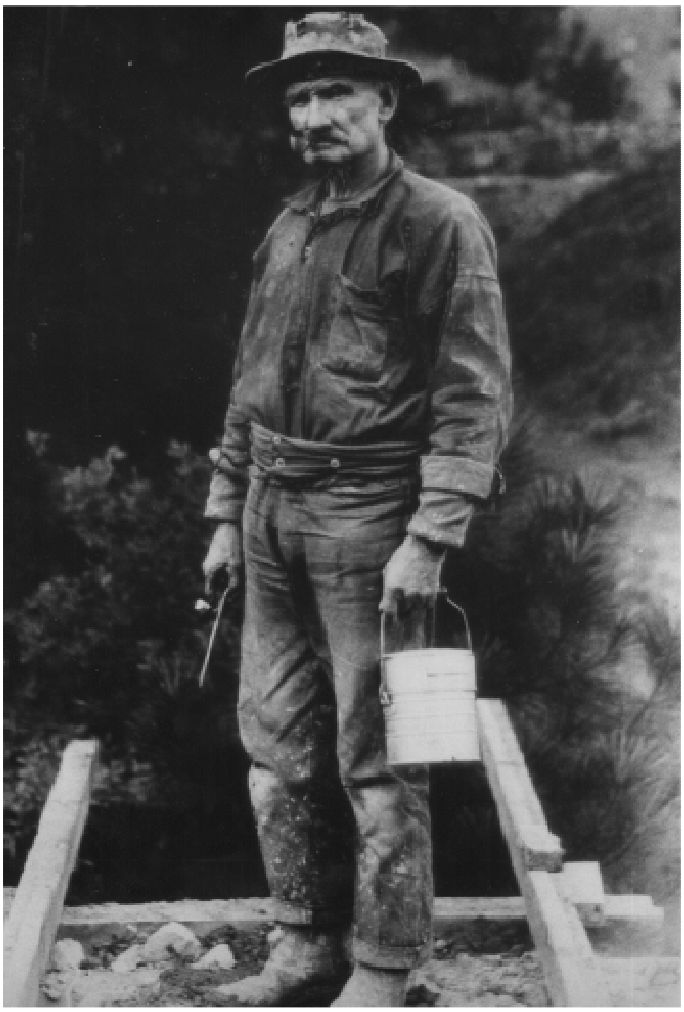
California State Parks
Sierra District

Plumas-Eureka State Park

Eureka (Adit) Tunnel Interpretive Plan



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Contents

1. Park Purpose

The purpose of Plumas-Eureka State Park is to protect and interpret the natural and cultural resources contained within the park boundaries and provide recreational opportunities to the public.

2. Park Significance

Plumas-Eureka State Park is bisected by Jamison Creek and located within the east-facing slopes of the northernmost Sierra Nevada mountain range. Within the upland forest one will experience montane, chaparrel, mixed pine, mixed fir and red fir sections. Lacustine, meadow and riparian examples makeup the Stream Riparian habitat. Because of the geology in the specific location, hardrock gold mining occurred from the 1850's through the 1890's. As a result, numerous archeological sites and related historic mining structures are found within the park.

The park was purchased in order to preserve the rich mining history and natural resources, while providing recreational opportunities for a growing California population.

3. Summary of Pre-existing Conditions and Special Concerns

Plumas-Eureka State Park is located 62 miles east of Reno, Nevada and 57 miles north of Truckee, California. The elevation at the park office is 5,168' above sea level and the highest point in the park is Eureka Peak at 7,447'.

Approximately 20 years ago the origin of visitors was as follows: Northern California (Bay Area) = 50%, Northern California (other) = 20%, Nevada = 15% and other = 15%. Today, the visitor origin is Nevada = 50%, Northern California (Bay Area) = 20%, Northern California (other) = 15% and other = 15%.

Overall visitor attendance peaks during the month of July and is the lowest during the month of December. The average annual attendance (in all forms), for the past 21 years is 71, 949. Approximately 70% of the campers are families. The average age of an adult visitor is 37 years old and the average youth age is 9 years old. The ethnic background of the visitor is Caucasian = 95%, Afro-American = 1%, Hispanic = 2% and other = 2%. Most visitors come for recreational pursuits of hiking, fishing and sightseeing. A smaller but growing number come to play on the nearby golf courses and the remainder for the local history.

Currently, a variety of interpretive programs and methods are used at the park. A group of State Park Docents provides visitor information, history talks, nature walks, history tours, living history portrayals and research. General topics focus on the mine history of the area, mining methods and area specific lifestyles.

The Plumas-Eureka State Park Association hires an interpretive aide that develops and distributes weekly interpretive activity sheets, provides visitor information and performs occasional interpretive programs. Interpretive tools such as exhibits, hand-held objects, 35mm transparencies, copies of historic photographs and recording devices are utilized. State Parks attempts to fill and utilize a Park Interpretive Specialist, Seasonal position for the summer peak season.

Interpretive mining resources in the surrounding communities include:

The Plumas County Museum, non-profit regional history
Quincy, California

The Sixteen to One Mine, commercial underground tours
Alleghany, California

The Kentucky Mine Museum
Downieville, California

Empire Mine State Historic Park
Grass Valley, California

Malkoff Diggins State Historic Park
Nevada City, California

4. The Tunnel (Adit)

Currently, there is no easy access to the adit. Visitors must walk approximately 200 yards south along the campground road from the museum building to an old mining road. At this point, visitors hike approximately ¼ mile up to the adit. Disabled visitors must arrange access through the road gate, upon reaching the adit area there is limited parking. Currently there are no restroom facilities at the site.

5. Goals and Objectives of the Planning Process

1. Involve staff and Plumas Eureka State Parks Association board and members in the planning process through focus groups and assignments.

1. Implement a complete hardrock gold-mining story program using exhibits, demonstrations and tours including: the discovery of gold, a tour inside the Eureka Tunnel and the Mohawk Stamp Mill complex.

2. Reconstruct the Eureka Adit (Tunnel) setting (to include appropriate equipment and buildings),

3. Restore the Plumas-Eureka Powderhouse and Mohawk Mill.

4. Implement a curriculum responsive school tour program.

6. Inventories

6.1 Natural Resources

6.1.1 Geology

The geology of the Plumas Eureka area is imperfectly known because much of the ground has a cover of glacial debris. However, outcrops of the main rock types are present in the upper part of the area, south of Eureka Lake and in the vicinity of Eureka Peak. The oldest rock in the area is the Sierra Buttes Formation. This formation, which is about 350 million years old, extends in a northwest-trending band for about 75 miles and is as much as 4,000 feet thick. The material is almost entirely volcanic ash and coarser fragments deposited in a deep sea and later compacted and uplifted as dense rock.

The next younger rocks are two types of igneous material called gabbro and pyroxenite. Gabbro is granite-like rock but contains no quartz. Pyroxenite is a rock composed almost entirely of augite. These two rock types are present in a roughly circular body, believed to be about 2 miles in diameter, that intruded (invaded in a molten state), the Sierra Formation.

The next youngest rock is also igneous; it is granite that forms northwesterly trending dikes. The rock is an even-grained mixture of light-colored quartz with feldspar and dark green minerals. The gabbro, pyroxenite and granite probably were from a mass of molten rock that formed deep in the earth's crust. The quartz veins and the gold mined at the Plumas Eureka Mine were later products from this molten body.

The gold discovery was on Eureka Peak. It was a rich ledge in an outcropping of quartz, the exposed top of the Eureka Chimney, a sub-surface deposit of gold-bearing quartz.

6.2 Cultural Resources

6.2.1 History of the Eureka Tunnel

There are several historic sites located within the boundaries of the park. Within the section of the park west of Johnsville, north of Jamison Creek, and south of Eureka Peak, the most important would, of course be the mine discovery site. Then, there are the Mammoth Mine, Seventy-Six, Rough and Ready and Plumas Eureka Mine sites. Most of the sites are not easily accessible to the public.

The Plumas Eureka site, consisting of the Mohawk Mill, Eureka Tunnel and associated mine operations buildings is the most prominent and accessible cultural site. Of special recognition are the two-tramway lines, that began just near the Seventy-Six mine site and terminated adjacent to the Eureka Adit. The trams proved to be unworkable and were only used for a very short period. Very little remains of the tram system. The cables that are believed to be part of the upper tram can still be seen silhouetted against the skyline from along the road to the Upper Jamison Creek campground.

