies then process the minerals to remove impurities and turn them into useable resources. Those resources are in turn used to manufacture products such as cosmetics, electronics, and automobiles. The waste materials must either be recycled into something useful or disposed of safely in a manner that complies with federal and local laws.

Activity Steps:

Caution: This activity involves handling and eating peanuts. Some people can have violent allergic reactions to eating or handling peanuts. Please make sure none of the participants are allergic to peanuts before using this activity.

1. Before starting the activity, use the markers to color on the unshelled peanuts. Different colors represent different minerals: Yellow=Gold, Blue=Silver, Red=Iron, Black=Lead, Green=Tin. Make 15-20 peanuts each color. Put the peanuts in small groups around the room, forming “mineral deposits.” The deposits need not be all one color since different minerals are often found together.
2. Hand out and discuss the Six Phases of Mining sheet.
3. Put the participants into five groups and assign each group a color and its corresponding mineral. Let the groups name their “mines” using the color in the mine’s name , like the Yellow Mountain Mine, or the Red Devil Mine.
4. For the *exploration phase* of mining, give each group a sheet of graph paper and have them hunt through the room for their color peanuts. THEY MUST LEAVE THE PEANUTS WHERE THEY ARE DURING THIS PHASE. Have them map on the graph paper their mineral’s locations in the room. If desired, the instructor may make a map of the room, make map copies for the groups and have them mark the locations of the peanuts on the map copy.
5. Participants now enter the *mining phase*. Have the groups mine their minerals by collecting the peanuts of their color. They should mark on their maps how many peanuts of their color they found at each “mineral deposit” they mine.
6. Participants then move on to the *processing phase* of mining. Participants must purify their minerals by removing the shells from the peanuts and placing the shells and nuts in separate piles. DON’T THROW THE SHELLS AWAY. Have each group put their shelled peanuts in a ziploc bag and pound them into small pieces. Mix the broken peanuts into the creamy peanut butter to make chunky peanut butter.
7. Have the groups use plastic knives to spread the Chunky peanut butter onto the apples and crackers. This is the *manufacturing phase*.
8. Let the participants eat the above manufactured items. This is the *consumption phase*. While they are eating, the instructor can discuss the household minerals sheet with them.
9. Have the participants brainstorm ways to use the peanut shells. This is the *recycling phase*.

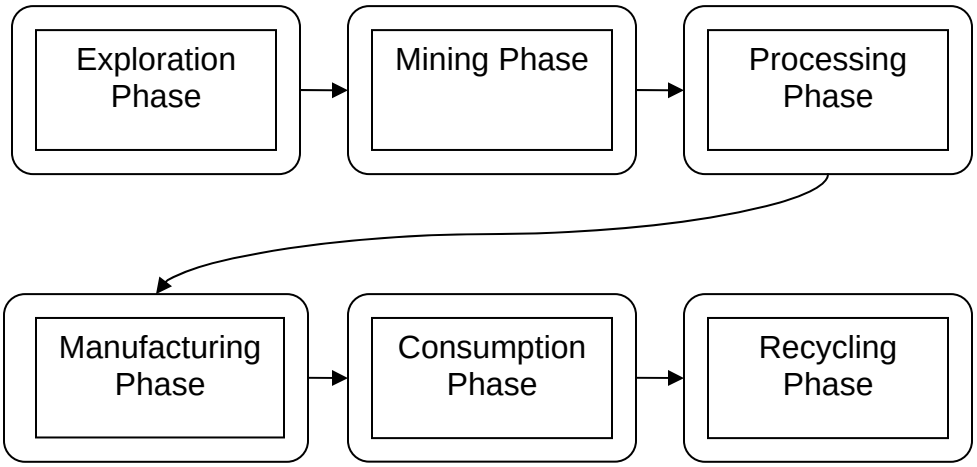
10. Discuss:
    Why is it important for companies to map out areas before mining?
    Do you think companies have to ask permission to mine in certain areas?
    Are processing and manufacturing as important as mining?
    Are unprocessed minerals as valuable as processed ones?
    Why is recycling waste products important?
11. Ask the participants to summarize the six phases of mining.

Extensions:

1. Have the participants try to make something useful out of the peanut shells or use them for an art craft activity to further expand on the recycling phase.
2. An advanced version of this activity (for 7^{th}-12^{th} grade levels) can be found at: www.coaleducation.org

This activity is used courtesy of the Women in Mining Education Foundation www.coaleducation.org Visit their website for further fun activities and games.

