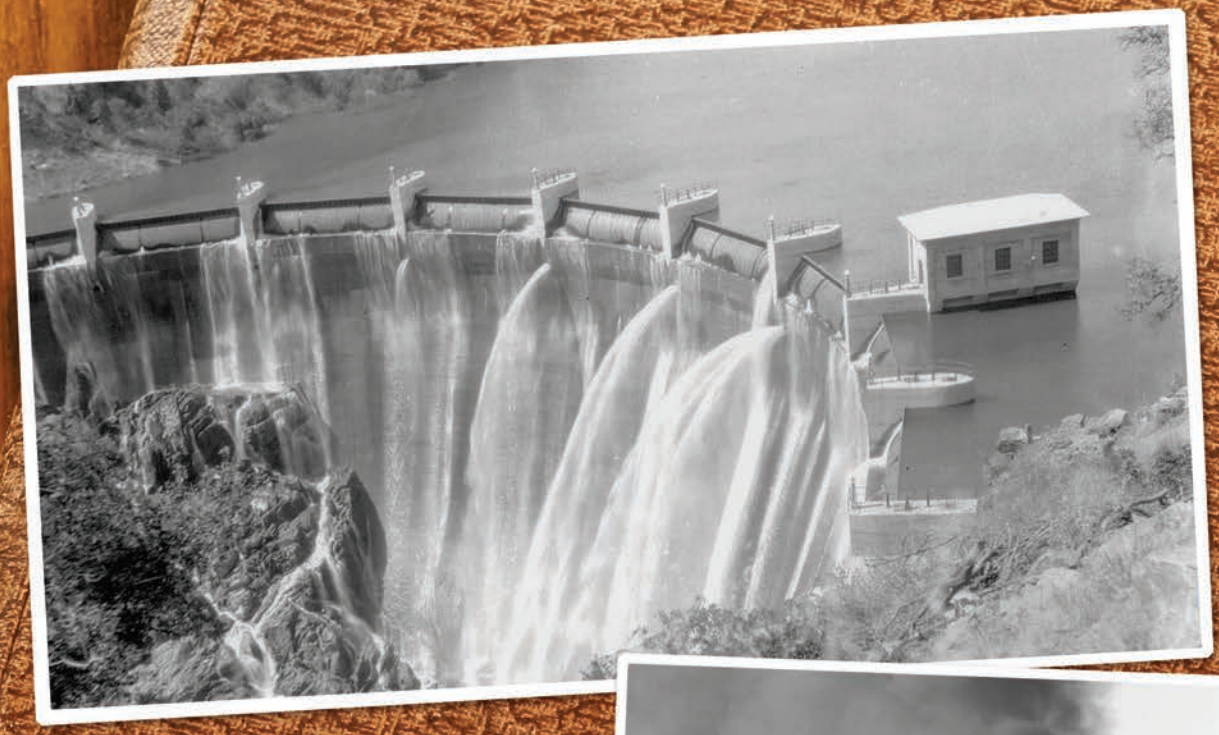
Name: _____

The Sierra Railway and Natural Systems

Grade 5 Student Workbook



Railtown 1897 State Historic Park

5th Grade Unit Plan: The Sierra Railway and Natural Systems

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Yosemite Sugar Pine Railroad at Crocker Ridge photo courtesy of Sierra Nevada Logging Museum
Railtown No. 3 steam photo courtesy of California State Railroad Museum

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Questions about this instructional unit should be directed to:
Railtown 1897 State Historic Park, 18115 5th Ave, Jamestown, CA 95327

Lesson 1: In Search of Lumber

August 19, 1899, morning

Dear Diary:

My name is Louise, and I am 10 years old. My brother, William, is 12 years old. Last week we moved to Jamestown, California from New York. New York is on the East Coast of the United States. We are so excited to learn about our new home! Our mother, Phoebe, gave us this diary to write down our thoughts and what we learn. We can also cut photographs and articles from the newspaper and put them in our diary. This is Jamestown where we live. The buildings are made of wood.

There is a train station in our town. It is the Sierra Railway depot. We can take the Sierra Railway train to other towns in the area. Some day maybe we'll explore other towns like Oakdale or Sonora. A train depot has been built in Carters/Summersville. Soon the train will travel there too.

Our father, Samuel, moved here months before we did. He bought our house in Jamestown. He has been fixing it for us so it's comfortable. Our house is made of wood. Father tried to fix our door but he couldn't. We need a new one. Today we are going to the lumberyard to buy wood to make a new door.

We'll write soon,

Louise and William

Downtown Jamestown

Photo courtesy of Tuolumne County Historical Society

August 19, 1899, afternoon

Dear Diary:

The lumberyard was fun! We helped Father choose the wood for our door. This is what a lumberyard looks like.

There are a lot of wood planks stacked high!

After our visit to the lumberyard we had many questions. We asked our father:

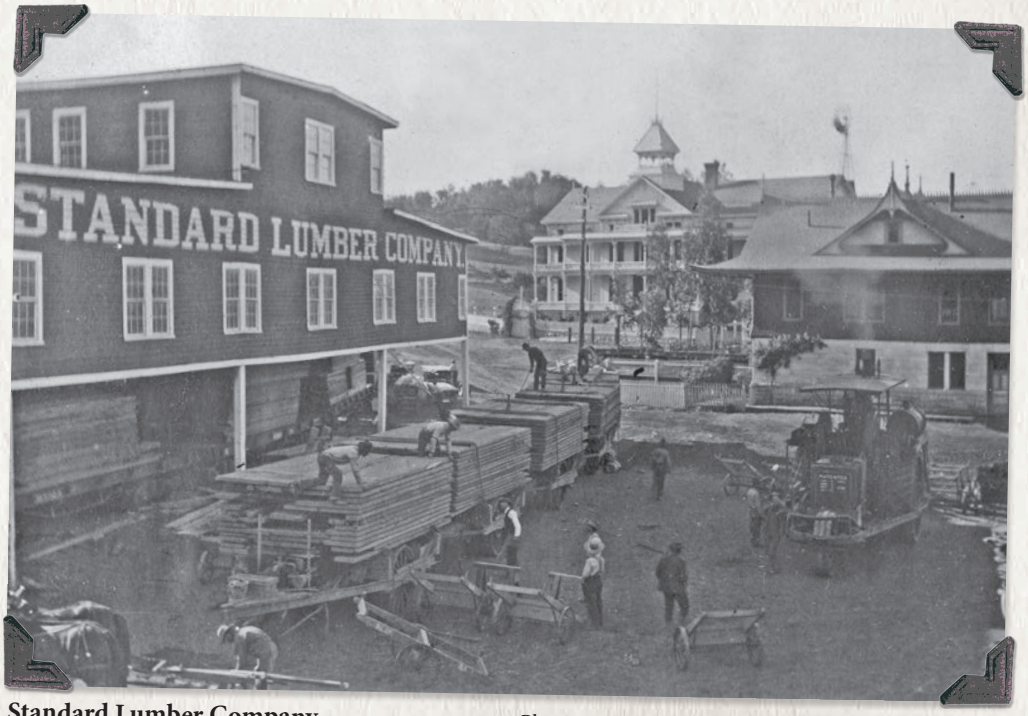
"Where did all this lumber come from?" and "How did it get here?"

He told us that if we help him make and hang the door, we could visit a sawmill. He said this is where big trees get cut into the planks we saw at the lumberyard. We learned in school that trees are an example of natural resources. So are water and minerals. People use these resources from nature in different ways. For instance, our house is made of wood. Father works in a mine to extract, or take out, minerals. This is how he makes money. The minerals are sold to other people. Those minerals are also called ecosystem goods. They help support Jamestown's economy. They also support our family. These ecosystem goods are essential, or necessary, for us in Jamestown.

We can't wait to go to the sawmill!

We'll write soon,

Louise and William



Standard Lumber Company

Photo courtesy of Tuolumne County Historical Society

August 27, 1899

Dear Diary:

Guess what? We helped Father with the door last Sunday, so yesterday he took us to a sawmill. It was amazing to see big logs cut into planks. We found a photograph of what we saw. The machines used to cut the trees are loud and have sharp blades! Now we have more questions we hope Father can answer. We want to know how lumber is transported to towns in the area. We also want to know where the trees come from. And, finally, we want to know how much lumber comes out of one tree.