Gold was first discovered on Eureka Peak in May of 1851 by nine miners including Merethew and Peck. The men found a rich ledge in an outcropping of quartz. The outcrop was the exposed top of the Eureka Chimney. The Chimney was a subsurface deposit of gold bearing quartz that wasn't worked out until 1865. The Eureka Company of 36 men was formed on June 5, 1851. In just a few weeks the rush commenced. Claims were quickly filed for the Rough and Ready mine, about 1/2 mile south, the Mammoth Mine to the north and the Seventy-six. Work began within days of the Eureka strike. After a few years only the Eureka and Mammoth mines were still in operation.

At beginning of the operations, ore from the Eureka and Mammoth mines was hauled to Eureka Lake where it was worked in arrastras. The Eureka Company built their first stamp mill in 1855 at Eureka Lake and another mill two years later. The Mammoth Company built a 12 stamp mill on the flat at Jamison Creek in 1856.

Throughout the 1850's and 1860's the Eureka Chimney was mined by both companies. The ore body was accessed from both its top shafts and seven different tunnels. San Francisco banker John Parrott had taken over the Eureka Mine for its debts, foreclosed on the Rough and Ready and acquired the Seventy-six in litigation by the late 1860's. The company reported shipping $13,000 worth of gold bars after only 18 days of work in 1869.

Eureka Peak, Eureka Lake, Eureka Boardinghouse (far right above the shoreline)

The Mammoth Mill and Ledge was taken over by James Thompson and John B. McGee in 1867. Under their direction a new 1,600 foot Upper Mammoth tunnel and a Lower mammoth tunnel were run. They were in rich ore by 1868.

The Sierra Buttes Gold Mining Co., Ltd., based in London, was the next company to be involved in the Eureka Peak mines. Sierra Buttes purchased the Eureka Mine for $1,000,000 in 1872. The next year the company purchased the Mammoth for $50,000 and the Mammoth Extension for another $50,000. These acquisitions consolidated the remaining claims on Gold Mountain. The company quickly built a new 40 stamp mill near the mouth of the Upper Mammoth tunnel. The new mill was powered by water from Eureka Lake and became operational in 1873. The company also re-timbered the tunnel and developed a new town called Eureka Mills laid out high up the mountainside. The town grew substantially.

In 1875 the company placed William F. Johns in charge. Johns was manager of the company's Sierra Buttes property. Under his highly efficient operation production doubled in the first year.

John's concentrated his efforts on expanding the Upper Mammoth tunnel adjoining the mill. Work also continued in the Railroad, Middle, Catlin and Lower Mammoth tunnels. The Eureka Tunnel was driven between 1876 and1878 at 5,400

feet elevation above sea level to reach the wider, deeper ore bodies and to supply a new mill.

Eureka Lake only provided enough water to operate three months of the year. A new mill was needed with a more dependable year-round source of power. Construction of the Mohawk mill began in 1878. An extensive flume and ditch system was designed to carry water to and from the mill site. The first 20 stamps of the mill began operation in December of 1878. The second set of 20 stamps was running by January of 1879. The 40 stamp mill was powered by an 8 foot diameter Knight water wheel and supplemented by a 75 horse power steam engine. By the end of that year the number of stamps was increased to 60. The Mohawk Mill was located further down the hill from the Mammoth and closer to nearby Johnsville. Ore was delivered to the new mill from the Mammoth, Seventy-six and Eureka tunnels.

Mohawk Mill 1880's, Steam generator building on right

Ore values dropped by 1882 and dividends fell. 1883 to 1887 was a discouraging period. Production at the mines began to decline by 1892. Most of the high grade ores were extracted. The mines and mill would stay in operation as long as they met costs. No funds for further development were approved. All mineral exploration ceased by 1896. In 1897 only 10 to 30 workers were employed and only 15 stamps were running in the mill.

From 1898 to 1902 the mine was worked by F.F. Vanzini and Messrs. Passetta and Tresidder under a lease agreement. They employed from 12 to 29 men. The operation was sold to eastern investors in 1905. Mining was conducted by the Johnston Graham Mining Company. The company employed contractors McCarty and Maxwell and rebuilt the mill. They replaced the existing equipment with 20 new stamps and new concentrators. During the winter of 1905-1906 the Eureka Tunnel was re-opened. Laborers were hard at it around the clock. The property was completely reopened by 1908.

The Plumas-Eureka Mining Company purchased the property in 1909. They reconstructed the mill the following year. The project included rebuilding the 20 stamps of the previous owner and adding 20 more. The Eureka Tunnel was 5,500 feet long by then. It had 26 miles of development work in adits, winzes, stopes, and inclines, only seven or eight miles of it were in working condition. The Plumas Eureka Mining Co. declared bankruptcy in 1916 and was reorganized as the Plumas Eureka Corporation.

Tunneling was limited to running a raise from the face of the Eureka tunnel to cross-cut the mountain for 1,100 feet and connect with the Seventy-six workings above. The raise was only driven 534 feet when it broke into the old workings of the Mohawk Flat vein. The manager decided the vein was easier to work from the Mohawk tunnel.

The mill was operated sporadically until 1928 when it became the property of the Phillips Trustees of Boston, Massachusetts. 20 stamps were still in place and three No. 3 Wilfey tables were added. Electric power came from water diverted by flume and ditch from Jamison Creek four miles upstream. At the mine all the timbers in the raise had fallen down.

Plumas Eureka Mines, Inc. leased a portion of the operation and hauled slide rock and gravel from above the mill to a screening and washing plant. The company started a new 20 stamp mill operation in 1936. They trucked 40 tons per day from higher elevations to the mill. In 1943 a lessee recovered gold, silver and lead ore from the old tailings in the area. When mining ceased that year miners left around 62 miles of tunnels in Eureka Peak.

7. Museum Collection Objects

Various pieces of mine machinery and tools are either already on display or stored at various outdoor sites and indoor locations. These include hardrock mining equipment and tool types. Artifacts include photographs and ephemera related to mining and daily life in and around the mines. Hands-on use permits will be completed and approved for each collection object used in the tour.

It is intended that typical period mining equipment such as drills, drill bit stock, ore carts and manual tools should be displayed in the tunnel, in situ as they might be found in a working mine.

8. Off –site Related Resources

The Plumas County Museum, located in the nearby town of Quincy contains mine-related artifacts and ephemera including photographs. The town is located about 30 minutes north of the Park on Highway 70 west of Beckworth/Graeagle.

Sierra District Offices for the Museum Curators I and II and the District Interpretive Specialist are located at Sugar Pine Point State Park in Tahoma, California.

9. Park References

Within the Unit collection are several original historic mining maps, some reference mining reports, several mining journals and a small reference library. In addition, there are a few oral histories from former local residents. There are a few State Parks docents such as Mr. George Ross, Bob Schoensee, Keith Papke and Phil Reese who are knowledgeable about park history, geology, mining history and historic sites. The "Report on the Construction of the Eureka Mine Timber Sets…" by Judith Marvin, January 2002 is helpful.

10. Primary Topics

Hardrock Gold Mining
Geology
Life in the mines

11. Primary Themes

Tunnel Tour Themes:

It's a hard, hardrock miner's life.
An explanation of hardrock mining methods and the development of hardrock mining equipment.
How shafts and tunnels are constructed.
What adits, winzes, stopes and inclines are.
How and when gold was formed.
What the amalgamation process involves.

12 Visitor Participation Summary

Historically, several different approaches to interpretation have been utilized at the park including audio-visual programs, history walks, history talks, campfire programs, historic demonstrations and living history events. Programs are presented by permanent and seasonal DPR staff and trained volunteers (docents).

School groups take advantage of the docents and staff by participating in "Gold Story" activities. This program consists of several "stations" that smaller groups rotate through learning various aspects of mining history and lifestyles of the period.

The heaviest programming takes place during the summer months with special tours conducted during the spring and fall each year. Approximately 8 school group visits occur each year.

13. Site Plans – Refer to the Eureka Adit (Tunnel) Operations Plan

14. Interpretive Context

14.1 Pre-tour information

At the posted gathering place for the tours and/or at the location the tickets are sold the visitors will be reminded of the environmental conditions within the tunnel.

All visitors on tour will be required to wear secure closed heel and toe shoes (no bare feet, sandals, flip flops, high-heels, clogs, etc. will be permitted). They will be reminded the tunnel condition is normally damp to wet and that mud and dirt are constants. Footing may be slippery.

The temperature will be somewhere around 48 degrees and the length of time in the tunnel may require some people to have additional clothing for warmth (shirts must be worn, no bathing suits or other inappropriate attire may be worn).