The Six Mining Phases



Exploration Phase: Mining companies find out where the minerals they want to mine are located so they know where to dig. They test for minerals in the earth. The company must also make maps of exactly where they intend to mine so they can figure out who owns the land and ask for permission.

Mining Phase: Mining companies use different methods to get minerals out of the ground. They may mine underground using hardrock mining techniques. They can also do strip mining or quarrying to get the minerals they want. How a company mines a mineral is important, because they must restore the land when they are done mining. The company must clean the water, plant new trees, and return the area to its original state. This is called reclamation.

Processing Phase: Minerals come from the earth mixed with rocks. The mining company has to separate the mineral from the waste rock before it can be made into useful things.

Manufacturing Phase: Raw minerals themselves aren't very valuable. When was the last time you bought a chunk of limestone or a heap of calcium carbonate? We don't buy those items, but big companies do. They use them to make everyday items such as toothpaste and microwavable containers. This is called manufacturing. It is the process of taking raw minerals and turning them into useable products.

Consumption Phase: Consumption means buying the products made from mineral resources and using them! Every time you use the phone, ride in a car, brush your teeth, watch TV, or even bake cookies, you are using minerals that were mined, processed, and manufactured.

Recycling Phase: Mining companies must decide what to do with the waste rock and other materials they separated from the minerals in the processing phase. A mining company can't just dump the waste anywhere. If they did it would cause pollution, and it is against the law. Companies look for ways to reuse the waste materials. This is called recycling. If the company can't find a way to reuse the waste it must find a way to dispose of it safely and legally.

Household Minerals

Lots of common things are made with the help of the mining industry.

Below are some products where you will find commonly mined minerals:

Fluorite—Toothpaste

Silver Ore—Photographic film

Quartz—Roof shingles

Limestone—Sugar, concrete, and carpets

Calcium Carbonate—Lipstick and certain types of ink

Mica—Paint

Clay—Vegetable oil and microwaveable containers

Pumice and **Volcanic Ash**—Kitty litter

Gold Ore—Computers

15 different minerals are used to make cars, 35 different minerals

are used to make television sets, and 42 different minerals are used to make telephones.

Fire In the Hole!

Objectives:

- Participants will identify how blasting works in the mining process.
- Participants will simulate the blasting process.
- Participants will analyze the results and recommend variations to increase blast effectiveness.

South Dakota Science Standards

K	1st	2nd	3rd	4th	5th	6th
Nature of Science Indicator 2	Nature of Science Indicator 2	Nature of Science Indicator 2	Nature of Science Indicator 2 3.E.1.2	Nature of Science Indicator 2 4.S.1.1	Nature of Science Indicator 2 5.P.2.1 5.L.3.1 5.S.1.2 5.S.2.1	6.N.2.1 6.P.2.1 6.E.1.1 6.S.1.1

South Dakota Mathematics Standards

K	1st	2nd	3rd	4th	5th	6th
	1.N.3.1 1.S.1.2	2.S.2.1 2.M.1.6	3.A.2.2 3.M.1.5 3.S.2.1	4.S.2.1	5.A.3.2 5.M.1.4 5.S.2.1	6.M.1.2

South Dakota Communication Arts Standards

K	1st	2nd	3rd	4th	5th	6th
K.LVS.1.1 K.LVS.1.6	1.LVS.1.1 1.LVS.1.6	2.LVS.1.1 2.LVS.1.4 2.LVS.1.6	3.LVS.1.1 3.LVS.1.2	4.LVS.1.1 4.LVS.1.2	5.LVS.1.1 5.LVS.1.2 5.LVS.1.3	6.LVS.1.3

Timeframe: 30-45 minutes

Materials:

Included in kit:
Blasting Area Container
Square dividers
Blasting patterns transparency
Fire in the Hole! Worksheet
Fire in the Hole! Worksheet Key
Photos 12 and 13
Blasting caps and tins

Provided by instructor or participants:
Duct or packing tape
Sand
Ruler
Pencil and Paper
Spoon
*If you wish to conserve sand, do this activity before the **strip mining**. Sand can be reused after this one, it cannot be reused after the strip mining.

Background Information:

Explosives have been a vital part of the mining industry for over two hundred years. Strip mines, hard-rock mines, and quarries from all over the world use explosives. Blasting is much more complicated than simply drilling a hole, placing a charge, and lighting the fuse. Miners must consider many variables such as the strength of the explosive, the kind of material being blasted, and the amount of material being blasted before they set a charge. Using explosives is a very difficult and dangerous job (see photo 13).