Our mother is calling us for dinner.

We'll write soon,

Louise and William

Interior of Sawmill
Photo courtesy of Tuolumne County Historical Society

What I've Learned about the Search for Lumber

In the spaces below, answer the three questions.

1. Define the word natural resources.

2. Louise and William said their house is made of wood. Where does wood used for construction come from? How do you know this?

3. Describe how trees are a natural resource that provides an essential good to communities.

Louise and William's Diary

March 17, 1900

Dear Diary:

Father promised us that he would take us to the roundhouse to learn how a steam locomotive works. But then we got busy with school and the holidays. Now it is March! Today is Saturday. Our parents finally have time to take us to the Sierra Railway roundhouse in Jamestown.

We are excited to talk to the train engineers. Months ago Father explained the Sierra Railway transports timber, ores, and other ecosystem goods throughout the region. It is a very important railroad!

We are excited to visit the roundhouse and learn about steam locomotives.

We'll write soon,

Louise and William

Sierra Railway Roundhouse
Photo courtesy of Jennifer Rigby

What I've Learned about Steam Matters

In the spaces below, complete the tasks.

1. Develop an initial model to describe that matter is made of particles too small to be seen.

_____

_____

_____

_____

_____

_____

2. Create a diagram showing that matter is conserved in the process of the functioning of a steam engine.

Lesson 3: The Forest from the Trees

July 21, 1900

Dear Diary:

On February 1, 1900, the Sierra Railway track reached Carters/Summersville. This town is in the foothills of the Eastern Sierra. There are huge forests nearby. Lumber companies are harvesting trees from those forests. The lumberjacks cut down trees. Then they transport them to a sawmill, like the one we saw in the fall. Once the wood planks are ready to be sold, they are transported to the lumberyard. The lumberyard is where we went to buy wood to make our new door.

Remember months ago we asked Father where the trees come from? Well, this weekend we are visiting our uncle Joshua who is a lumberjack! We are seeing where the trees come from.

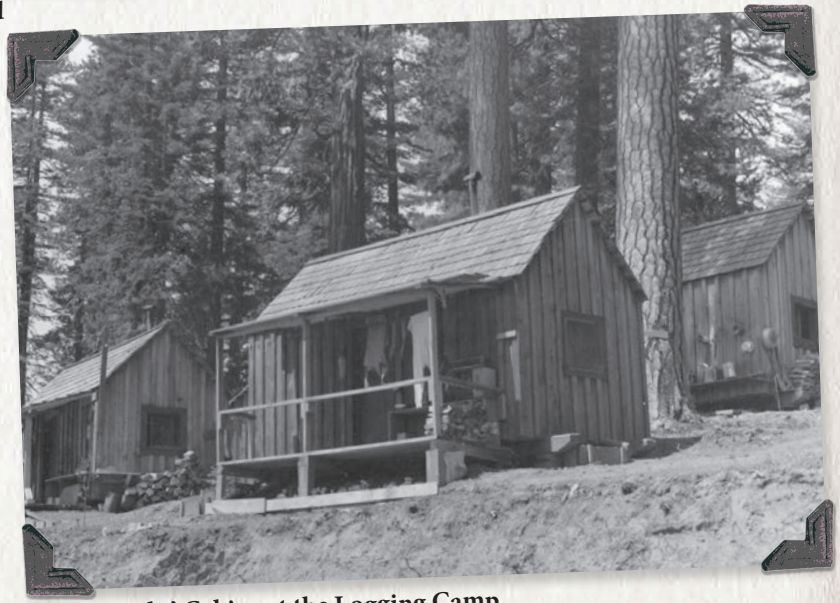
We are spending the weekend at the camp in the forest where our uncle Joshua lives and works.

We got to watch him cut down trees that will be made into lumber.

Yosemite Sugar Pine Railroad at Crocker Ridge
Photo courtesy of Sierra Nevada Logging Museum

We asked him questions about the machines they use to cut the trees. We also asked him how much wood comes from each tree.

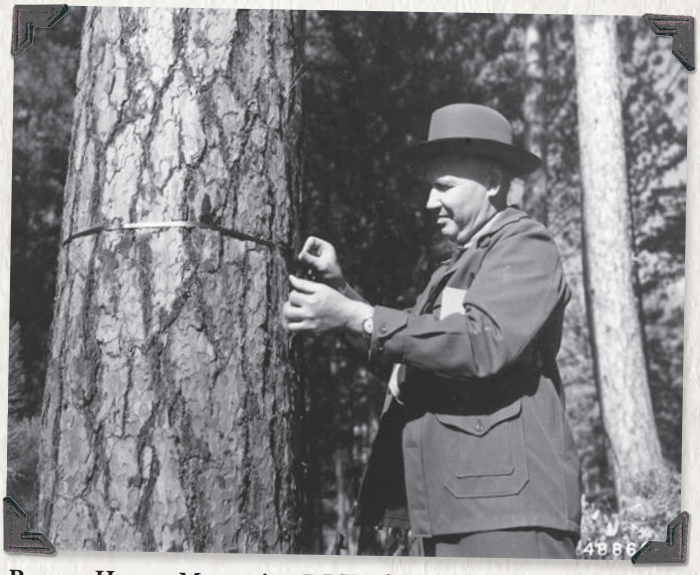
Uncle Joshua explained that wood is sold in a unit of measurement called board-foot. This is the volume of wood



Lumberjacks' Cabins at the Logging Camp
Photo courtesy of Sierra Nevada Logging Museum

in a 12 inch x 12 inch x 1 inch piece of wood, or 144 cubic inches. To calculate how many board-foot units are in a standing tree, two measurements need to be made. The diameter at breast height (DBH), in inches, of the tree is measured. Breast height is four and one-half feet above the ground.

The height, in feet, of the tree is also measured. There are many different ways to measure the height of a tree.



Ranger Hamm Measuring DBH of a Large Pine, 1958
U.S. Forest Service, Eastern Region. Photograph courtesy of the Forest History Society, Durham, NC