The tour guide may exercise discretion and require people to wear appropriate clothing or dismiss them from the tour and authorize a refund for their tickets.

14.2 The guided tour

Tour size will be limited to 15 people inside the tunnel at any one time.

The group assembles across the parking lot and entry road from the park museum at the lawn area. Here, the tour guide gives the specifics of the program

such as logistics, length of program, disabled participants, claustrophobic concerns, adult supervision of children, comfort and safety issues.

The guide begins the interpretive component of the program by first discussing how gold came to be in this area, the geologic process involved in the formation of gold and the geology of the immediate area will be discussed. After this, the gold discovery is covered with a brief history of the various periods of mine operations leading up to the Eureka Adit construction. At the conclusion of this section, the guide directs the group to the dirt entrance road and from there up to the tunnel itself.

At the mine entrance the guide reviews some of the common terms used in describing mine workings. These include portal, set, adit, winze, drift, stope, incline, shoot, skip, face wall, powder charge, etc. Helmets and head lamps are checked, issued and properly fitted, and any last minute instructions are given prior to entering the portal.

Just within the entrance, the guide discusses set construction and reviews the terms of post, cap and lagging and other materials used in the method of constructing wooden sets. At the same time old timbering is pointed out and discussed, which gives the participants an appreciation for the historical significance.

Headlamps are turned on and re-checked as the group leaves the reinforced section and enters the hardrock portion of the shaft. Environmental factors are discussed such as air quality and temperature inside the tunnel. Just inside the hardrock area the group stops and reviews the various types of rock described. During this time the participants are adjusting to the darkness and their surroundings. This point in the program will be the most intriguing for the group as they first experience the excitement of being inside a mineshaft. The leader will evaluate visitors and watch for anyone feeling uncomfortable with the mine.

Walking further into the shaft, the next item of discussion involves periods and methods of portable lighting, drill steels, the drilling process, blasting process, and ore removal. Display and discussion objects include quartz chunks, a miner's candlestick, carbide lamp, various lengths of drill steel and a drill exhibited inside the shaft. A simulation of the drilling and blasting process is conducted.

At this point, the group is taken to the end of the shaft and there all headlamps are turned off with the exception of the tour guide's. Then, the guide recites a quotation or other pertinent emotional first-hand account related to mining made by a miner. The group is given a minute of silence (in the dark) to absorb the atmosphere, difficulty and intrigue of hardrock mining.

Next, the group retreats to the entrance, turns in their headlamps and are lead to the rear of the Mohawk Stamp Mill. Near the top level of the mill at or in the trestle a discussion of the milling operation and amalgamation process take place. From here the group is lead back to the park museum for the program conclusion.

An exhibit featuring ore cart tracks and an ore cart will be incorporated into the area to show how ore was moved from the adit to the mill.

15. Interpretive Special Events

It is anticipated that individual groups will request private tours and that those requests will be granted. In addition, on Living History days the tour pattern will be modified to accommodate the increased visitor attendance. Other special activities such as interpretation skill tours can be incorporated.

16. Staffing

For the most part, the tours will be conducted by docents (trained volunteers), seasonal park interpretive specialist and ranger staff. Appropriate training in the interpretive skills, tour mechanics, safety and the history of mining operations and techniques will be presented to the docents and staff as necessary.

17. Safety and Security

17.1 Communications

Two-way radios or other communications devices will be carried by all personnel guiding tours into the mine.

17.2 Lighting

Lighting will be provided in the form of battery operated two or three LED light head lamps mandatory for each individual in the tour.

17.3 Safety Equipment

First aid materials and equipment including bottled oxygen and a litter will be stocked and maintained in a ready mode within the tunnel at all times. Additional batteries and lamps will be carried by the tour guide and available at all times.

Headbands on safety helmets and lamps will be disinfected between each group using an approved liquid spray disinfectant and paper wipes. Two sets of safety helmets and lamps should be available so that a new set of helmets and lamps

are immediately available for the next tour as the headbands of the first set dry after disinfecting.

18. Funding

All revenue from tour fees will go to the Plumas-Eureka State Park Association. These fees will be used to fund tour guides positions and equipment needs such as new safety helmets, lamps, batteries, hand-held objects and other interpretive aids. Long term maintenance of the facility will be planned for, funded and conducted by DPR.

19. Special Considerations

The most obvious consideration will be accommodating disabled visitors. A fully disabled parking space is located near the adit. In addition, the walkway within the shaft will be wheel chair accessible and will include a turn around platform or space for maneuverability of a wheel chair. Proper grading of the path from the parking space, into the tunnel and then over to the Mohawk Stamp Mill trestle will be included.

A disabled accessible chemical toilet will be hidden inside a historically styled outbuilding. Other special uses of the shaft such as weddings, or company dinners, etc. will not be considered since they are incompatible with the intended interpretation, maintenance and safety considerations for visitors in the facility,

20. School Groups

School program guidelines and a teacher's guide will be developed as funding becomes available. The teachers guide will highlight the compatibility of the program with state educational content standards appropriate for each grade level (included at the end of this report). The guidelines will include pre-trip information about the natural, cultural and recreational history of the park a glossary of terminology as well as logistics information for pre-registration and arrival.

21. Interpretive Training

Interpretive, operational and first aid training will be necessary before any docents or staff may lead tours. DPR staff and seasoned Docents will conduct the training. Topics should include geology, historic mining methods, Plumas-Eureka S.P. mining operations history, interpretive techniques, and tour methods. It is anticipated that the training course would be given in the late spring and would involve up to several days of training.

22. Volunteer Interpreters

Guidelines outlined in the Volunteers in Parks VIP Program Manual will be followed.

23. Evaluation

Periodic evaluation of the tour procedures and interpretive information is necessary to maintaining a successful and effective program. Self-evaluation and visitor evaluation is always beneficial. The DPR "Rapport" evaluation process will be utilized regularly.

24. The Wayside Interpretive Panel Exhibits

The wayside Interpretive Panel Exhibits will consist of three panels exploring the rich cultural history of mining at Plumas Eureka State Park and the Eureka Mine. The panels will feature the highest quality interpretive graphics and text.

The panels will be made from high density, high pressure laminate with a graphic overlay. The panels will be displayed in the area of the Eureka Tunnel portal so they can be viewed when the tunnel is closed. They will be mounted on the wooden walls of the portal. Another of the panels will be displayed at the trestle of the Mohawk Mill and another below the mill. These two panels will be mounted on metal stands.

24.1 Miles of Tunnels led to Tons of Gold!

What life must have been like for those miners! The gold boom began here when a group of miners discovered gold on Eureka Peak in 1851. They created the Plumas Eureka Mining Company soon thereafter. They drilled and blasted over 30 miles of tunnels in Eureka Mountain, working in the lantern-lit dark with explosions ringing in their ears and soot covering their clothes. When mining stopped in the 1940's, over $20 million in gold had been carved out from this mountain.

Well the shaker said to John Henry,
"this mountain she's a cavin in."
John Henry said to his shaker man,
"ain't nothin' but my hammer suckin wind."

Miners drove the 4,800 feet of Eureka Tunnel in 1878 in mine carts, passing right through an unsuspected deposit of grade ore. Even with finding these new deposits, miners never mined the lower portion of Eureka Peak. Estimates are that there is about a half ounce of gold per ton of rock in that area. How many products do you use that come from mining?