The most important elements in setting off a successful blast are where the charges are placed and in what order they are fired. If the charges are too close together the explosion will blast the rock into pieces that are too small. If the charges are too far apart, the rock pieces will be too big. If the charges go off in the wrong order, the blast will not loosen the rock effectively. This activity simulates a blast done using the diamond pattern (see photo 12). The diamond pattern is commonly used when blasting out *stopes*, or chambers in a mine. When blasting out a stope there is no open space for the debris to fly into so the middle part of the stope must be blown out first. With the middle part gone, the flyrock, or debris, from the other blasts will have some place to go. Blasting in the diamond pattern makes the entire rock wall cave in on itself. To achieve this, the charge in the middle must blow first with the succeeding charges blowing in sequence from the middle to the outside. This pattern ensures that there will always be an open space for the debris to go into.

Activity Steps:

1. Share the Background Information above with the participants and display the Blasting Pattern transparency to illustrate the effect that will take place. Pass around the blasting caps and tins so that the participants can see the devices that would be used to trigger each explosion. The funneled Blasting Area Container with grooves for the square dividers used in this activity will give participants an idea of how the pattern and blasting sequence work. Each square represent a different blast.
2. Put the Blasting Area Container on a table with the participants gathered around it. Plug the hole in the bottom of the Container with a strip of tape. Make sure the strip extends beyond the edge of the container to make it easier to pull off. Once the hole is plugged, put the square dividers in their appropriate grooves. Make sure that the dividers are pushed down as far as they will go so no sand can leak underneath them. With the dividers in place, begin filling the container with sand. When filling between the two dividers, make sure that the smaller one is not covered. Fill up to its top edge but not beyond it. Use a spoon to fill the area on the outside of the large divider. Once all of the sand is in place you are ready to begin “blasting.”
3. Pull the tape off the hole in the bottom of the Container. When the hole is unplugged, the sand should drain from inside the first divider only. When the first divider is removed, the sand between the dividers will drain. The remaining sand will drain out when the larger divider is removed. This illustrates what happens during a diamond blasting pattern detonation.
4. After doing the simulation a few times so all the participants can see it clearly, distribute the Blasting Pattern Worksheet. Using the worksheet and measurements from the Blast Area Container, participants will figure out the *perimeter* and the *area* for each of the three blasts. Round the measurements to the nearest inch. Have one participant measure one side of each of the dividers. Use 5 inches as the length for the side of the container. Share the measurements with the rest of the group, and have them complete the worksheet.
5. Discuss:
    - How does the perimeter of each blast compare with the area removed?
    - What other patterns might achieve the same or similar results?
    - What could make blasting dangerous in a mine? (Unexpected cave-ins and explosions, unfired charges, etc.)

Fire in the Hole! Worksheet

Calculate the *perimeter* and surface *area* of the sand being removed from the Blasting Area Container for each blast.

Blast One: (Area inside small divider)

1. Area _____ **x** _____ **=** _____ **square inches**
small divider side small divider side

2. Perimeter _____ **+** _____ **+** _____ **+** _____ **=** _____ **inches**
small divider side small divider side small divider side small divider side

Blast Two: (Area between small and large dividers)

3. Area _____ **x** _____ **–** _____ **=** _____ **square inches**
large divider side large divider side answer for 1.

4. Perimeter _____ **+** _____ **+** _____ **+** _____ **=** _____ **inches**
large divider side large divider side large divider side large divider side

Blast Three: (Area outside larger square)

5. Area _____ **x** _____ **–** _____ **=** _____ **square inches**
container side **container side** **answer 1 + answer 3**

6. Perimeter _____ **+** _____ **+** _____ **+** _____ **=** _____ **inches**
container side container side container side container side

Fire in the Hole! Worksheet Key

Calculate the *perimeter* and surface *area* of the sand being removed from the Blasting Area Container for each blast.

Blast One: (Area inside small divider)

1. Area 2 (small divider side) **x** 2 (small divider side) **= 4 square inches**

2. Perimeter 2 (small divider side) **+** 2 (small divider side) **+** 2 (small divider side) **+** 2 (small divider side) **= 8 inches**

Blast Two: (Area between small and large dividers)

3. Area 4 (large divider side) **x** 4 (large divider side) **–** 4 (answer for 1.) **= 12 square inches**

4. Perimeter 4 (large divider side) **+** 4 (large divider side) **+** 4 (large divider side) **+** 4 (large divider side) **= 16 inches**

Blast Three: (Area outside larger square)

5. Area 5 (container side) **x** 5 (container side) **–** 16 (answer 1 + answer 3) **= 9 square inches**

6. Perimeter 5 (container side) **+** 5 (container side) **+** 5 (container side) **+** 5 (container side) **= 20 inches**

Panning for Gold

Objectives:

- Participants will identify the uses for and necessities of gold panning.
- Participants will recognize and demonstrate the steps involved in panning for gold.
- Participants will analyze the process and evaluate its effectiveness.