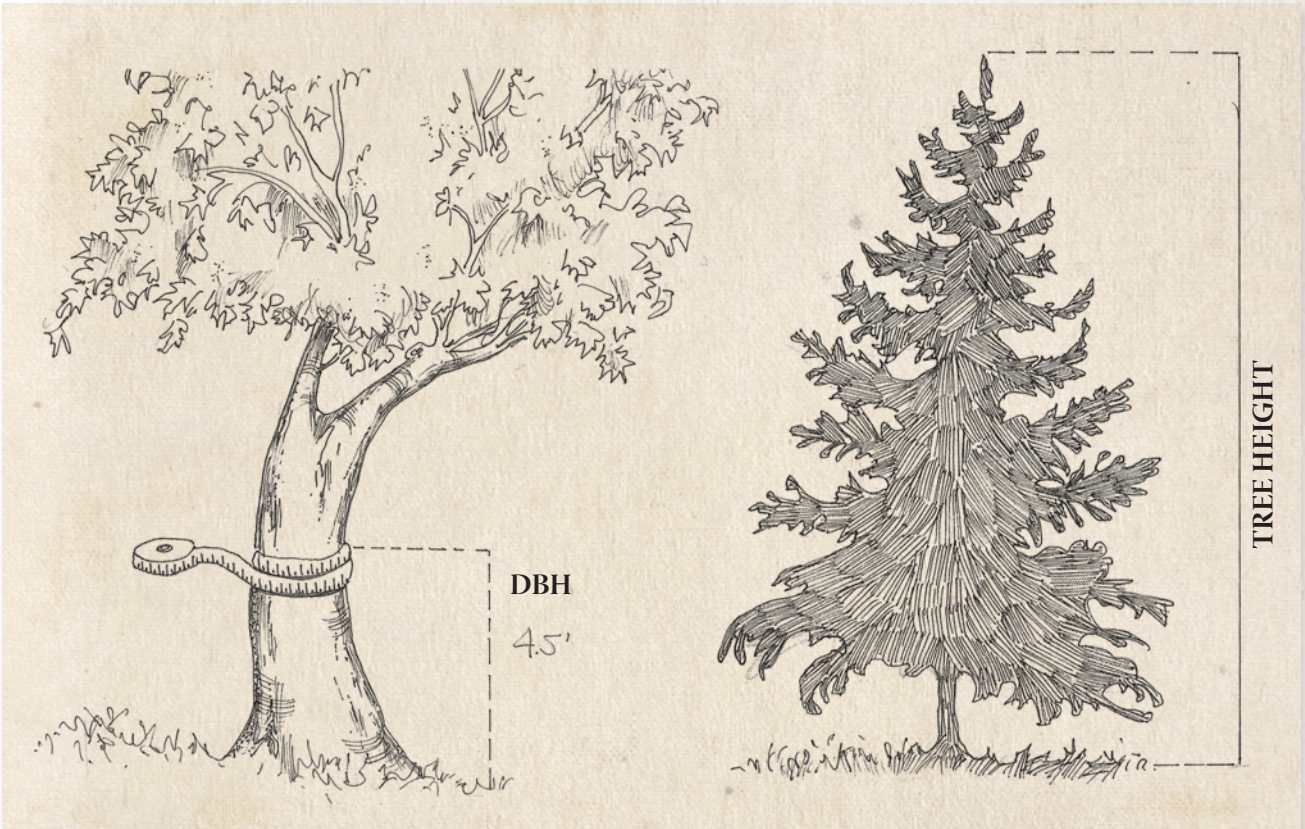


Illustration by Julia Rigby

Another way to measure the height of the tree is by using a tool called a clinometer.

Once you know the height and DBH of the tree, you can use a formula to calculate how many board-foot units are in a tree. The problem is, not every type of tree has the same shape or form! And trees have different bark. Some types of trees have a very thick bark. Other types of trees have a thin bark. The bark is not used to make lumber. This means there are many different formulas to calculate board feet in a tree. Scientists have developed charts based on the calculations. But there are many different

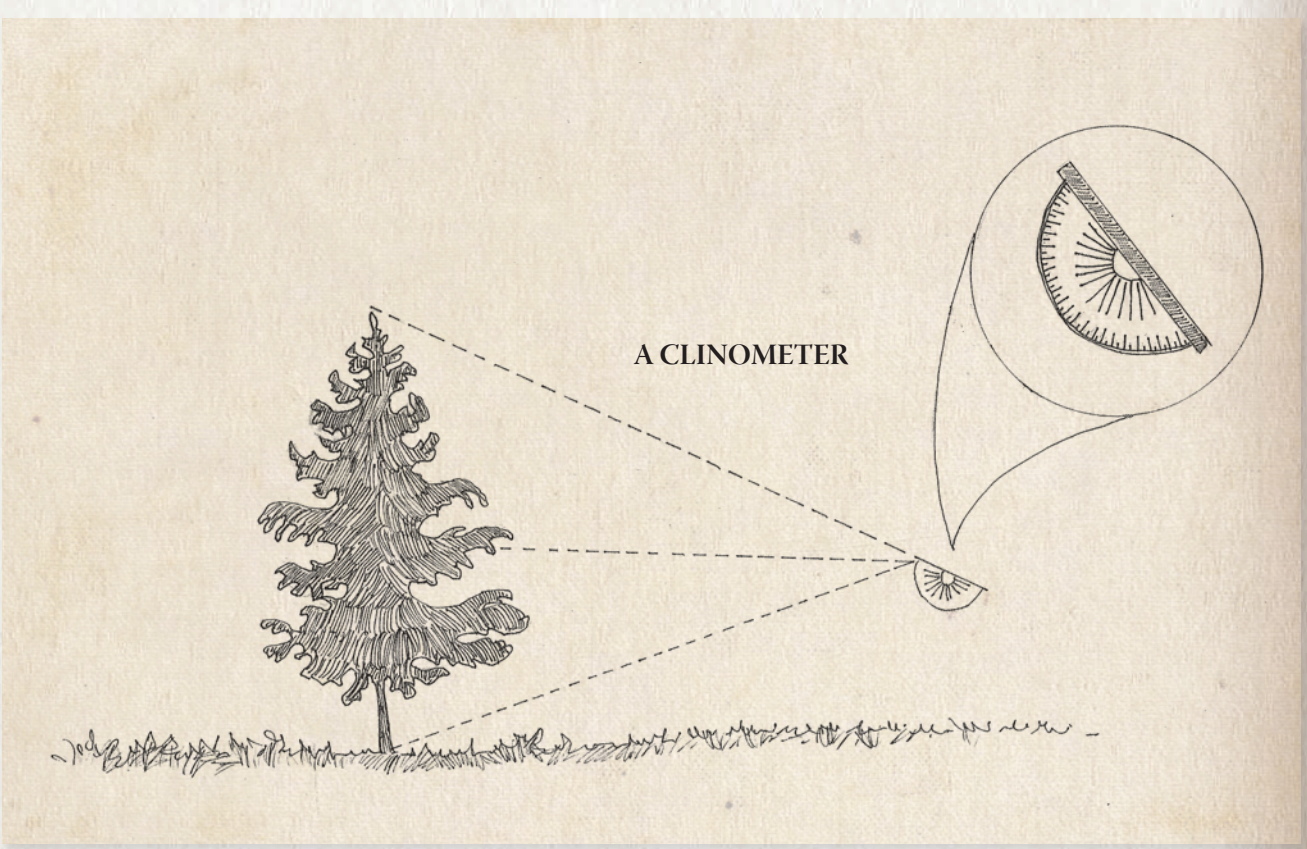


Illustration by Julia Rigby

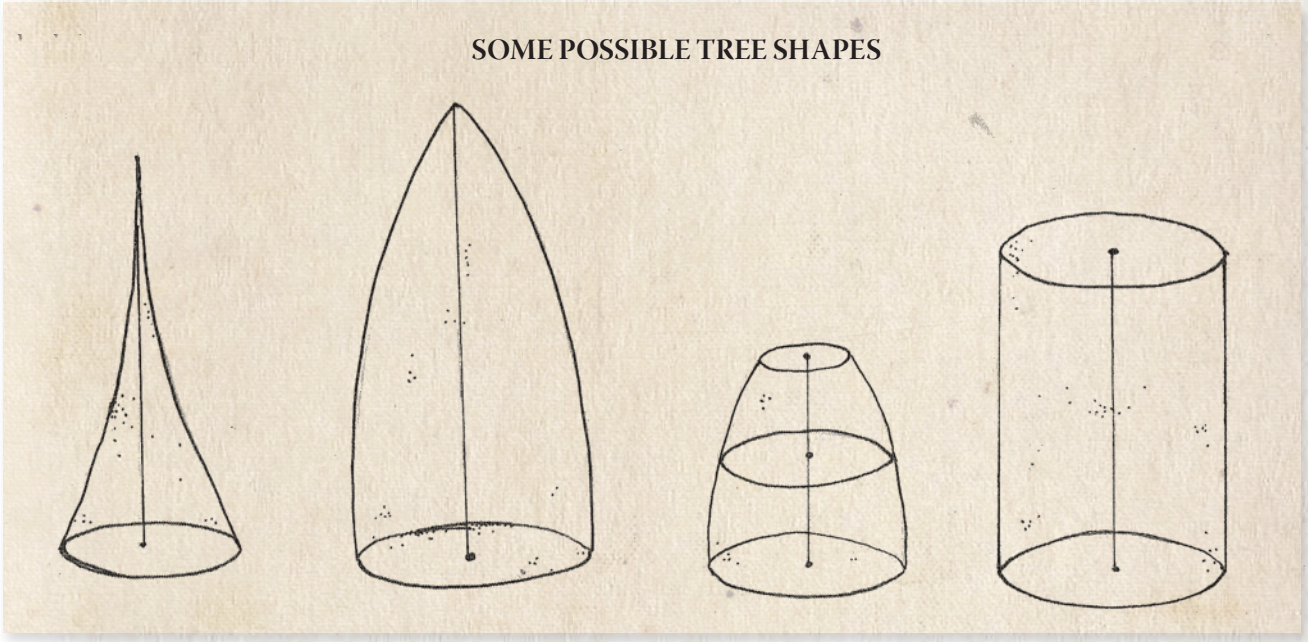


Illustration by Julia Rigby

charts, too! Some charts are specific for types of trees in a certain location. Other charts take into account the shape of a type of tree. Charts also account for the width of a saw cut, as well as the waste resulting from the cutting process. All of these formulas and charts can be confusing!