Images:

Tom Opie, miner

24.2 Thar's Gold in Them Hills!

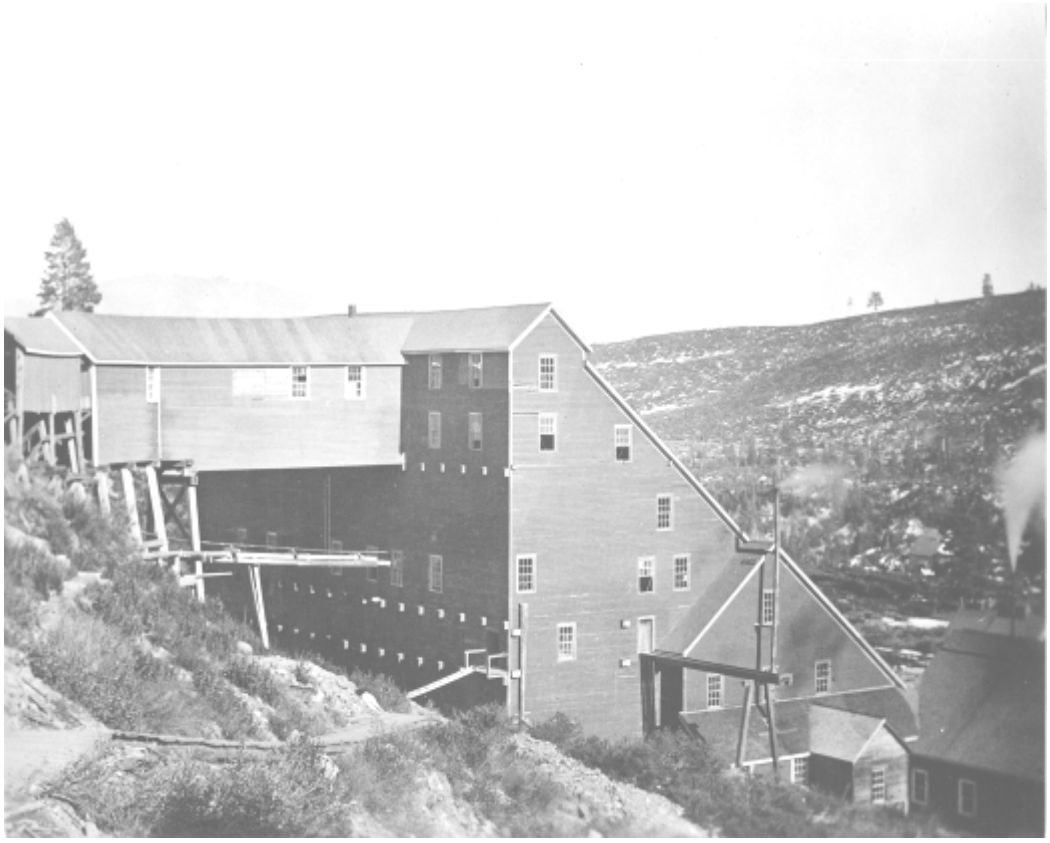
You might think the discovery of gold led to instant success, but that was not the case. Early miners lacked the capital to develop the mines. The Sierra Buttes Gold Mining Co. Ltd. bought the mines in the 1860's and developed them successfully. 326 men were on the Eureka Mills payroll by 1872. They worked year-round to extend tunnels, lay tracks for mule-drawn ore carts and to complete a sawmill.

The Mohawk Mill began operation in 1878, with power to run the mill coming solely from the nearby stream. The mill cost about $50,000 to build. It had 60 stamps, each of which could crush 21/2 tons of ore every 24 hours.

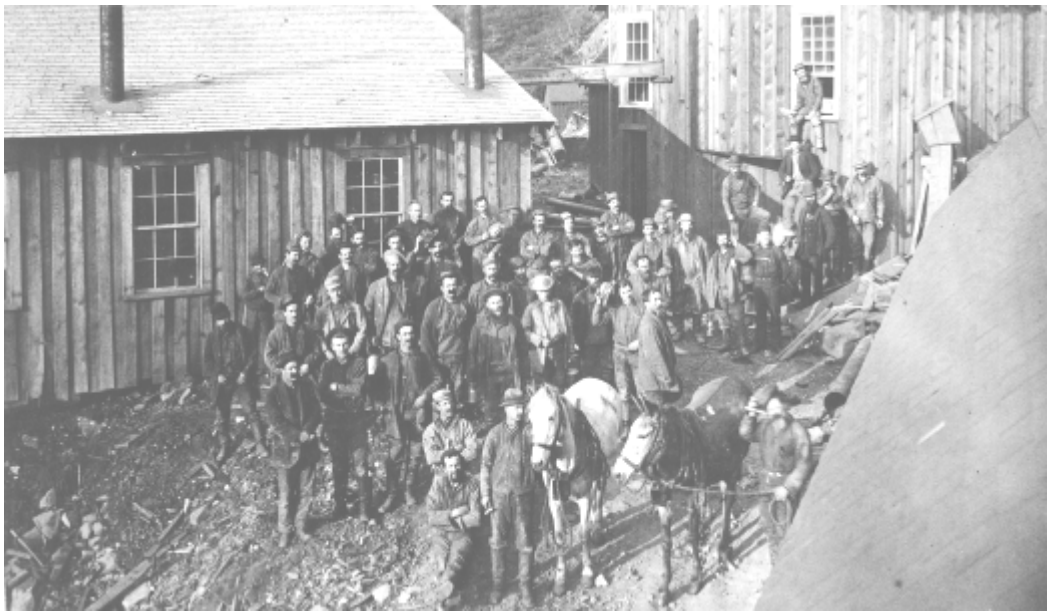
The stamps were very loud! People grew accustomed to the continuous din of milling. Suddenly the mills would go silent and people would rush to find out what happened. Why might the mills stop?

Images:

Mohawk Mill is in left center, tram from Mammoth Mine above, Eureka Mills is upper right, Daly City is right of Eureka Mills and Johnsville in center.



Mohawk Mill circa 1880's, note clear-cut hillsides, steam generator building on right side of photo



Eureka Mills, miners going to work

Eureka Mills, man standing on deck of boarding house.

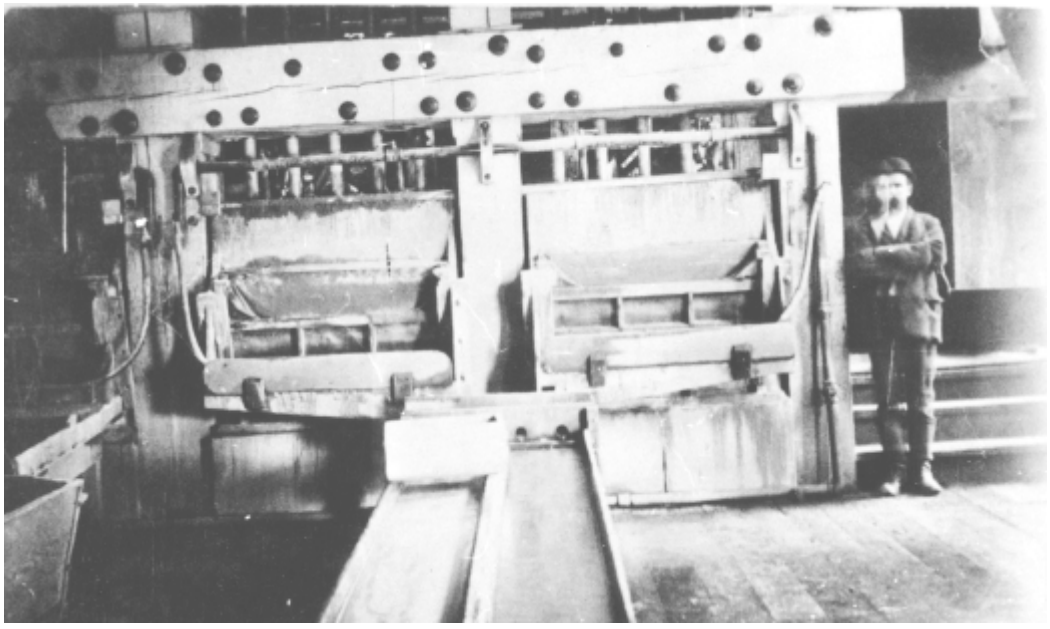


Photo below: Stamp battery in Eureka Mill.

24.3 Winter in the Sierra - A Struggle for Survival

Back in its hey-day Eureka Mills, high up on the mountainside, was primarily a family town. Jamison City, down near the creek, was the place for single miners to live. Life was difficult during winter months in this area. Much like today, people in the1870's endured many months of deep, heavy snow.

The mountainside took on quite a village appearance. There were two stores, a hotel with a saloon, two other saloons, a bootmaker's shop, livery stable and a few dwellings. People would often ride the empty ore carts back up the mountain to the townsite. After completion of the Mohawk Mill in 1878, Johnsville became the primary town for miners and their families.