South Dakota Communication Arts Standards

K	1st	2nd	3rd	4th	5th	6th
K.LVS.1.1 K.LVS.1.6	1.LVS.1.1 1.LVS.1.6	2.LVS.1.1 2.LVS.1.4 2.LVS.1.6	3.LVS.1.1 3.LVS.1.2 3.LVS.1.4	4.LVS.1.1 4.LVS.1.2	5.LVS.1.1 5.LVS.1.2 5.LVS.1.3	6.LVS.1.3

South Dakota Mathematics Standards

K	1st	2nd	3rd	4th	5th	6th
K.A.1.2 K.A.4.2 K.N.3.1	1.A.4.2 1.N.3.1	2.A.3.1 2.M.1.7 2.N.3.1 2.S.1.1 2.S.2.1	3.A.2.2 3.M.1.4 3.N.1.3 3.S.2.1	4.M.1.3 4.S.2.1	5.A.3.2 5.M.1.4 5.S.2.1	6.M.1.1

Timeframe: 60 minutes

Materials:

Included in kit
2 gold pans
Pyrite and/or BBs
Balance scale
Panning worksheet

Provided by instructor or participants
Tub, 2 ½ ft diameter, 1 ½ ft deep
Gravel, 1 large bucketful
Tarp
Towel
Water

Background Information:

Many of the miners who came to the Black Hills were equipped only for placer mining. Gold panning is the primary process placer miners used to find gold. Efficient miners could go through a pan in as little as 30 seconds, allowing them to process large amounts of material in a day. Many miners made a good living doing this while others barely scraped by. Discovering gold was hard enough, and greenhorn miners often lacked the efficiency to pan a deposit profitably. As a result, success as a placer miner depended on hard work, good panning techniques, and a little luck. This activity lets participants try their hand at gold panning.

Activity Steps:

1. Lay down the tarp and place the tub, half-filled with water, and bucket of gravel on it. If you are outside you could use a hose for your water source. The instructor should first demonstrate panning and then let the participants try it.
2. Give each participant or group, if you are doing this as a small group activity, a copy of the Panning worksheet.
3. Weigh about 15-20 BBs or some of the pyrite (fool's gold) on the balance scale. This will be the "gold" for the activity. You will also weigh the gold after panning to determine how much was recovered. Once the "gold" has been weighed, put it in the bottom of the gold pan and fill the pan half-full with gravel.

4. Submerge the pan of gravel and let it sink to the bottom of the tub. Knead the gravel like bread dough to get rid of the dust; this will make the water dirty and cloudy. Lift the pan out and dump some water, leaving enough in the pan to cover the gravel. Shake the gravel from side to side, like you would if you were screening dirt, with the pan tipped away from you at a slight angle. This is done so that the "gold" settles on the bottom of the pan. The gravel should form a pile at the far side of the pan.
5. Dip the pan into the water at about a 45° angle so the gravel is completely submerged. When the water reaches this point pull the pan out at the same 45° angle. The dipping and removing of the pan should be a fluid motion. The water will carry off the large rocks. Repeat the dipping and removing motion 5 times. Remove the pan from the water and shake the gravel from side to side 5 times. Repeat this process until you are left with only small rocks and sand.
6. When you are left with only small rocks and sand you will use a careful wave motion to remove the remaining rocks. Pick out the larger rocks. Dip the pan as before at a 45° angle, so that water barely covers the sand. This time, instead of lifting the pan out at a 45° angle, gently flip the bottom of the pan away from you as you lift it out. Alternate doing the wave motion 5 times and shaking down the contents 5 times until most of the rocks are removed and you are left with only sand.
7. Shake down the contents so they collect at the far side of the pan as before. Keep enough water in the pan so that the contents are barely covered. Begin gently swirling the water in the pan. This can be done by tilting the pan up and down in a clockwise circular motion so that the water moves in a circle around the inside edge of the pan. As you swirl the sand should move with the water revealing the "gold." Pick out pieces of "gold" as they are found.
8. Remember to have participants weigh their "gold" both before and after panning. See who can get the highest rate of recovery. Discuss:

Based on the gold they recovered, how successful do the participants think they would have been as gold miners?
Could they do this for a living?
How difficult would such a lifestyle be?