Uncle Joshua explained a couple of the formulas. Now we are less confused!

We're off to measure some standing trees and calculate board feet!

Louise and William

Louise and William's Forest

Illustration by Julia Rigby

Tree	Height (feet)	DBH (inches)
A	250'	168"
B	220'	144"
C	180'	60"
D	200'	120"
E	250'	84"
F	32'	15"
G	64'	30"
H	48'	20"

***Directions:** You need to know the diameter, in inches, at breast height (DBH) and the height, in feet, of the tree. Use these to calculate the number of board feet that can be harvested from Trees A, F, G, and H from this forest. For some trees you will use your calculator and the formula below. This formula assumes the tree's shape is neiloid. But it doesn't account for the thickness of the bark, or how much waste there will be in cutting. You will be able to use the Scribner Decimal C chart (on page 16) for some of the trees. It assumes one-quarter inch saw cut (called kerf), one-inch thick boards, and that the tree is a cylinder shape. You will also notice you need to add a "0" to the number from the chart to get the board-foot measurement.*

Calculation Process for Each Tree: $V = (¼)\ \pi \times r^2 \times h$ (volume for a neiloid)

1. Divide DBH by 2 to get the **radius** (r).

2. Convert the radius from inches to feet so all the units of measurement are the same. You can do this by multiplying by a fraction equal to 1, or by using proportions and cross-multiplying *(see examples of both methods on the next page)*.

3. Find the **area** of the tree in feet: $\pi \times r^2$ (use $\pi=3.14$)

4. Find the **volume** of the tree in cubic feet: Area (ft.) × height (ft.)

5. Divide the answer from Step #4 **by 4** to account for tapering (narrowing) of the tree at the top.

This completes the calculation of the volume for a neiloid.

Now we need to **convert volume in cubic feet to board feet.**

6. **Multiply** the answer from Step #5 (tapered volume in cubic feet) **by 12** because there are **12 board feet in one cubic foot.** *(This does not account for the cutting process. In reality there might be five to eight board feet in one cubic foot due to the saw width and waste.)*
7. **Add** all the board feet measurements from each tree to determine **the total board feet** that can be harvested from this forest.

Example Calculation
Tree DBH = 40 inches
Tree Height = 100 feet

Step #1: Divide DBH by 2 to get the radius (r).
40 inches ÷ 2 = 20 inches

Step #2: Convert 20 inches to feet using one of these two alternatives:

Alternative #1: Multiplying by 1, example:

$$20 \text{ inches} \times \frac{1 \text{ foot}}{12 \text{ inches}} =$$

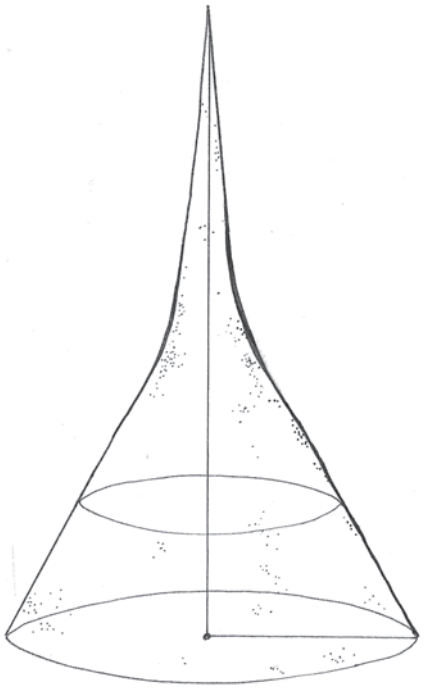
$$\frac{20 \text{ feet}}{12} = 1.67 \text{ feet} = \textbf{radius} \text{ in feet}$$

Alternative #2: Using Proportions and Cross-Multiplying, example:

$$\frac{20 \text{ inches}}{\text{r foot}} = \frac{12 \text{ inches}}{1 \text{ foot}}$$

Cross multiply: $20 \times 1 = 12 \times r \qquad 20 = 12r$

Isolate the r by dividing both sides by 12
$20 \div 12 = r = 1.67$ feet = **radius** in feet



a neiloid shape

Step #3: Find the **area** of the tree in feet: $\pi \times r^2$ (use π=3.14 and r = radius in feet)
3.14 × 1.67 feet × 1.67 feet = 8.76 feet squared = 8.76 feet^2 = **area**

Step #4: Find the **volume** of the tree in cubic feet: area (feet^2) × height (feet)
8.76 feet^2 × 100 feet = 876 feet cubed = 876 feet^3

Step #5: Divide the answer from Step #4 by 4 to account for tapering (narrowing) of the tree at the top.
876 feet^3 ÷ 4 = 219 feet^3

Step #6: Multiply the answer from Step #5 (tapered volume in cubic feet) by 12 because there are 12 board feet in one cubic foot. This is a conversion:

$$\frac{1 \text{ feet}^3 \text{ (V)}}{12 \text{ board ft.}} = \frac{219 \text{ feet}^3}{\text{? board ft.}}$$

Cross multiply

$219 \text{ feet}^3 \times 12 = 2628$ board feet

Answer:

According to this formula, there are 2,628 board feet in a tree with DBH = 40 inches and a height of 100 feet.

Calculation Space:

Tree volume table based on Scribner Decimal C rule.*

Diameter 4 ½ feet above ground (inches)	16 foot log	32 foot log	48 foot log	64 foot log
	Volume in board feet			
10	3	4		
11	4	6		
12	5	8	10	
13	6	9	12	
14	7	11	15	
15	8	14	18	
16		16	21	25
17		18	25	29
18		21	26	33
19		24	32	38
20		27	26	41
21		30	41	49
22		34	46	55
23		37	51	61
24		41	46	66
25		45	62	74
26			68	81
27			74	89
28			80	96
29			86	104
30			93	112

*The figures shown in this table must be multiplied by 10 to obtain board foot values.

What I've Learned about the Forest from the Trees

Here is an image of a forest you will harvest. You have two goals. One is to maximize the board feet harvested. The other is to minimize the impact on the forest. Which trees will you choose to harvest? Use the Scribner chart or the formula on the previous page of your workbook to help you. Answer the three questions at the bottom of the page. You will be sharing your strategy with your classmates.

Illustration by Julia Rigby

Tree	Height (feet)	DBH (inches)
A	8'	12"
B	25'	15"
C	16'	10"
D	32'	15"
E	32'	10"
F	32'	15"
G	200'	120"
H	150'	80"
I	8'	20"
J	32'	15"
K	8'	20"
L	32'	15"
M	60'	30"
N	8'	5"
O	16'	20"
P	150'	80"
Q	80'	40"

Calculation Space:

Total board feet we will harvest from this forest: _____

Trees we will harvest from this forest (write the letter of the trees):

_____

Reasons why we chose to harvest these specific trees:

_____

_____

_____

Lesson 4: A Changing Landscape

December 23, 1905

Dear Diary:

Five years have gone by since we've written in this diary! We've been writing in our own diaries these years, and decided to write together again in this one.

We have noticed that more people are moving to our town and nearby. The Sierra Railway now travels between Oakdale, Jamestown, Carters/Summersville, Angels Camp, Sonora, and other towns in between. It regularly carries goods and passengers. Easy transportation between these cities has brought more people to the area. More people build more houses and businesses.

Our local newspaper had an interesting set of photographs last week. We clipped them.

These images made us realize how much the area around us has changed over the years.

The photographs also made us think back to when we went to visit our Uncle Joshua at the logging camp. We remember standing on the edge of the forest that was being logged and looking at the part that had already been logged. They looked so different! One was full of huge trees and the other one just had piles of broken branches and bits of trees.

We're going to the library to look at other photographs,
Louise and William

A Changing Landscape: Images

Jamestown before the Sierra Railway and after the Sierra Railway came to town.