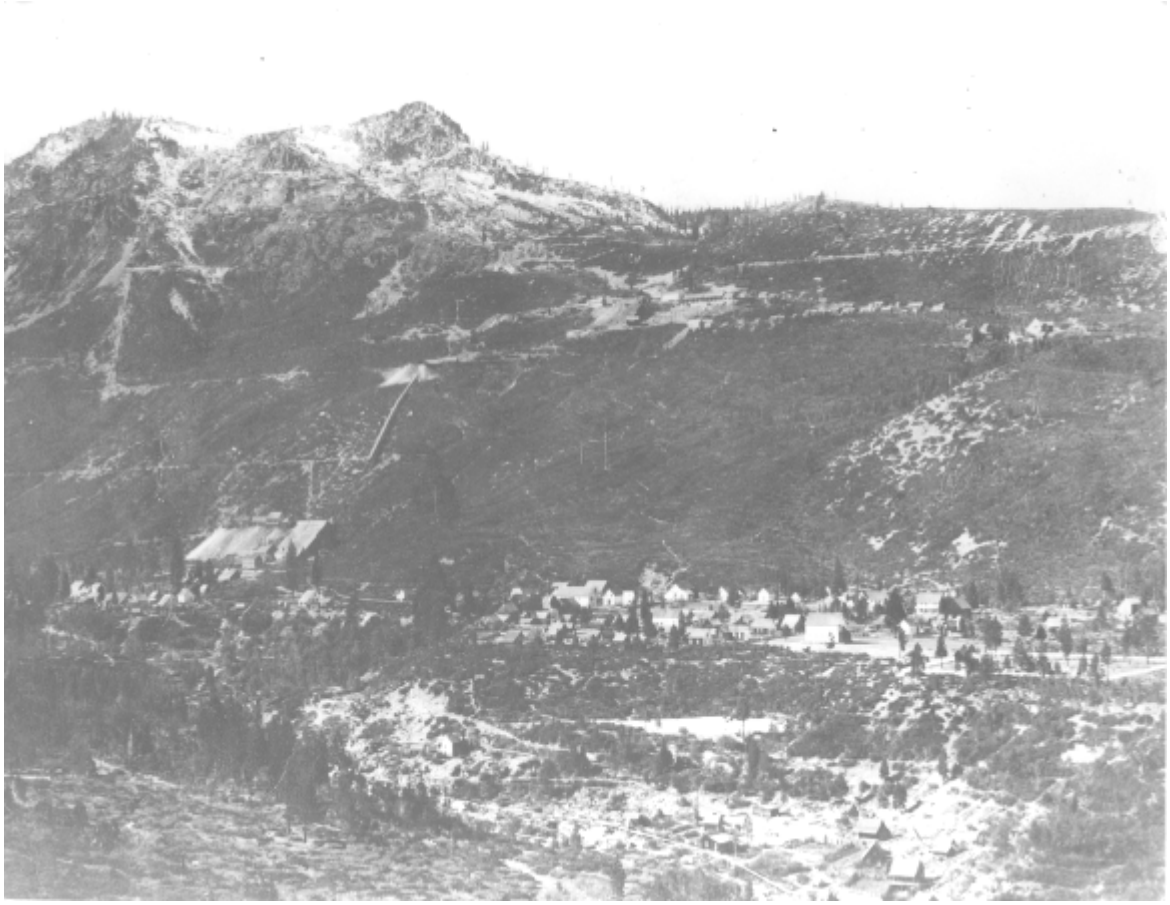
Have you ever gone cross-country skiing? How would you do on eight foot long, 15 pound wooden skis? Imagine busting through untracked, waist-deep snow, day after day, month after month, all the while wearing formal attire. How would you get to work or school? How would you get the groceries home?

Images:

Winter view overlooking Eureka Mills, Mammoth Mill is on the right. Note the ski tracks and longboard skis in the snow outside the buildings. Circa 1870

Ore cart trestle to the Mohawk Mill with the tram terminus building in background, aerial tram from the 76 mine... closed for the season

Fashionable attire for a social call on skis



After completion of the Mohawk Mill in 1878, Johnsville became the primary town for miners and their families.

Mines, Mills, Notations and Johnsville ca. 1890

24.4 Mother Nature Knows Best (Mohawk Mill, lower area)

The process developed to mill gold industrially copies natural erosion and gravity. It takes nature countless ages to deposit fine placer gold in mountain stream beds. In the 1870's mining and milling reduced that time to a few hours. 150 tons of rock could be processed inexpensively in one day.

Driven by gravity, just like an avalanche, the gold bearing ore begins its decent from inside the mines to the top of the mill.

Try to imagine a giant sieve. At the top of the mill rocks too large to pass through the bars of the grizzly must first be crushed to a smaller size.

A jaw crusher like the iron vice of glacial ice breaks rocks into smaller chunks that will fit through the grizzly and down into the stamps pounding below.

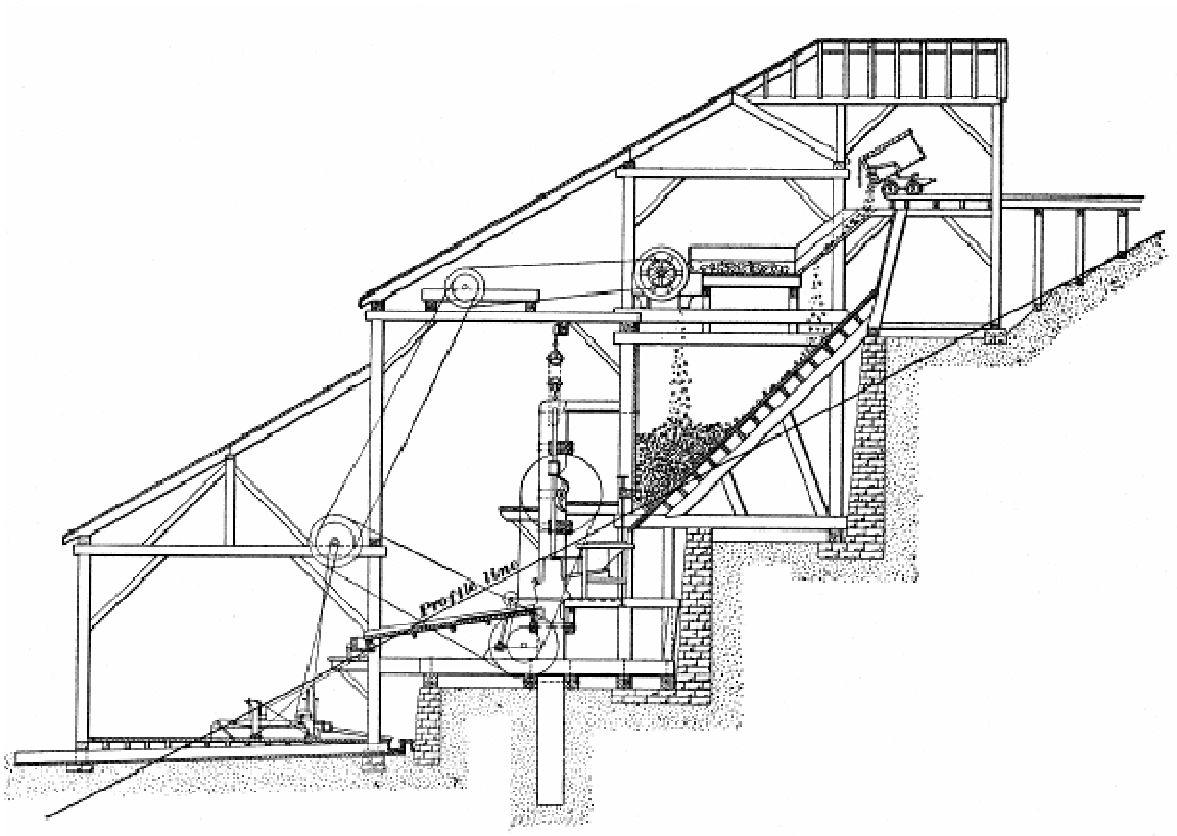
Five stamps in each of 20 stamp batteries do the back breaking work of thousands of miners swinging heavy hammers. The ore is pulverized into fine sand.

Stamped powder is combined with water and flows down over the amalgamating plates. Some gold naturally adheres to mercury painted on the copper plates.

Finally the slurry slides over concentrating tables with wooden riffles resembling a wavy stream bed. The last of the heavier gold particles settle out here.

The imposing building before you, known as the Mohawk Mill, often operated 24 hours each day and seven days every week. Imagine the danger of working 12 hours per shift inside the dust and noise of this mechanical avalanche.