Panning Worksheet

The scale weighs in grams, so muliply the gram weight by .0353 to convert the weight to ounces.

Weight of gold before panning _____ oz.

Weight of gold panned _____ oz.

Amount lost _____ - _____ = _____ oz.
weight of gold before panning weight of gold panned

Percentage of gold recovered _____ ÷ _____ = _____%
weight of gold panned weight of gold before panning

Panning Sequence

Put the following steps for panning gold in order. Some of the steps are used more than once.

A. Swirl water in the pan in a circular motion to uncover gold
B. Knead the gravel to remove any loose dirt
C. Use a gentle wave motion to remove small to medium-sized rocks.
D. Submerge the pan in the tub, allowing it to sink to the bottom.
E. Remove gold from the pan
F. Dip and remove pan at a 45° angle so that the water carries off any large rocks.
G. Shake pan like you were screening dirt, allowing gold to settle on the bottom and gravel to collect at far side of the pan. (Hint: this step is used three times)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____

Panning Worksheet Key

The scale weighs in grams, so muliply the gram weight by .0353 to convert the weight to ounces.

Weight of gold before panning _____ oz.

Weight of gold panned _____ oz.

Amount lost _____ - _____ = _____ oz.
weight of gold before panning; weight of gold panned

Percentage of gold recovered _____ ÷ _____ = _____%
weight of gold panned; weight of gold before panning

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1. ___D___
2. ___B___
3. ___G___
4. ___F___
5. ___G___
6. ___C___
7. ___G___
8. ___A___
9. ___E___

Strip Mining and Reclamation

Objectives:

- Participants will develop an understanding of strip mining and its purpose.
- Participants will practice both strip mining and reclamation.
- Participants will discuss the necessity of reclamation and its effect on the environment.

South Dakota Communication Arts Standards

K	1st	2nd	3rd	4th	5th	6th
K.LVS.1.1 K.LVS.1.6	1.LVS.1.1 1.LVS.1.6	2.LVS.1.1 2.LVS.1.4 2.LVS.1.6	3.LVS.1.1 3.LVS.1.2 3.LVS.1.4	4.LVS.1.1 4.LVS.1.2	5.LVS.1.1 5.LVS.1.2	6.LVS.1.3

South Dakota Science Standards

K	1st	2nd	3rd	4th	5th	6th
K.P.1.1	1.P.1.1 1.P.2.1 1.E.1.2	2.P.1.1 2.P.1.3	3.E.1.2	4.S.1.1	5.L.3.1	6.E.1.1 6.S.1.1

Timeframe: Two 45-60 minute sessions (one to build the mines, one to mine them)

Materials:

Provided by instructor or participants

2 cups of flour	15 charcoal briquettes
1 cup of salt	1-gallon ziploc bags
Water	1-quart transparent plastic containers, like Gladware
1-2 lbs sand	Paper towels
1-2 lbs gravel	Metal spoons
1-2 lbs potting soil	Roll of wax paper

Background Information:

Coal has been a vital source of energy ever since the Industrial Revolution. It has been used to run machinery, produce heat and electricity, and make steel. As the demand for coal increased an economical mining method was needed. The answer was strip mining.

Strip mining is done near the surface of the earth. Miners follow a coal seam while piling the *overburden*, the earth or other materials that lie over the coal seam, in a pile next to the coal seam. By piling the overburden along the seam the miners can easily fill the holes back in after the coal has been extracted. This process of converting waste land into land suitable for habitation or cultivation is called *reclamation*. Early practices of strip mining were not environmentally sound, making reclamation a very important aspect of contemporary coal mining. In this activity, participants will make a coal deposit in a container, strip mine it, and replace the overburden.

Activity Steps

1. Instructor should mix up the silt layer recipe before the activity period. This layer is made of a pretend rock, similar to play doh with sand in it.

To provide silt layers for 3 to 5 1-quart square containers (approx. 4x4 in.):

2 cups of flour
1 cup of salt
2 cups of sand
1 cup of water

Mix the dry ingredients in a bowl. Pour some water into the dry ingredients and start kneading the dough by hand. Slowly add more water until it feels like play doh.