Both photos courtesy of Tuolumne County Historical Society

Jamestown pre-1897

Jamestown 1903

Directions: Look at the two images of Jamestown. Answer the questions below.

Describe some of the differences and similarities you see between the two images.

_____

_____

Use the 100-square grid transparency to find out what percent of the town was developed before and after the Sierra Railway came to town.

Lay the grid over the pre-1897 photograph. Count all the squares that have a building or other structure in them. How many squares did you count? _____

There are a total of 100 squares on the grid, so the number of squares is the same as the percentage: _____ %

Now do the same for the 1903 image.
Number of squares that have a building or other structure in them: _____

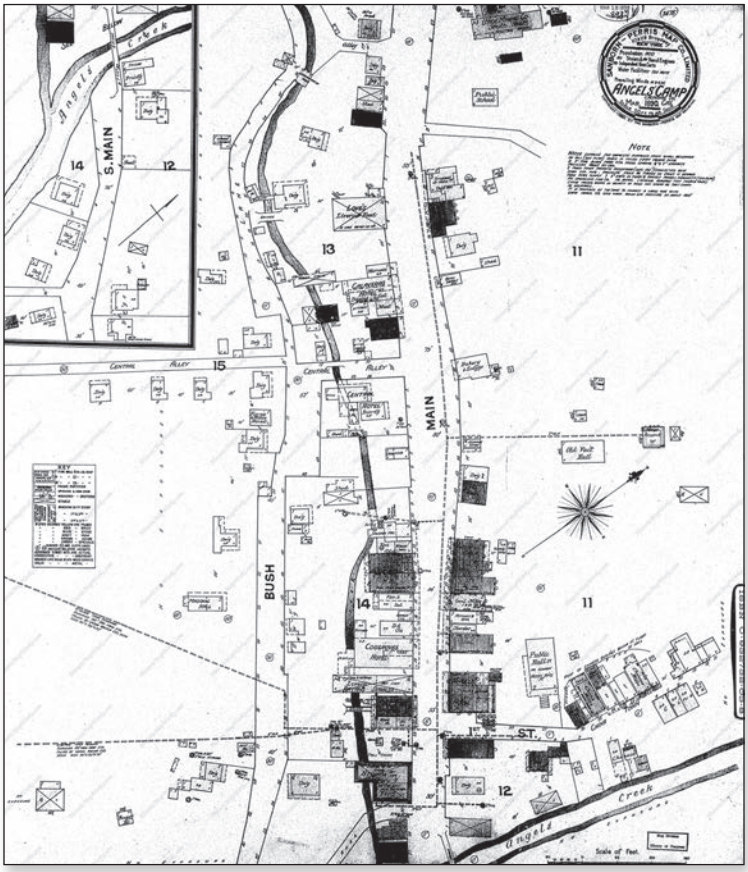
Percentage of development: _____ %

Describe what happened to both Jamestown and the surrounding open space by 1903.

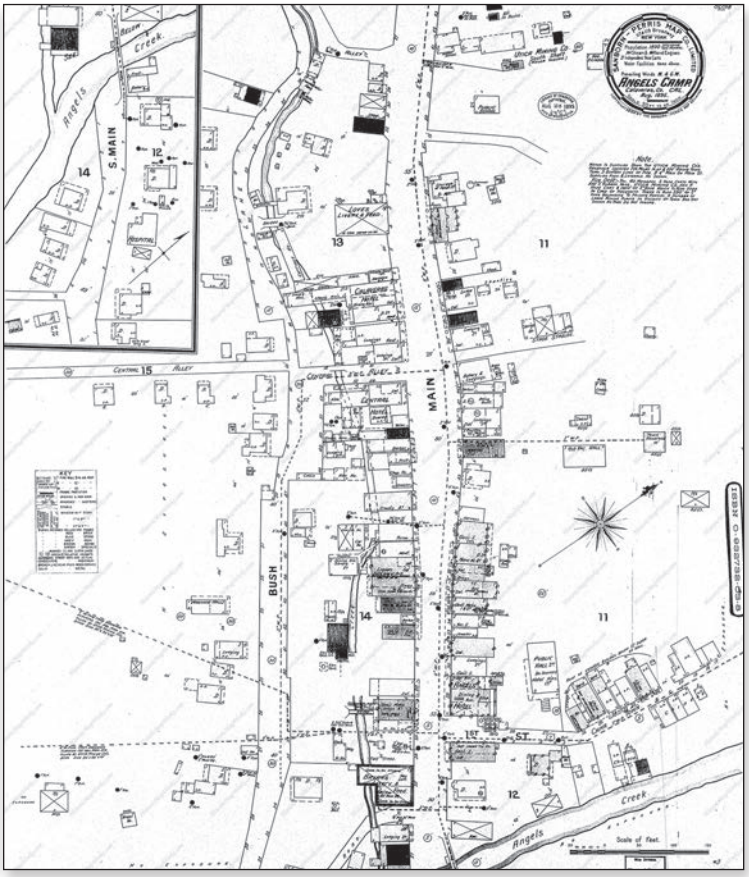
_____

_____

Angels Camp from 1890 to 1905



Angels Camp in 1890



Angels Camp in 1895

Directions: Look at the 1890, 1895, 1898, and 1905 maps of the same area of Angels Camp. The first Sierra Railway train came to Angels Camp in 1902. Use the 100-square grid transparency to find out what percent of the town was developed before and after the Sierra Railway came to town in 1902.

1890: _____ % 1895: _____ % 1898: _____ % 1905: _____ %

Describe some of the differences and similarities you see between the images.

