

# FIELD TRIP

## Lesson Plan



**Squire Boone Caverns**

# Suggested LESSON PLAN

## Unit 1

### **Behavioral objective:**

Students should be able to list the different types of wax that were used in candle making and give the traits that made them a good or bad wax.

Students should especially understand the traits of paraffin since that is the wax used at Squire Boone Caverns.



## Unit 2

### **Behavioral objective:**

Students should be able to list the types of wheels that can be found on mills. They also should be familiar with the different types of mills and what they were used for.

Lastly, they should understand how a mill works and be able to list the main structures found in a mill.



## Unit 3

### **Behavioral objective:**

Students should be able to identify and explain the ways in which miners mined for gold. They should also know the types of rocks that may be found while gem mining at Squire Boone.



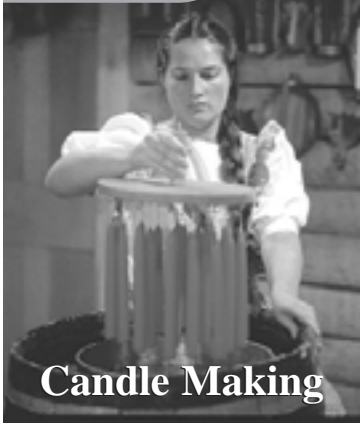
## Unit 4

### **Behavioral objective:**

Students should understand how soap was discovered and what the three main ingredients are in soap today. They should also understand the difference between the “hot” and “cold” methods of soap making (saponification).



## Unit 1



**C**andles have been around for many years. The earliest candles were thought to be made around 2500 B.C. These first candles were made with vine fibers and dipped in resins and wax.

In early Japanese and Chinese civilizations, candles were made from the cocus insects and seeds from certain trees, then molded in paper tubes. Later, rolled-up paper was used as a wick.

In the first century A.D. the Romans used candles made of rope dipped in wax. These candles were called links.

The word “candle” wasn’t used until the Middle Ages. It comes from the Latin word “candere”, meaning “to shine”. The people who made candles were called “chandlers”.

The evolution of candles continued into the 1700s when beeswax and spermaceti were found. Before then, tallow had been used in candles, but it gave off a horrible odor. Beeswax solved this problem because it

has a pleasant smell. Spermaceti also helped in the evolution of candles because it is a solid wax that will not bend in the summer’s heat.

Two more discoveries in the 1800s helped influence candle making. The first was the use of plaited candle wicks, which gave a brighter and more even light. The second was the discovery of paraffin. Paraffin is colorless, odorless, easy to mold, clean burning and inexpensive.

Early pioneers in America used animal fat to make candles. Certain animal fats were better than others because they didn’t have a bad odor, or were harder and wouldn’t melt. In order, their preferences were beef, mutton (sheep), bear, deer, moose and elk. Pig fat was the last choice because it was very soft and would melt on hot days.

The pioneers also thought that candles could predict the weather, good fortune, or tell when the family was safe. When the candlelight turned blue, it was believed that ghosts would walk.

When gas, oil and electricity were introduced, candle making suffered a great decline because these other fuels were easier to obtain. Today, most candles are made of paraffin wax and are thought to symbolize peace, calm and warmth.

On your field trip, you will see a demonstration of how candles are hand-dipped. You will

also get to try your hand at dipping candles. At Squire Boone Caverns, candles are made from paraffin in 23 colors with 22 different scents. The white candle is unscented for people who are allergic to fragrances.

Tapers consist of a string (the wick) with candles on both ends. There are five sizes of tapers—mini, skinny, tiny, chubby and standard. The mini and skinny tapers have to be dipped 20 times, and the large and chubby tapers are dipped 30 times. This takes anywhere from three to five hours.

### Definitions

**Cocus** – The Chinese and Japanese used the wax from this insect to make some of the first candles.

**Links** – The name given to candles by the Romans.

**Candere** – A Latin word meaning “to shine”. This is where the word “candle” comes from.

**Spermaceti** – A solid, waxy substance found in the head region of sperm whales that was popular for candle making in the 1700s. It is odorless and would not bend in the summer heat.