Recipe is adapted from *Mock Rock* recipe found at www.saltthesandbox.org/rocks/mockrock.htm

2. Have the containers, sand, gravel, potting soil, ziploc bags, briquettes, silt mixture, and paper towels on a table so all the participants can get to them easily.

3. Share the background information with the participants. Organize into small groups of 3 to 5 individuals. Give each group one transparent container to built their coal mine in.

4. Have them put an even layer of sand, about 1 cup, in the bottom of container. This is the subsoil layer. Layers do not have to all be the same. Variation within and between layers makes the activity more realistic.

5. The next layer is the lignite or coal layer. To form this layer, put 3-4 charcoal briquettes in a 1-gallon storage bag and fill the bag with water until the briquettes are covered. Let stand for about 5 minutes, then pour off the water. Keeping the briquettes in the plastic bag, knead them through the bag until they break apart and feel like course flour. If briquettes are difficult to break, soak them for an additional five minutes as needed until soft. After the briquettes are the consistency of flour, spread them on top of the sand in the container. The coal layer does not have to be very thick, but make sure that it is deep enough to be seen through the side of the container. Pat the coal layer with a paper towel to remove any excess moisture.

6. Spread a layer of silt on top of the coal. This layer should be a little bit thicker than the coal layer.

7. Add a layer of gravel over the silt, and then cover the gravel with a layer of potting soil.

8. To mine the coal, give each group a metal spoon and a large piece of wax paper. The members of the group can “specialize” on different layers, each removing a separate layer. Have the first member of each group remove the topsoil onto the wax paper. Spread the topsoil out in a line about 1 in. to 1-1/2in. high. Each layer should be placed at the end of the line creating a continuous line of overburden from one layer to the next. Once the topsoil and gravel layers begin to mix, transfer the spoon to the next member and have them remove the gravel continue until the next layer is reached and so on. When the coal layer is reached, stack that in a pile of its own, separate from the overburden line. The sand, since it is the subsoil layer, should not be removed.

9. After the coal has been removed, replace the layers in reverse order, from the end of the line to the beginning. This represents reclamation after the coal is mined.

Discuss:

Is it easier to perform the mining or the reclamation?
Does the container look the same after reclamation as it did before mining? If not, how is it different?
Why would reclamation be an important step in strip mining?

Mapping Claims

Objectives:

- Participants will discuss how best to divide land into mining claims.
- Participants will compare their methods to those used by Black Hills miners.
- Participants will apply the strategies they have developed.

South Dakota Communication Arts Standards

K	1st	2nd	3rd	4th	5th	6th
K.LVS.1.1 K.LVS.1.6	1.LVS.1.1 1.LVS.1.6	2.LVS.1.1 2.LVS.1.4 2.LVS.1.6	3.LVS.1.1 3.LVS.1.2 3.LVS.1.4	4.LVS.1.1 4.LVS.1.2	5.LVS.1.1 5.LVS.1.2	6.LVS.1.3

South Dakota Social Studies Standards

K	1st	2nd	3rd	4th	5th	6th
K.G.1.3	1.G.1.1 1.C.2.1	2.G.1.1 2.C.1.2 2.E.1.1	3.US.1.1 3.US.2.1 3.G.1.1 3.C.1.4 3.E.1.1	4.C.2.1 4.E.1.1	5.G.1.2	6.E.1.1

Timeframe: 45-60 min.

Materials:

Included in kit	Provided by instructor or participants
Golden Gulch Map transparency	Rulers
Golden Gulch Map master	Pencils
Iron Pyrite (Fool's Gold) pieces	Drawing Paper

Background Information:

When gold was discovered in the Black Hills hundreds of miners rushed to the area. These miners had to find a way to live and work together. Mining claims let everyone know who had rights to specific land and the gold found there. Because there were no legal courts or law enforcement, the miners developed their own laws and means of settling disputes. The miners set up a ' mining district' with claim offices to record claims and miners' courts to deal with disagreements. The more frequent complaint brought before the miner's court was over ownership of land.