_____

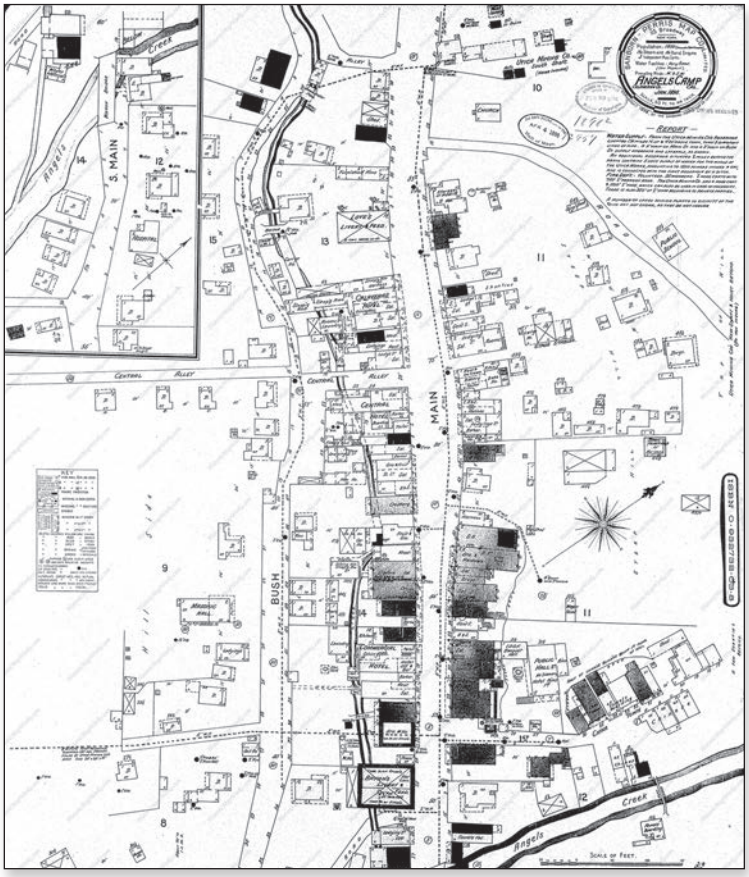
_____

_____

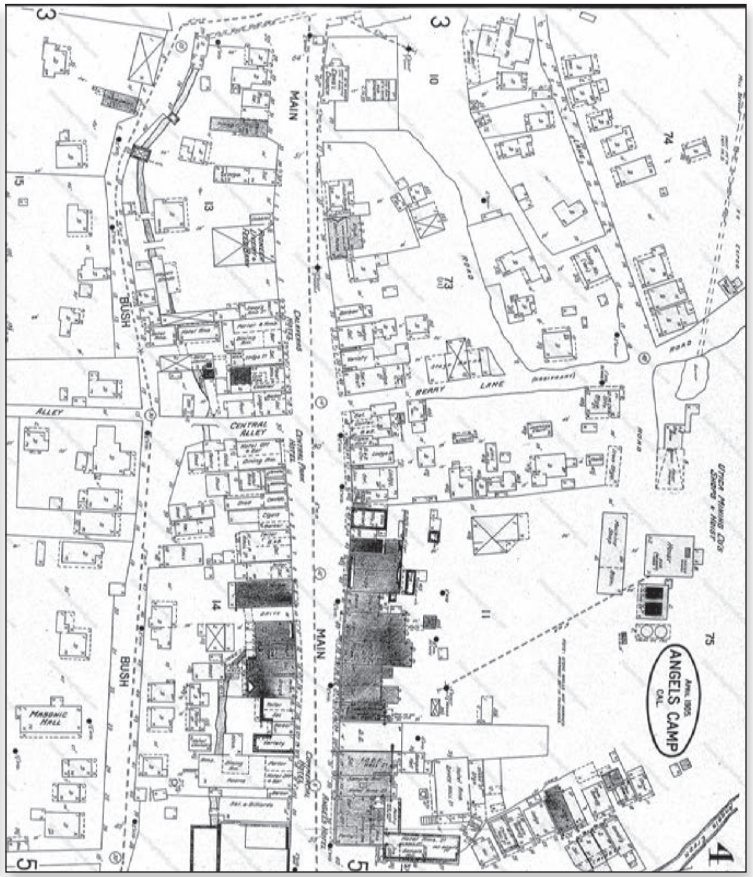
_____

_____

All maps courtesty of Historic Map Works



Angels Camp in 1898



Angels Camp in 1905

Describe what happened to both Angels Camp and the surrounding open space by 1905.

Harvesting Methods

The Gold Rush first fueled California's timber industry. People needed wood to build mines and buildings. As the demand for wood grew, more trees were logged. Large areas of land were cleared of trees, a practice called clearcutting.

Logging was originally done with hand tools. Loggers used an ax to cut a wedge in a tree. Then two loggers used a crosscut saw to cut the tree down. They removed the tree's branches, or "limbed" the tree. Then they used a whip-saw to cut the tree into logs by "bucking" it.

Teams of animals like oxen and mules dragged the logs to a landing or yard area. They also pulled timber on carts. Some sawmills were located in the forest where harvests took place. Other sawmills were farther away. Some companies used wooden flumes or canals, filled with water, to transport logs to a sawmill.

Once steam-powered engines were developed, new machines made logging easier. The steam-powered donkey let loggers lift or drag large logs. It had more power than a team of animals. The traction engine also hauled heavy loads. Loggers often used this equipment where railroads could not be built.

Some people began realizing these logging practices were destructive. When large trees were harvested, young trees and shrubs often were trampled. The forest floor and the soil itself were damaged.

Wildlife habitat was altered. Without plant roots to hold the soil in place, the soil would wash away during storms. It ended up in streams where silt degraded fish habitat. Deer, owls, and other animals lost their homes. If clearcutting continued, there would be fewer forests. There would also be less wood—and less money.

Some science ideas were known, but they were not yet applied. Some people realized that trees grow bigger if they are not crowded. They also realized the waste left behind from a harvest could catch on fire from a lightning strike. The fire could grow and spread. They also discovered that some trees grow better in open sunlight. Others grow better in the shade.

While clearcutting was still very popular in the 1910s and 1920s, some people thought selective cutting was healthier for forests. Selective cutting means that only some trees are harvested in a forest. This allows young trees to grow and some mature trees to stay, still able to release seeds. If given

Clearcut Hills Behind a Logging Camp
Photo courtesy of the California History Room, California State Library, Sacramento, California

A Mule Team Pulling a Timber Cart
Photo courtesy of Tuolumne County Historical Society

Felling A Tree with Axes and a Crosscut Saw
Photo courtesy of Old Oregon

Logging Crew with Oxen and Steam Donkey c 1900
Photo courtesy of Old Oregon

Brennan Creek Log Flume
Mendocino Coast Model Railroad and Historical Society

the right conditions, those seeds will germinate and become young trees. This harvesting practice was used in some national forests in the 1930s and 1940s. But then clearcutting made a comeback in the 1960s and 1970s. It was cheaper. And seeds or seedlings could be planted after the clearcut. The foresters replanted with the type of tree that was valuable. This decreased the diversity of the forest.

Since the 1990s, clearcutting has not been common in National Forests. It is more common on private land, but modern clearcutting is different from that of the late 1800s. The clearcuts are smaller. The areas are irregular so they provide better habitat for wildlife. Trees are replanted. The logging companies have to follow laws to protect rivers, streams, and wildlife. With the 1973 Forest Practices Act in place, private logging companies must submit a Timber Harvest Plan before they can harvest trees. In it, they need to explain how they will protect the habitat and follow laws.

Helio-logging
Photo courtesy of Idaho Department of Lands

Cable Logging
Photo courtesy of the Forest History Society, Durham, NC

After a century of research, scientists better understand forest ecology. We know how wildlife depends on forest habitats. We recognize the role of snags, standing dead trees. We understand how forests affect the health of rivers and streams, and how fire affects forests. While larger "firestorms" destroy forests, smaller, cooler fires can make forests healthier by thinning dead and dying trees. They also create open space for new trees to grow. Prescribed fires are now conducted on some private and public-owned land.

Foresters work hard to maintain healthy soil and adequate spacing for trees. Sometimes they even thin the trees to allow remaining trees to grow bigger. Foresters also take advantage of modern tools and technology to help them harvest timber. For instance, helicopters can transport timber out of a forest. Cables can haul timber out of the forest. These harvest methods are expensive, but they protect other plants, soil, and streams. Many machines have replaced manual and animal-powered equipment.

The science of forestry has grown since the Gold Rush. Many universities have forestry departments where research is conducted. Now we better understand how certain trees grow, the conditions they need, and how best to reforest an area. In contrast to the days of the Sierra Railway, forestry practices are more sustainable.

A Grapple Skidder Moves Logs
Photo courtesy of John Deere

Chain Saw is Used to Fell a Tree
Photo iStock/edelmar

Loggers Use a Feller Buncher to Fell a Tree
Photo courtesy of John Deere

What I've Learned about a Changing Landscape

In the spaces below, answer the question by writing at least three complete sentences.

1. Describe what happens to natural areas when many people move in. Why does this happen?

_____

_____

_____

2. Examine the two harvesting techniques pictured below.

1.

Selective Cut
Photo courtesy of Michael De Lasaux, University of California Cooperative Extension

2.

Clearcut Logging Site
Shutterstock/TTPhoto

In the boxes below, draw what you think the two areas will look like six months after the harvest is done.

1.

2.

April 20, 1906, morning

Dear Diary:

A very large earthquake hit San Francisco a couple days ago! Buildings collapsed, fires were started, and hundreds of people are missing.

We think it's scary that the firefighters don't have enough water to put out the fires in the city! We've heard that some people are looking for new sources of water for San Francisco.

We are sad for San Francisco.

Louise and William

Los Angeles Herald
Volume 33, Number 202, 20 April 1906

Eyewitness Tells of the Horrors He Experienced

"When I awakened in my room at the Palace hotel shortly after 6:30 o'clock Wednesday morning my bed was rocking from side to side. I knew what was occurring. I dressed and rushed to the street. The halls were filled with men, women and children, some dressed and some in their night clothes.

"The hotel was in no particular danger. Only ornaments and bits of plastering were falling. Once into the street I found myself in a frenzied mass of human beings. A dull hoarse roar pervaded. It was like a horde of wild animals in a tropic forest, before the storm breaks.

"Suddenly there came the clang of fire engines. At 6:30 o'clock there were six fires in the city. The firemen were unable to cope with the flames, as the whole water system had been destroyed by the earthquake. People roamed through the city like groups of cattle lost from the herd.

"By 10 o'clock the whole city was a seething mass of flame."