## Unit 2



**G**ristmills came into existence because the major crop was corn for the pioneers. To be useful for baking, corn had to be ground into flour. The earliest method of grinding corn was to use a small stone, turned by hand, on top of a larger stone. This was very hard, manual labor, so people looked for an easier way and thus gristmills were developed.

There are three major parts to a gristmill: the raceway, wheel and grinding stones. The raceway channels the flowing water to the wheel. The water forces the wheel to turn. The turning wheel powers the grinding stones by a series of shafts and pulleys. The grinding action of the stones breaks the grain into small, usable pieces like flour, cornmeal and grits.

### **Raceway:**

To get the water—which powered the mill wheel—to the mill, a raceway had to be built. A raceway is the path that carries the water to the wheel. First, the stream had to be dammed to get enough water to power the large wheels. Then a floodgate was put in to control the amount of water flowing down to the wheel. The last part of the raceway, which

includes the floodgate, is called the mill run.

### **Wheel:**

There are four main types of wheels used on gristmills:

1. Overshoot, 75% efficient.
2. Undershoot, 30% efficient.
3. Breast wheel, 65% efficient.
4. Tub wheel, 50% efficient.

The overshoot wheel was the most popular and is the type of wheel on Squire Boone's mill.

This wheel utilizes buckets called brickets. The water from the raceway falls into a bricket and as the bricket fills with water, it moves the wheel forward, causing the next bricket on the wheel to fill with water. This action makes the wheel spin.

### **Grinding Stones:**

There are two grinding stones in a gristmill, stacked one on top of the other. The pair are referred to as a run of stones. The upper stone, called the runner stone, has furrows on its lower surface. The lower stone, or nether stone, has furrows on its upper surface. With these furrows, the stones act like scissors that grind the grains.

The nether stone is generally immobile and harder than the runner. Both stones have a hole in the center through which runs the shaft or spindle. The spindle is connected to the waterwheel through a system of belts and gears. These belts and gears turn the running stone which then grinds the grain. A wheel hoop encases and protects the stones.

Originally, grinding stones were made out of ballast rocks that had been cast out on shore by English ships as they unloaded for the return trip. Later, burr stones from France were used.

Each type of grain needs a different type of stone, either because it requires a different hardness or a different set of furrows. Therefore, there were many types of mills: flour mills for wheat; provender mills for cattle feed; and gristmills for grain.

Squire Boone and his four sons began building our gristmill in 1804, shortly after moving to Indiana from Kentucky. It began grinding corn in 1809. The mill burned in 1852, was rebuilt, then burned a second time in the 1920s. It was rebuilt a second time in 1976 on its original foundation.

The water that turns the wheel is from a stream that runs through the cave. It is dammed inside the cave and gravity pulls it down a 400-foot raceway to the mill. On your field trip, you'll see a demonstration of corn being ground.

## Definitions

**Burr stone** – The big stones in the mill that grind grain. There are two, each weighing one ton. A pair is called a "run" of stones.

**Runner stone** – The upper stone.

**Nether stone** – The lower stone.

**Furrows** – Grooves in the stones where the grain is crushed.

**Brickets** – The buckets on the mill wheel that catch the water and make the wheel turn.

**Raceway** – The path that the water travels down on its way to the mill.

## Unit 3



### Gem Mining/Sluice

“Pikes Peak or bust!” This was the rallying call of the gold miners who were on their way to California during the gold rush. It officially started on January 24, 1848. A few struck it rich, but most people ended up with nothing.

Most of the gold that was found is what is called placer gold. This is gold that was found mixed with gravel and mud along the stream beds.

To mine the gold, the first miners used washpans made of iron. In this process, called panning, miners would get some dirt in the pan and then let stream water run in it. They would shake gently, and since the gold was heavier than the sand and mud, it would fall to the bottom. They then poured the mud out and picked up the gold. This was very time-consuming, and eventually panning gave way to cradles, Long Toms, sluices and finally hydraulic mining.