Recording the locations and boundaries of claims without the use of modern technology was no easy matter. Often a claim record simply gave the claim number, a short description of the area the mine was located in, estimated distances along the claim's borders, and notable landmarks. Other records were even less descriptive. The following is the example from a district claim recorder's record book taken from Watson Parker's *Gold in the Black Hills*:

> "Personally appeared before me James Andrews and recorded the undivided right title and interest to Claim Number 9, 'Above Bear Rock' of 300 feet for mining purposes. Recorded this 9th day of July 1875."[38]

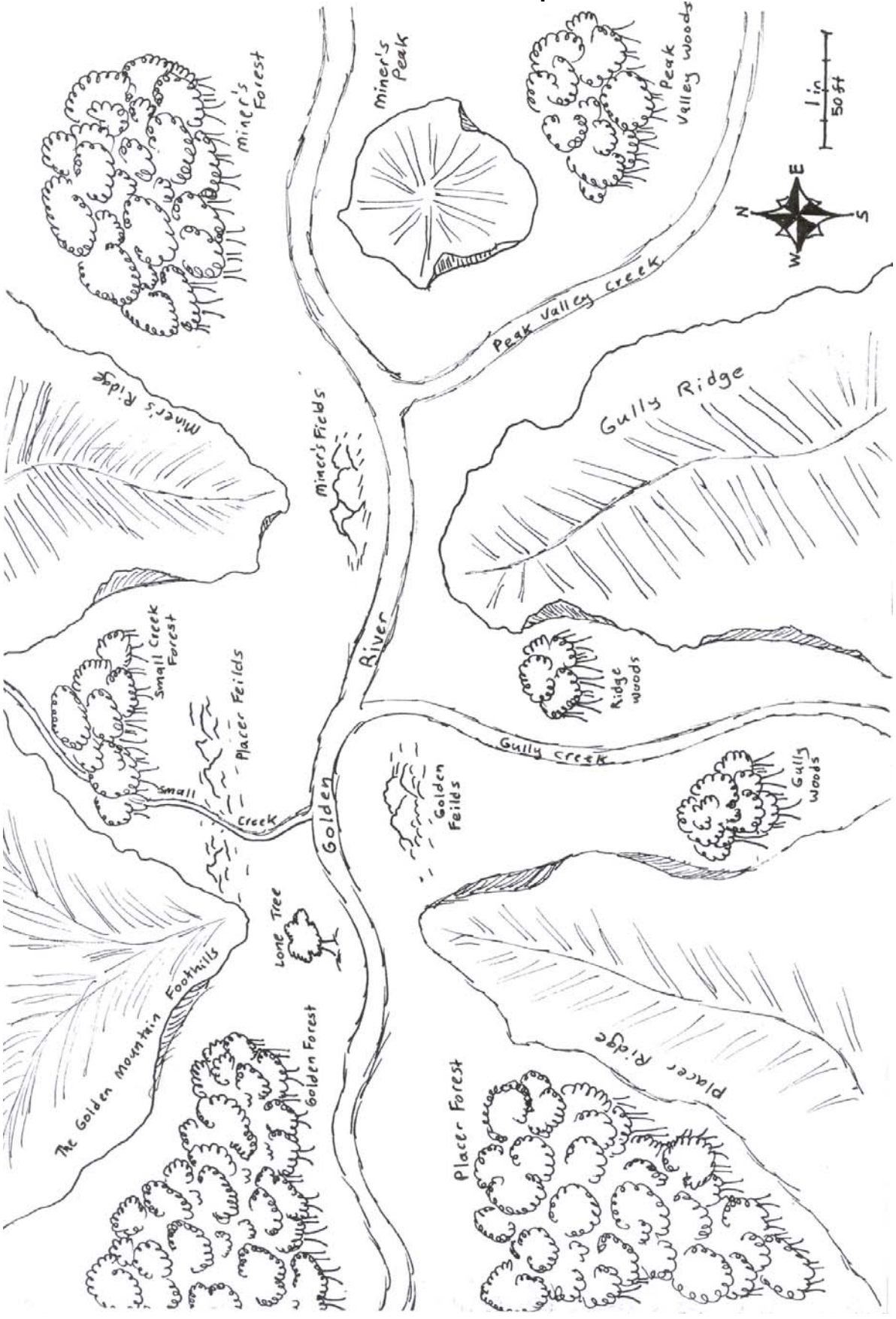
[38] Parker, Watson. *Gold in the Black Hills* P. 61

A paper copy of this mining deed would be given to the claimant and the claim was officially theirs. But even with official records and courts, disputes could still be settled violently. This activity illustrates the difficulties filing claims presented and the problem solving skills needed to handle both everyday operations and occasional disputes.