California Digital Newspaper Collection, Center for Bibliographic Studies and Research, University of California, Riverside, http://cdnc.ucr.edu.

December 31, 1926

Dear Diary:

Many years have passed! We came across this diary when we returned to Jamestown to celebrate the holidays. We now have families of our own.

We remember the last time we wrote something. That was back in 1906 when the huge earthquake struck San Francisco. Many fires were burning and there was not enough water to put them out. Well, that issue has been fixed. San Francisco built a dam. A dam is a barrier that holds back water. The water is released into a waterway and moved to various places.

Over the last 15 years, the Sierra Railway was used to help build three dams: O'Shaughnessy Dam, Don Pedro Dam, and Melones Dam. While the dams changed the natural systems around them, they store water and make electricity for people.

We plan to visit the dams with our children.

Louise and William

San Francisco 1906 Earthquake
Photo courtesy of The Bancroft Library, University of California, Berkeley BANC PIC 19xx.169:057

Information Card: Groups 1 and 4: O'Shaughnessy Dam

Hetch Hetchy Valley Before The Dam Was Built
Photo courtesy of the Yosemite National Park Archives, Museum, and Library

O'Shaughnessy Dam
Photo courtesy of the San Francisco Public Utilities Commission

Dates
O'Shaughnessy Dam was built: 1919–1923
O'Shaughnessy Dam was raised higher: 1935–1938

Why Was This Dam Built?

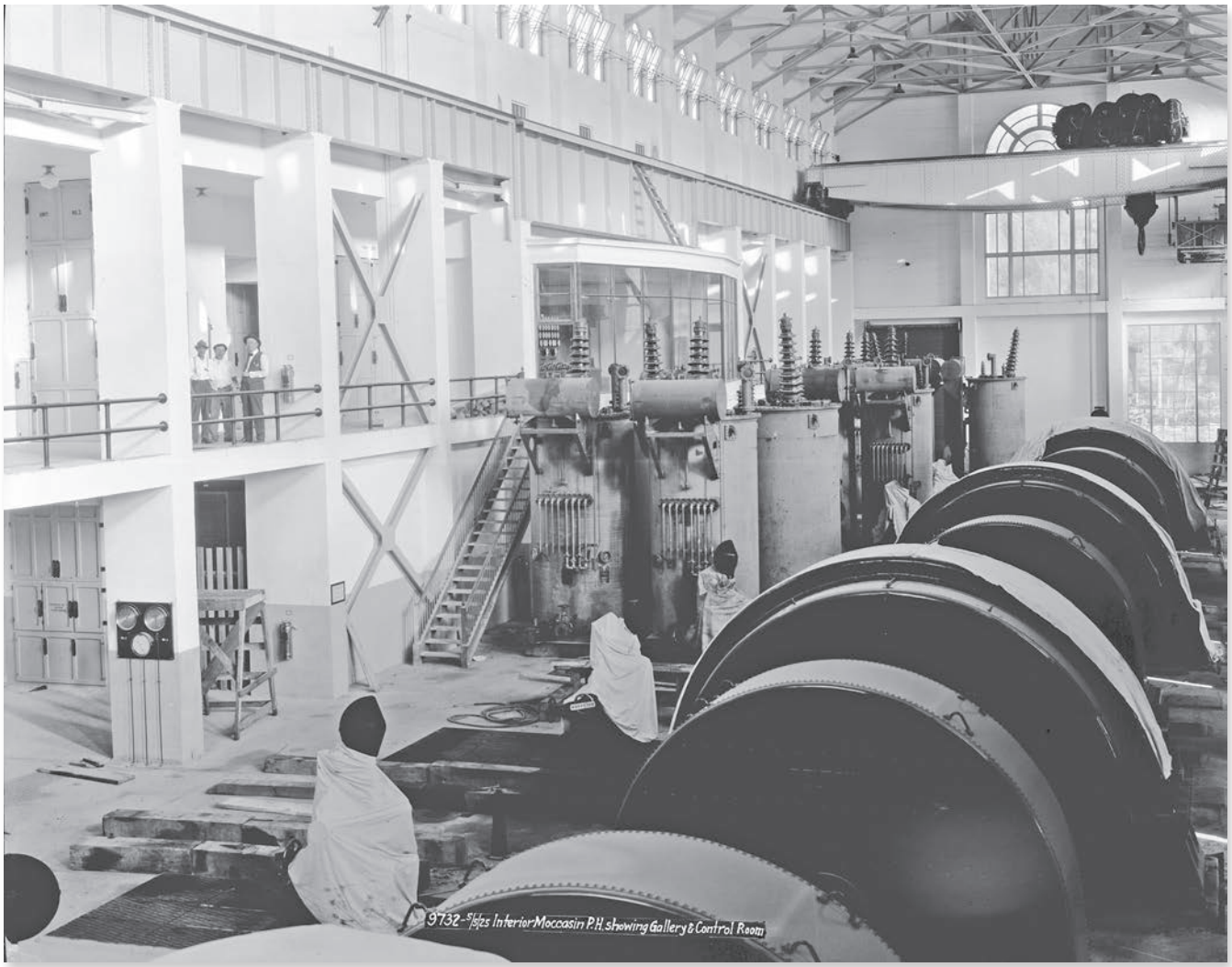
This dam was built to store water. It provides a reliable source of water for San Francisco. The project also provides hydropower to San Francisco.

Role of the Sierra Railway

In 1914, the Sierra Railway Company and San Francisco made an agreement. The Hetch Hetchy Railroad would branch off from Sierra Railway's milepost 26. Construction began on the Hetch Hetchy Railroad in 1916.

Construction materials and workers for the dam were transported on the Sierra Railway. At the junction at milepost 26, the materials and people were transferred to Hetch Hetchy railroad cars. Sometimes the Sierra Railway cars were used on the Hetch Hetchy track. Some of the Sierra Railway's engines were rented for use on the Hetch Hetchy Railroad. The railroad also had six locomotives of its own.

When the height of O'Shaughnessy Dam was increased, in the 1930s, San Francisco contracted with Sierra Railway Company once again. The company operated the Hetch Hetchy Railroad to the dam. The Sierra Railway transported supplies, passengers, and mail on the Hetch Hetchy Railroad line.



Moccasin Powerhouse
Photo courtesy of the San Francisco Public Utilities Commission

Influence of the Dam's Presence on Natural Systems

Hetch Hetchy Reservoir sits at an elevation of 3,700 feet in the Sierra Nevada range. Located in Yosemite National Park, Hetch Hetchy Valley was once a landscape of meadows, oak woodlands, and pine forests. The Tuolumne River flowed through it. For thousands of years, American Indians fished its waters and hunted and gathered food in the valley.

When the dam was built, millions of board feet of timber were removed from the valley floor. The river changed its course, spreading out and filling the reservoir. Plant life changed, and animals that lived in Hetch Hetchy's meadows and forests left the area. People who had relied on Hetch Hetchy Valley's natural resources, like game and plant material, left the area as well. Downstream of the dam, the level and speed of the Tuolumne River changed. The river is controlled by the dam instead of by natural seasonal cycles.

Information Card: Groups 2 and 5: Don Pedro Dam

Old Don Pedro Dam
Photo courtesy of CA-A-0014, WaterArchives.org

Dates
Built: 1921–1923

Why Was This Dam Built?

The Don Pedro Dam is on the lower Tuolumne River. It was built to provide water to farmers and others in the San Joaquin Valley. The farmers especially needed water during the summer. The dam provided power to people in Modesto and Turlock. It was built by the Modesto Irrigation District and the Turlock Irrigation District. In 1923, Don Pedro Dam was the tallest dam in the world.

Role of the Sierra Railway

An eight-mile spur was added to the Sierra Railway's track from Rosasco Junction to the Don Pedro Dam site. The Sierra Railway transported supplies, machinery, and workers during construction of Don Pedro Dam. The supplies included 10 boxcar loads of cement and 40 boxcar loads of gravel every day! These materials were used to build the dam.