Images



Profile view of typical stamp mill
Used with permission from The Mining Camps Speak, Sagstetter

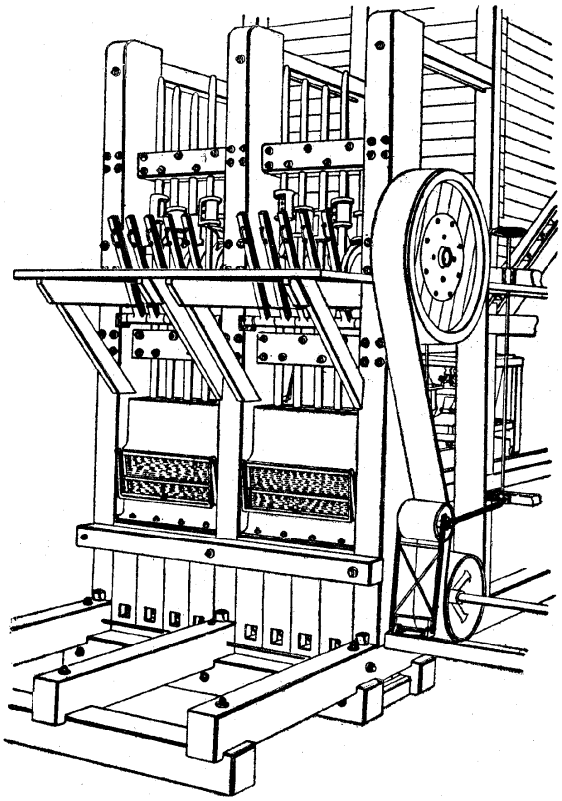
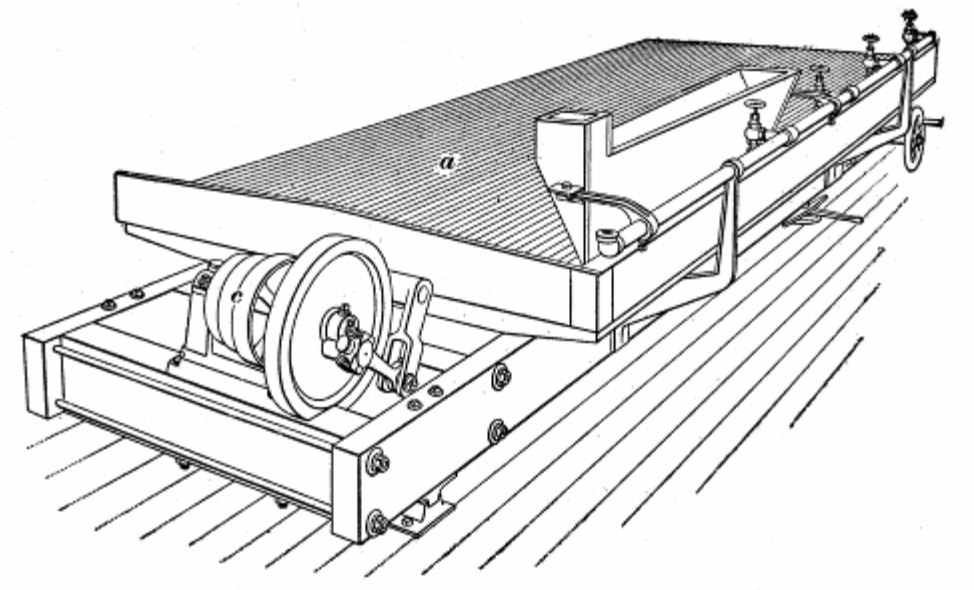


Illustration of two five-stamp batteries side by side, ten stamps total
Used with permission from The Mining Camps Speak, Sagstetter



Concentrating (shaker or Wilfey) table
Used with permission from The Mining Camps Speak, Sagstetter

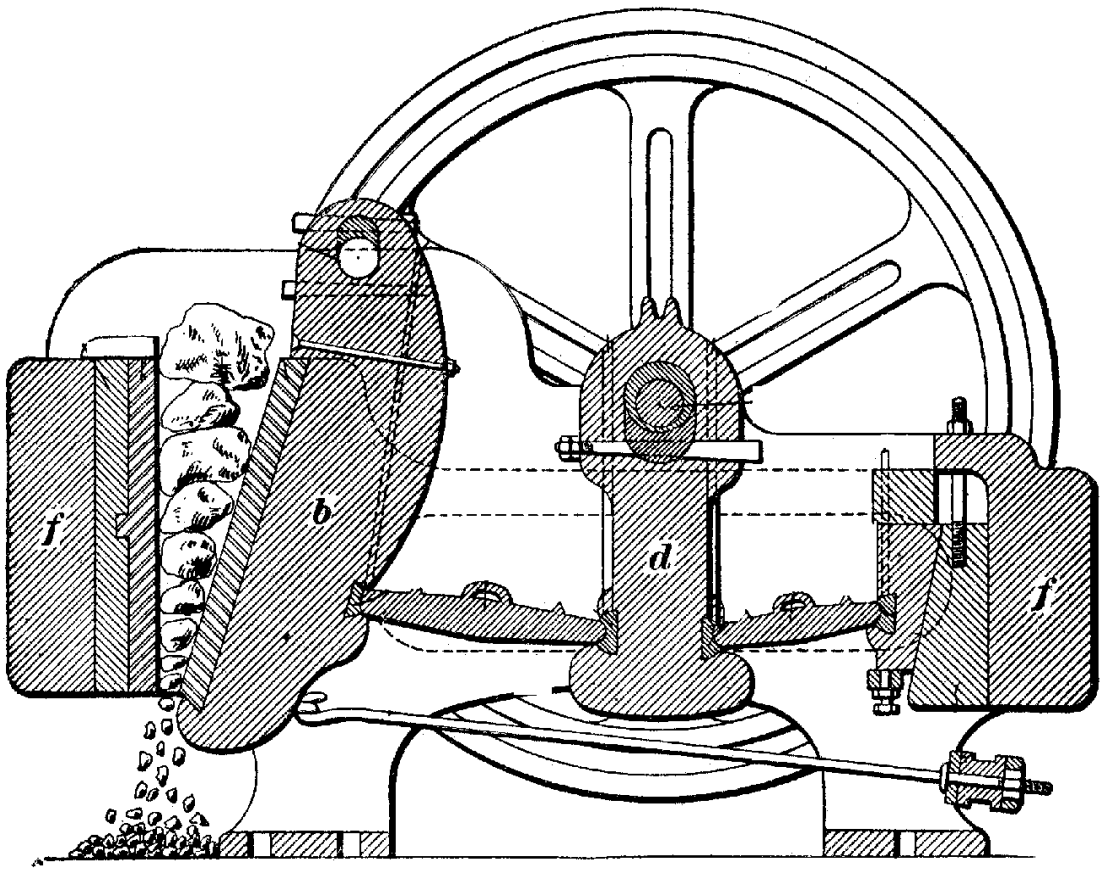


Illustration of jaw crusher crushing ore for stamping
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Applicable Content Standards - Science

Kindergarten

Physical Sciences

1. Properties of materials can be observed, measured, and predicted. As a basis for understanding this concept:

a. Students know objects can be described in terms of the materials they are made of (e.g., clay, cloth, paper) and their physical properties (e.g., color, size, shape, weight, texture, flexibility, attraction to magnets, floating, sinking).

b. Students know water can be a liquid or a solid and can be made to change back and forth from one form to the other.

c. Students know water left in an open container evaporates (goes into the air) but water in a closed container does not.

Life Sciences

3. Earth is composed of land, air, and water. As a basis for understanding this concept:

a. Students know characteristics of mountains, rivers, oceans, valleys, deserts, and local landforms.

c. Students know how to identify resources from Earth that are used in everyday life and understand that many resources can be conserved.

Investigation and Experimentation

4. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

a. Observe common objects by using the five senses.

b. Describe the properties of common objects.

c. Describe the relative position of objects by using one reference (e.g., above or below).

Physical Sciences

c. Students know the way to change how something is moving is by giving it a push or a pull. The size of the change is related to the strength, or the amount of force, of the push or pull.

d. Students know tools and machines are used to apply pushes and pulls (forces) to make things move.

e. Students know objects fall to the ground unless something holds them up.

GRADE TWO

Earth Sciences

3. Earth is made of materials that have distinct properties and provide resources for human activities. As a basis for understanding this concept:

a. Students know how to compare the physical properties of different kinds of rocks and know that rock is composed of different combinations of minerals.
b. Students know smaller rocks come from the breakage and weathering of larger rocks.
c. Students know that soil is made partly from weathered rock and partly from organic materials and that soils differ in their color, texture, capacity to retain water, and ability to support the growth of many kinds of plants.
d. Students know that fossils provide evidence about the plants and animals that lived long ago and that scientists learn about the past history of Earth by studying fossils.
e. Students know rock, water, plants, and soil provide many resources, including food, fuel, and building materials, that humans use.

c. Compare and sort common objects according to two or more physical attributes (e.g., color, shape, texture, size, weight).
g. Follow oral instructions for a scientific investigation.