Activity Steps:

1. Hand out copies of the Golden Gulch Map to the participants. They are prospectors who have entered the Black Hills as a group and want to divide Golden Gulch up into mining claims. They must decide how they will go about dividing up the land and who gets what claim.
2. Once they have reached a decision they feel is fair, have participants physically draw their claim's boundaries on the map and write a short description of it using directional language and land marks to describe their claim. They can use the map's scale and rulers to take measurements of their claims.
3. Share the background information with the participants. What were the similarities between the miner's process and the participant's? What were the differences? Which process do the participants think works the best? Would they do anything differently knowing how the miner's divided the land?
4. Have the group divide the room up using their method, the miner's method, or a combination of both. They may need to draw a map of the room to help them.
5. When they all have their claims, have them face the wall with their eyes closed. Hide the pieces of pyrite from the kit (or some other small objects) randomly in the room. To make things interesting , place one object directly on the boarder to two claims. Have the participants search their claims for the hidden items.
6. If there are any disputes as to whose claim an item is on, the participants must decide how to solve the issue. Discuss:
    How would the miner's have solved the issue?
    Should they flip a coin or have a trial?
    What if real gold was on the line, would their decision change?

Golden Gulch Map



What Can A Photo Tell You?
Compare and Contrast; Sequencing; Tell Your Story

Objectives:

- Participants will compare and contrast historic mining photos to help them make conclusions about mining in the Black Hills.
- Participants will use photos to organize a sequence of events.
- Participants will develop their own stories using photographs as an inspiration.

South Dakota Communication Arts Standards

K	1st	2nd	3rd	4th	5th	6th
K.W.1.1 K.LVS.1.2 K.LVS.1.6	1.W.1.1 1.W.1.2 1.LVS.1.1 1.LVS.1.4 1.LVS.1.6	2.W.1.1 2.LVS.1.4 2.LVS.1.5 2.LVS.1.6	3.W.1.3 3.LVS.1.1	4.W.1.2 4.LVS.1.2	5.W.1.1 5.LVS.1.3	6.W.1.1 6.LVS.1.2 6.LVS.1.3

Timeframe: 30-40 minutes for each activity

Materials:

Included in kit	Provided by instructor or participants
Photos 1,5,11,14-21	pen or pencil
Tell Your Story worksheet	
Compare and Contrast worksheet	.

Background Information:

Photographs are an important tool in our understanding of the past. Photographs capture things that might not otherwise be remembered. Analyzing photographs helps historians to better understand the people and events that they study. In this activity, participants will analyze photos relating to mining in South Dakota and form conclusions about the past from their observations. Some photos are recent, some are old. How can a historian tell when a photo was taken? What clues do they look for? The type of clothing worn by the people or the technology present in the background will help date a photo. Deciphering a photograph is like being a detective. The photos give you clues about the past. In this activity, participants will compare photos from different times and different places, organize photos in a sequence, and write their own stories based on observations made while looking at the photographs.

Activity Steps:

1. Tell Your Story, What's the Order? and Compare and Contrast may be done by individual participants or working in small groups.

2. Make copies of the Tell Your Story and Compare and Contrast worksheets for the participants.

3. Tell Your Story: Have participants look at Photos 1, 5, 11, 14 and 15. Have them choose one of the photos and write a story about it. The story should be at least 10 sentences long. The story could be told from the point of view of the writer, one of the people in the photo or even from an animal in the photo's perspective. Let participants use their imagination. They should consider *who* is in the story, *what* they are doing, *where* they are doing it, and *why* the story characters are acting the way they are. Encourage the use of descriptive words. When the stories are completed, have the writers share their work with the group.

4. What's the Order? Have participants view Photos 17, 18, 19, 20, and 21, the Coal Mining Sequence Photos. Have them put the photos in order based on what they think happened first, second, and so on. Discuss their choices. How do they decide which photo comes first? What clues did they use from the photos to make their decisions? Discuss as a group.
(Photos go in order: 19, 18, 17, 20, 21)
5. Compare and Contrast: Look at Photo 16, the two sets of miners. On their worksheet, have participants write some of the things they see that are the same in each photo, and things that are different. Have them make some hypotheses based on their observations. What clues tell them which photo is older? Why do they think these photos were taken? Discuss as a group.

Tell Your Story

Write a story about the photo you have chosen. In your story, who are you? What are you doing? What has happened recently? What are you feeling? Your story has to be at least 10 sentences long.

Compare and Contrast

Find three things that are the SAME in the photos and three things that are DIFFERENT.

SAME

1._____

2._____

3._____

DIFFERENT

1._____

2._____

3._____

Which photo do you think is older? TOP PHOTO BOTTOM PHOTO
Circle your answer.
Why? What do you see in the photo that makes it look older?

_____

_____

_____

_____

_____

_____

_____

_____