Influence of the Dam's Presence on Natural Systems

As with all dams, Don Pedro Dam changed the natural landscape of the area. Its presence meant less water was available downstream past the dam. Sediment that was usually carried downstream was held back, and no longer available to create healthy river habitat. The lake water was often warmer than the natural river water. Most aquatic animals need cool water, so the lake cannot support them. Animals and plants that lived there before the dam was constructed lost their habitat. Migrating fish faced barriers that prevented them from swimming upstream to lay their eggs.

The construction of the dam flooded a gold mine town called Don Pedro Bar. A fire had destroyed this town in 1864. When the dam flooded it in 1923, there were just a few burned structures and a graveyard remaining.

The dam reached 1,040 feet across the Tuolumne River canyon. The reservoir that was formed was 14 miles long and 3 miles wide.

Other Facts

Construction of a new Don Pedro Dam began in 1967. The old dam is underneath the water in the reservoir created by the new dam. The gold mine town of Jacksonville was flooded when the new dam was built.

Information Card: Groups 3 and 6: Melones Dam

Old Melones Dam
Photo courtesy of Calaveras County Historical Society

Dates
Built: 1925–1926

Why Was This Dam Built?

Melones Dam was built to provide irrigation water and power to parts of the San Joaquin Valley. It was built on the Stanislaus River. The dam was constructed by Oakdale Irrigation District and South San Joaquin Irrigation District.

Role of the Sierra Railway

A seven-mile spur was added to the Sierra Railway's track branching from the main line at McCormicks below Jamestown. The area the train had to pass through was very steep. The Sierra Railway bought its heaviest engine and equipment to haul gravel to the dam site.

Influence of the Dam's Presence on Natural Systems

Construction of the dam prevented salmon from migrating upstream and downstream.

When New Melones Dam was built downstream from Melones Dam, the old dam was flooded in the reservoir of the new dam. In drier years when there is less rain, cold water gets trapped behind the old dam and does not flow. In between the old dam and the new dam, the water is warmer. Water is released from the base of the new dam to support fish migration. But the fish do not do well in warm water. During summer months, the water at the surface of the reservoir can be 77 degrees Fahrenheit, and deep in the reservoir it can be just 50 degrees Fahrenheit. The fish need the cooler water, but that water becomes trapped behind the old dam.

Other Facts

The town of Melones was flooded by the construction of the New Melones Dam.

Sierra Railway's Role in Dam Building

Notes on _____ Dam and the Sierra Railway

This dam was built between the years: _____ to _____

Why was this dam built?

_____

_____

Describe the Sierra Railway's role in the building of this dam:

_____

_____

Describe the influence of the dam's presence on natural systems:

_____

_____

What I've Learned about the Role of the Sierra Railway in Building Three Dams

In the spaces below, answer the two questions. Answer the first question by writing one or two sentences about each dam. For the second question, examine the drawing and write or draw your answer.

1. Describe the Sierra Railway's involvement in the building of:

O'Shaughnessy Dam:

_____

_____

(old) Don Pedro Dam:

_____

_____

(old) Melones Dam:

_____

_____

2. Look at the drawing below.

Hetch Hetchy Valley
Illustration by Laura Cunningham

This river will have a dam built across it to store water and also to create electricity. Describe or draw what will happen to this natural area.

_____

_____

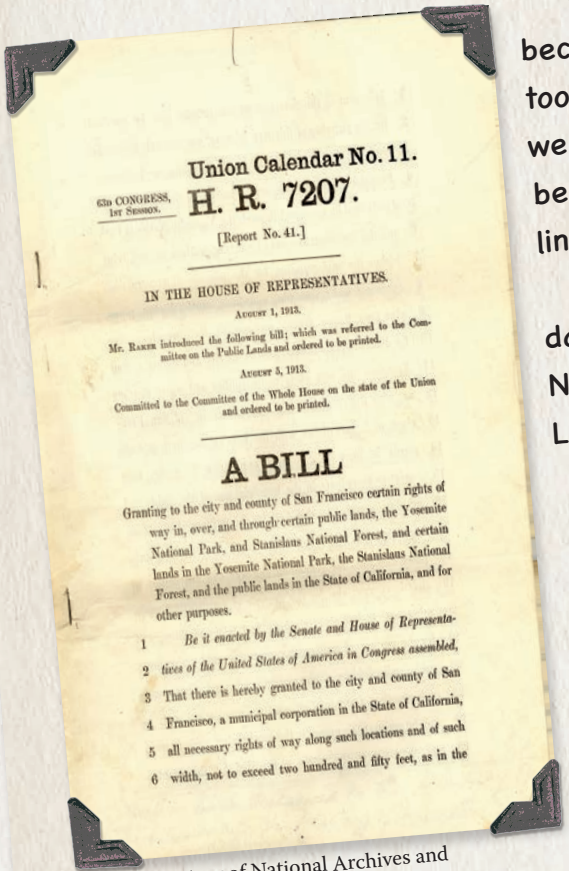
Lesson 6: Storing Water, Stirring Debate

December 20, 1913

Dear Diary:

Yesterday President Woodrow Wilson signed a bill into law. It allows the creation of a dam in the Hetch Hetchy Valley. This is in Yosemite National Park.

We have been following this story in the newspaper for many years. Some people are against building the dam. Some people are in favor of it. We know that people in San Francisco need more water. That became obvious during the big earthquake and fires.



Union Calendar No. 11.

63d CONGRESS, 1st SESSION. H. R. 7207.

[Report No. 41.]

IN THE HOUSE OF REPRESENTATIVES.

AUGUST 1, 1913.

Mr. RAKER introduced the following bill; which was referred to the Committee on the Public Lands and ordered to be printed.

AUGUST 5, 1913.

Committed to the Committee of the Whole House on the state of the Union and ordered to be printed.

A BILL

Granting to the city and county of San Francisco certain rights of way in, over, and through certain public lands, the Yosemite National Park, and Stanislaus National Forest, and certain lands in the Yosemite National Park, the Stanislaus National Forest, and the public lands in the State of California, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*
3 That there is hereby granted to the city and county of San
4 Francisco, a municipal corporation in the State of California,
5 all necessary rights of way along such locations and of such
6 width, not to exceed two hundred and fifty feet, as in the

Image courtesy of National Archives and Records Administration

We are interested in this law because the Hetch Hetchy Valley is not too far away from Jamestown. Also, we wonder if the Sierra Railway will be used to help build the dam since its line runs near the area.

We have our own ideas about the dam.

Not sure when we'll write next,

Louise and William

Science Perspectives: Storing Water, Stirring Debate

Every person needs water. Every human community needs water as well. We need water to survive. We also use it for growing food, washing, raising animals for food, bathing, transportation, and more. When the population of California began to swell in the late 1800s, the state realized it needed to bring water to people. The state, as well as various cities, built dams, canals, and aqueducts. The dams capture river water and store it. Canals and aqueducts transport the water throughout the state.

Over time, we have learned how dams affect natural systems. O'Shaughnessy, Don Pedro, and Melones Dams all changed the natural area around them. Plants and animals were affected.

We now have the technology and science ideas to build dams and reduce environmental consequences. For instance, some dams have fish ladders that enable salmon to swim upstream. Some dams release water at certain times of year to support wildlife and fish species. Some dams are even being removed. We've learned that the environmental cost of them is greater than the benefit to human communities.

O'Shaughnessy Dam is still controversial, as it was over 100 years ago. Some groups want it removed. They say studies show that San Francisco city could get water and electricity from other places. They want to restore Hetch Hetchy Valley. Others argue that removing the dam is not cost-effective and that the loss of clean hydropower would be significant.

Fish Ladder
iStock/Tammy Fullum

What I've Learned about Storing Water, Stirring Debate

In the spaces below, answer the three questions using complete sentences. Each answer should contain at least three sentences.

1. Describe at least two of the anti-dam and two of the pro-dam perspectives you heard during the town hall meeting.

_____

_____

_____

2. How can science ideas be used to make decisions that affect the environment?

_____

_____

_____

3. Pretend you live in 1913 and O'Shaughnessy Dam has not been built yet. You are speaking at the town hall meeting to share your thoughts. What would you say?

Claim:

_____

_____

_____

Evidence Statement 1:

_____

_____

_____

Evidence Statement 2:

_____

_____

_____

Evidence Statement 3:

_____

_____

_____