GRADE THREE

Physical Sciences

c. Students know machines and living things convert stored energy to motion and heat.
d. Students know energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.
e. Students know matter has three forms: solid, liquid, and gas.
f. Students know evaporation and melting are changes that occur when the objects are heated.
g. Students know that when two or more substances are combined, a new substance may be formed with properties that are different from those of the original materials.

GRADE FOUR

4. The properties of rocks and minerals reflect the processes that formed them. As a basis for understanding this concept:

a. Students know how to differentiate among igneous, sedimentary, and metamorphic rocks by referring to their properties and methods of formation (the rock cycle).
b. Students know how to identify common rock-forming minerals (including quartz, calcite, feldspar, mica, and hornblende) and ore minerals by using a table of diagnostic properties.

5. Waves, wind, water, and ice shape and reshape Earth's land surface. As a basis for understanding this concept:

a. Students know some changes in the earth are due to slow processes, such as erosion, and some changes are due to rapid processes, such as landslides, volcanic eruptions, and earthquakes.
b. Students know natural processes, including freezing and thawing and the growth of roots, cause rocks to break down into smaller pieces.
c. Students know moving water erodes landforms, reshaping the land by taking it away from some places and depositing it as pebbles, sand, silt, and mud in other places (weathering, transport, and deposition).

GRADE FIVE

Physical Sciences

1. Elements and their combinations account for all the varied types of matter in the world. As a basis for understanding this concept:

c. Students know metals have properties in common, such as high electrical and thermal conductivity. Some metals, such as aluminum (Al), iron (Fe), nickel (Ni), copper (Cu), silver (Ag), and gold (Au), are pure elements; others, such as steel and brass, are composed of a combination of elemental metals.

6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.

GRADE SIX

Shaping Earth's Surface

2. Topography is reshaped by the weathering of rock and soil and by the transportation and deposition of sediment. As a basis for understanding this concept:

a. Students know water running downhill is the dominant process in shaping the landscape, including California's landscape.
b. Students know rivers and streams are dynamic systems that erode, transport sediment, change course, and flood their banks in natural and recurring patterns.
c. Students know beaches are dynamic systems in which the sand is supplied by rivers and moved along the coast by the action of waves.
d. Students know earthquakes, volcanic eruptions, landslides, and floods change human and wildlife habitats.

GRADE SEVEN

4. Evidence from rocks allows us to understand the evolution of life on Earth. As a basis for understanding this concept:

a. Students know Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.
b. Students know the history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impacts of asteroids.
c. Students know that the rock cycle includes the formation of new sediment and rocks and that rocks are often found in layers, with the oldest generally on the bottom.
d. Students know that evidence from geologic layers and radioactive dating indicates Earth is approximately 4.6 billion years old and that life on this planet has existed for more than 3 billion years.

GRADES NINE THROUGH TWELVE—EARTH SCIENCES

California Geology

The geology of California underlies the state's wealth of natural resources as well as its natural hazards. As a basis for understanding this concept:

a. Students know the resources of major economic importance in California and their relation to California's geology.

Applicable Content Standards - History

KINDERGARTEN THROUGH GRADE FIVE

Historical and Social Sciences Analysis Skills

The intellectual skills noted below are to be learned through, and applied to, the content standards for kindergarten through grade five. They are to be assessed only in conjunction with the content standards in kindergarten through grade five. In addition to the standards for kindergarten through grade five, students demonstrate the following intellectual, reasoning, reflection, and research skills:

Chronological and Spatial Thinking

1. Students place key events and people of the historical era they are studying in a chronological sequence and within a spatial context; they interpret time lines.
2. Students correctly apply terms related to time, including past, present, future, decade, century, and generation.
3. Students explain how the present is connected to the past, identifying both similarities and differences between the two, and how some things change over time and some things stay the same.
4. Students use map and globe skills to determine the absolute locations of places and interpret information available through a map's or globe's legend, scale, and symbolic representations.
5. Students judge the significance of the relative location of a place (e.g., proximity to a harbor, on trade routes) and analyze how relative advantages or disadvantages can change over time.

Research, Evidence, and Point of View

1. Students differentiate between primary and secondary sources.

2. Students pose relevant questions about events they encounter in historical documents, eyewitness accounts, oral histories, letters, diaries, artifacts, photographs, maps, artworks, and architecture.

3. Students distinguish fact from fiction by comparing documentary sources on historical figures and events with fictionalized characters and events.

Historical Interpretation

1. Students summarize the key events of the era they are studying and explain the historical contexts of those events.
2. Students identify the human and physical characteristics of the places they are studying and explain how those features form the unique character of those places.

3. Students identify and interpret the multiple causes and effects of historical events.
4. Students conduct cost-benefit analyses of historical and current events.

KINDERGARTEN

Learning and Working Now and Long Ago

Students in kindergarten are introduced to basic spatial, temporal, and causal relationships, emphasizing the geographic and historical connections between the world today and the world long ago. The stories of ordinary and extraordinary people help describe the range and continuity of human experience and introduce the concepts of courage, self-control, justice, heroism, leadership, deliberation, and individual responsibility. Historical empathy for how people lived and worked long ago reinforces the concept of civic behavior: how we interact respectfully with each other, following rules, and respecting the rights of others.

2. Learn examples of honesty, courage, determination, individual responsibility, and patriotism in American and world history from stories and folklore.

Students compare and contrast the locations of people, places, and environments and describe their characteristics.

Determine the relative locations of objects using the terms near/far, left/right, and behind/in front.

Students understand that history relates to events, people, and places of other times.

Understand how people lived in earlier times and how their lives would be different today (e.g., getting water from a well, growing food, making clothing, having fun, forming organizations, living by rules and laws).

A Child's Place in Time and Space

Students in grade one continue a more detailed treatment of the broad concepts of rights and responsibilities in the contemporary world. The classroom serves as a microcosm of society in which decisions are made with respect for individual responsibility, for other people, and for the rules by which we all must live: fair play, good sportsmanship, and respect for the rights and opinions of others. Students examine the geographic and economic aspects of life in their own neighborhoods and compare them to those of people long ago. Students explore the varied backgrounds of American citizens and learn about the symbols, icons, and songs that reflect our common heritage.

4. Describe how location, weather, and physical environment affect the way people live, including the effects on their food, clothing, shelter, transportation, and recreation.

GRADE ONE

Students compare and contrast everyday life in different times and places around the world and recognize that some aspects of people, places, and things change over time while others stay the same.

1. Examine the structure of schools and communities in the past.
2. Study transportation methods of earlier days.
3. Recognize similarities and differences of earlier generations in such areas as work (inside and outside the home), dress, manners, stories, games, and festivals, drawing from biographies, oral histories, and folklore.

Students describe the human characteristics of familiar places and the varied backgrounds of American citizens and residents in those places.

1. Recognize the ways in which they are all part of the same community, sharing principles, goals, and traditions despite their varied ancestry; the forms of diversity in their school and community; and the benefits and challenges of a diverse population.
3. Compare the beliefs, customs, ceremonies, traditions, and social practices of the varied cultures, drawing from folklore.

Students understand basic economic concepts and the role of individual choice in a free-market economy.

1. Understand the concept of exchange and the use of money to purchase goods and services.
2. Identify the specialized work that people do to manufacture, transport, and market goods and services and the contributions of those who work in the home.

GRADE TWO

People Who Make a Difference

Students in grade two explore the lives of actual people who make a difference in their everyday lives and learn the stories of extraordinary people from history whose achievements have touched them, directly or indirectly. The study of contemporary people who supply goods and services aids in understanding the complex interdependence in our free-market system.

Students differentiate between things that happened long ago and things that happened yesterday.

4. Compare and contrast basic land use in urban, suburban, and rural environments in California.

Students understand basic economic concepts and their individual roles in the economy and demonstrate basic economic reasoning skills.

2. Understand the role and interdependence of buyers (consumers) and sellers (producers) of goods and services.
3. Understand how limits on resources affect production and consumption (what to produce and what to consume).

Students understand the importance of individual action and character and explain how heroes from long ago and the recent past have made a difference in others' lives.

Continuity and Change

Students in grade three learn more about our connections to the past and the ways in which particularly local, but also regional and national, government and traditions have developed and left their marks on current society, providing common memories. Emphasis is on the physical and cultural landscape of California

Students describe the physical and human geography and use maps, tables, graphs, photographs, and charts to organize information about people, places, and environments in a spatial context.