Cradles were like a big bin in which dirt thought to have gold in it would be placed. Water was then poured into the cradle while the dirt, sand and

gold would be washed down into a ripple box. The ripple box would trap the gold because it was heavier, and then the miners would pick it out. This method took four men to operate and could process 100 buckets of dirt per day.

Long Toms were then built, which also used a ripple box. Water flowed down a long, wooden trough that widened. The water would then fall down into a ripple box and separate the gold. An advantage was the constant running of the water. It was possible to separate 400-500 buckets of dirt a day with the Long Tom, which required three to six men to operate.

The next technique to come along was the sluice—a very long trough (up to 1,000 feet) through which water flowed constantly. Miners poured dirt into the trough which had ripple bars along its entire length to trap gold. As many as 20 miners could use one sluice.

The final improvement in processing gold was hydraulic mining. A high-pressure stream of water was shot at a hillside, forcing dirt and gold to fall into a sluice. This method could process more dirt with fewer men than any other method.

When all the gold was gone from the streams, mining companies would search for veins of gold, then drill into the rock to extract the gold.

At Squire Boone Caverns, there is a 50-foot sluice in which you will be able to mine for Fool’s Gold (iron pyrite) as

well as many other gems and rocks such as quartz (clear in color), agate (flat, usually dyed many different colors), ulexite (called TV stone, with fibers running through it), pumice (the only rock that floats), sulfur (yellow color), and amethyst (a purple rock that is used extensively in jewelry making).

On the next page is a list of the specimens you might find at the sluice at Squire Boone Caverns.

### Definitions

**Placer gold** – This is the gold that is found mixed with gravel and mud along the stream beds.

**Dry washing** – A process of mining in which the mud was dried, crushed and tossed into a blanket. The lighter sand and dirt were blown away, leaving the heavier gold flakes behind.

**Ripple box** – A box with wooden bars fastened to the bottom that would trap the heavy gold.

**Fool's Gold**  $\text{FeS}_2$  – Also known as iron pyrite, it is an important iron ore. Gold in color and multi-crystaled. It came to be called Fool's Gold because miners very often mistook it for gold.

**Amethyst** – Quartz based, purple in color, with crystal points. It is used to make jewelry and is supposed to bring prosperity when worn.

**Citrine** – Quartz based and crystal shaped, its color ranges from light tan to dark brown. Because of its similarity to topaz, it is sometimes used in jewelry.

**Ulexite**  $\text{NaCaB}_5\text{O}_9\text{H}_2\text{O}$  – Clear or milky colored and usually odd shaped. Also known as TV stone because its vertical fibers can project an image from underneath the rock to the top surface.

**Peacock Ore** – Related to bournite, this is a dark colored ore with multi-colored patterns caused by other minerals also present in the rock. Important copper ore.

**Optical Calcite**  $\text{CaCO}_3$  – Usually clear in color and square or rectangular in shape. The cleavage lines run horizontal and at an angle, so when you place it on the page of a book, you will see two images of the same letter. Thin slices of optical calcite were once used as microscope lenses. It is related to the calcite that forms cave formations.

**Pumice** – Tan colored, very coarse and very lightweight, used for cleaning. Pumice is formed when volcanos erupt, shooting hot lava into the air.

Sometimes when the lava cools, air is trapped inside, forming air pockets. This cooled lava is called pumice. The air pockets inside give it the distinction of being the only rock that floats.

**Petrified Wood** – Usually streaked with shades of brown and red. Minerals seeped into the wood of trees and over many thousands of years, caused it to become hardened.

**Mica** – Thin, flexible, clear or black in color. A long time ago, clear mica was used to make windows. Mica is also used to make formica countertops.

**Talc**  $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$  – Light, green in color with a soft texture. Talc is ground up and used to make talcum powder.

**Agate Slice** – Usually thin cut and polished, dyed many different colors. Agate is made primarily of two elements: silicon and oxygen. Layers of agate are deposited on the inside of cavities below the Earth's surface.

**Geodes** – There are two types of geodes: regular and cystoid. Regular geodes are round and have hollow cavities inside lined with crystals. Cystoid geodes are prehistoric sea creatures that have died and turned to stone.