1. Identify geographical features in their local region (e.g., deserts, mountains, valleys, hills, coastal areas, oceans, lakes).
2. Trace the ways in which people have used the resources of the local region and modified the physical environment (e.g., a dam constructed upstream changed a river or coastline).

GRADE THREE

Students draw from historical and community resources to organize the sequence of local historical events and describe how each period of settlement left its mark on the land.

2. Describe the economies established by settlers and their influence on the present-day economy, with emphasis on the importance of private property and entrepreneurship.
3. Trace why their community was established, how individuals and families contributed to its founding and development, and how the community has changed over time, drawing on maps, photographs, oral histories, letters, newspapers, and other primary sources.

Students demonstrate basic economic reasoning skills and an understanding of the economy of the local region.

1. Describe the ways in which local producers have used and are using natural resources, human resources, and capital resources to produce goods and services in the past and the present.

2. Understand that some goods are made locally, some elsewhere in the United States, and some abroad.
3. Understand that individual economic choices involve trade-offs and the evaluation of benefits and costs.
4. Discuss the relationship of students' "work" in school and their personal human capital.

California: A Changing State

Students learn the story of their home state, unique in American history in terms of its vast and varied geography, its many waves of immigration beginning with pre-Columbian societies, its continuous diversity, economic energy, and rapid growth

Students demonstrate an understanding of the physical and human geographic features that define places and regions in California.

4. Identify the locations of the Pacific Ocean, rivers, valleys, and mountain passes and explain their effects on the growth of towns.
5. Use maps, charts, and pictures to describe how communities in California vary in land use, vegetation, wildlife, climate, population density, architecture, services, and transportation.

Students explain the economic, social, and political life in California from the establishment of the Bear Flag Republic through the Gold Rush and the granting of statehood.

Students explain how California became an agricultural and industrial power, tracing the transformation of the California economy and its political and cultural development since the 1850s.

2. Explain how the Gold Rush transformed the economy of California, including the types of products produced and consumed, changes in towns (e.g., Sacramento, San Francisco), and economic conflicts between diverse groups of people.
3. Discuss immigration and migration to California between 1850 and 1900, including the diverse composition of those who came; the countries of origin and their relative locations; and conflicts and accords among the diverse groups.

Historical and Social Sciences Analysis Skills

The intellectual skills noted below are to be learned through, and applied to, the content standards for grades six through eight. They are to be assessed only in conjunction with the content standards in grades six through eight. In addition to the standards for grades six through eight, students demonstrate the following intellectual reasoning, reflection, and research skills:

Chronological and Spatial Thinking

1. Students explain how major events are related to one another in time.
2. Students construct various time lines of key events, people, and periods of the historical era they are studying.
3. Students use a variety of maps and documents to identify physical and cultural features of neighborhoods, cities, states, and countries and to explain the historical migration of people, expansion and disintegration of empires, and the growth of economic systems.

Research, Evidence, and Point of View

1. Students frame questions that can be answered by historical study and research.
2. Students distinguish fact from opinion in historical narratives and stories.
3. Students distinguish relevant from irrelevant information, essential from incidental information, and verifiable from unverifiable information in historical narratives and stories.
4. Students assess the credibility of primary and secondary sources and draw sound conclusions from them.
5. Students detect the different historical points of view on historical events and determine the context in which the historical statements were made (the questions asked, sources used, author's perspectives).

Historical Interpretation

1. Students explain the central issues and problems from the past, placing people and events in a matrix of time and place.
2. Students understand and distinguish cause, effect, sequence, and correlation in historical events, including the long- and short-term causal relations.
3. Students explain the sources of historical continuity and how the combination of ideas and events explains the emergence of new patterns.
4. Students recognize the role of chance, oversight, and error in history.
5. Students recognize that interpretations of history are subject to change as new information is uncovered.
6. Students interpret basic indicators of economic performance and conduct cost-benefit analyses of economic and political issues.

GRADE EIGHT

Students analyze the divergent paths of the American people from 1800 to the mid-1800s and the challenges they faced, with emphasis on the Northeast.

1. Discuss the influence of industrialization and technological developments on the region, including human modification of the landscape and

how physical geography shaped human actions (e.g., growth of cities, deforestation, farming, mineral extraction).

Students analyze the divergent paths of the American people in the West from 1800 to the mid-1800s and the challenges they faced.

Students analyze the transformation of the American economy and the changing social and political conditions in the United States in response to the Industrial Revolution.

1. Trace patterns of agricultural and industrial development as they relate to climate, use of natural resources, markets, and trade and locate such development on a map.

References

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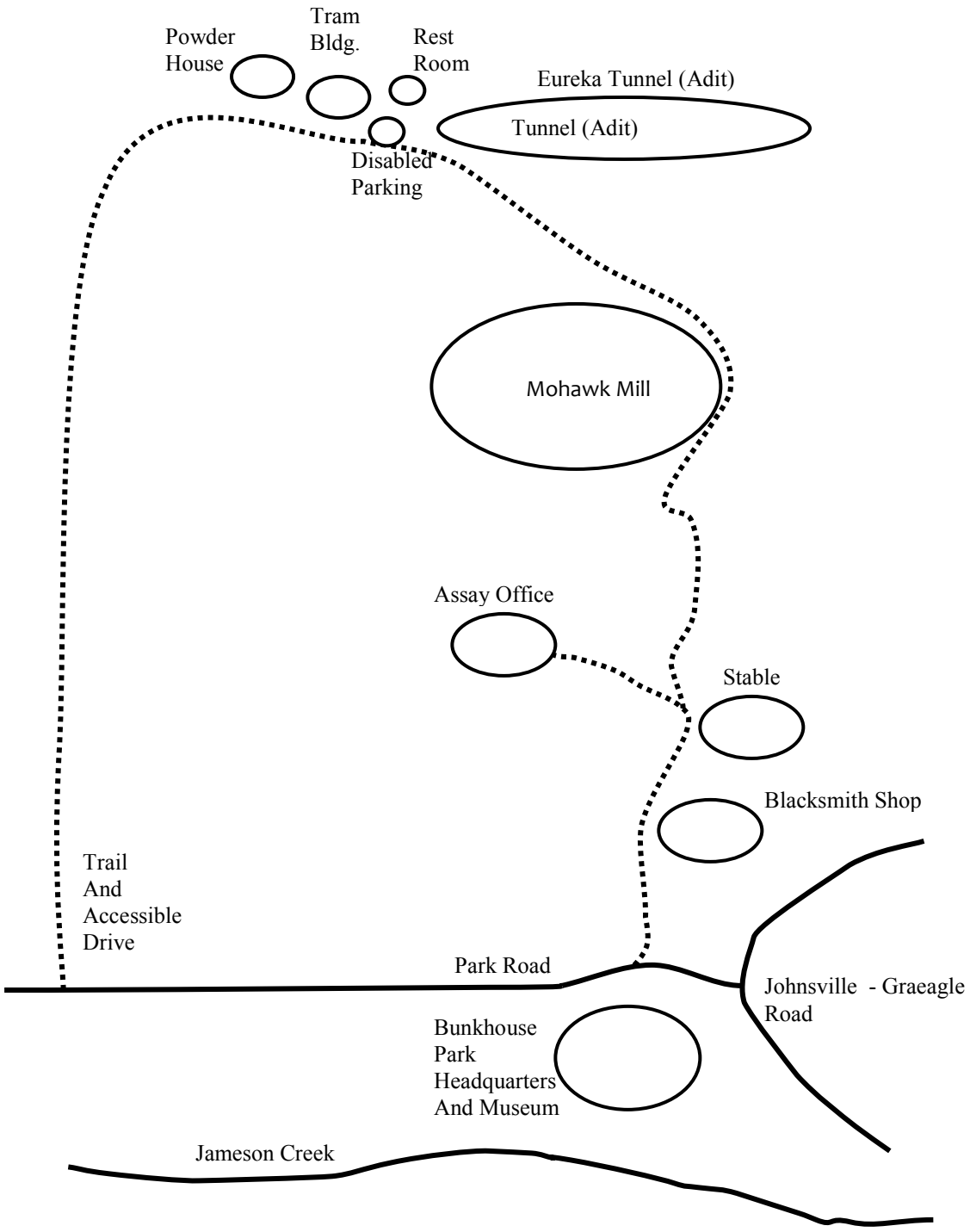
The Mining Camps Speak, Beth and Bill Sagstetter, Benchmark Publishing, Denver, Colorado, 1998

Bubble Diagram Plumas Eureka State Park Museum, Mill, Tunnel Area



1 Inch equals approximately 200 feet