**Sulphur** – Yellow in color, and sometimes has an odor like rotten eggs. Sulphur is used in making gun powder, match heads and many types of medicines.

**Dinosaur Bone** – After dinosaurs died, minerals seeped into their bones, crystallized and turned them to stone. Pieces of

dinosaur bones are grayish in color and very rough in texture.

**Clear Quartz** – Crystal points are shaped like polygons with flat sides and a point on the end. Tumbled quartz has been made smooth and round by a tumbling process. Quartz is used in making watches, pressure gauges, oscillators and resonators.

**Sculptured Copper**  $\text{Cu}$  – This is real copper that has been melted down and then poured on wet straw or into water to form odd shapes.

**Fuschite** – Related to mica, metallic green in color, found in many different shapes.

**Orange Calcite** – Orange in color and many different shapes.

**Pseudo Fossil** – Minerals attach to soapstone and cause fern-like patterns that resemble fossils.

**Apache Tear** – Apache tear is made of obsidian, or natural glass, and is black in color. It is translucent, meaning you can see through it if you hold it up to a light.

**Rose Quartz** – Made primarily of silicon and oxygen, with a pink color caused by trace amounts of magnesium or titanium. Ancients believed rose quartz helped people to give and receive love more easily.

**Desert Rose** – A form of barite,  $\text{BaSO}_4$ , light tan and white in color. Its shape is reminiscent of rose petals.

**Aragonite**  $\text{CaCO}_3$  – White in color, usually with small, round bumps on its surface.

**Halite**  $\text{NaCl}$  – Natural salt, very light to very dark pink.

**Lodestone** – A form of magnetite,  $\text{FeFe}_2\text{O}_4$ . It is a natural magnet, black or dark gray in color.

## Unit 4



Soap Making

Soap was used as early as 2000 B.C. Rather than for cleaning, it was used as a scent or ointment that was rubbed on the skin. It was first discovered to be a cleaning agent around 1000 B.C.

At that time, it was common for the people living near Rome to sacrifice animals by fire. Animal fat would accumulate at the base of the altar and mix with ashes. Rain washed this mixture down the Sapo Hill to the clay banks of the Tiber River. Women who came to the river to wash clothing found that their clothes became cleaner with less effort when they were rubbed in this mixture of animal fat and ashes, which came to be called “sapo”. This is the origin of the word “soap”.

In the 1600s, a heavy tax was put on soap, making it very expensive to buy, so people looked for other ways to produce more affordable soap. The juice from the yucca plant was used, as was the soap berry, which could be rendered into a soapy substance called “saponin”. This is where we get the word “saponification”, which is what

we call the process of making soap.

There are three main ingredients in soap—water, lye and lard or tallow. Soap making depends on a very sensitive chemical reaction which requires pure water. The pioneers used rainwater, which they collected in barrels.

Lye is an alkali that is bitter, slippery and caustic. Sodium hydroxide (caustic soda) is the type of lye used most often. In pioneer days, lye was made by pouring rainwater over potash (the ashes of burned wood). The strength of the lye was tested by dropping an egg in the lye water. If the egg floated on top, the lye was too strong. If the egg fell to the bottom, it was too weak. If the egg floated in the middle, the lye was perfect.

The third ingredient is lard or tallow, derived from animal fat. Tallow, from cows or goats, was preferred by pioneers because it is firmer and cures in less time.

There are two methods of saponification: hot and cold. In the hot method, the lard or tallow was melted and boiled with lye water in a kettle over an open fire. This resulted in a soap that was very harsh. It was used for laundry or scrubbing floors, but contact with the skin was avoided.

The cold method of saponification starts by combining a certain amount of lye with cold water. As soon as the lye is added, the temperature of the water quickly rises to about

140°F because of a chemical reaction. This lye solution must be allowed to cool for about three hours, till it reaches 80°F. Meanwhile, lard is being melted in a kettle. When the lard has cooled to the same temperature as the lye, they are combined in the kettle and soap is formed. The mixture is then poured into a mold and cut into bars. Soap made this way is milder, but it must age for three weeks before it can be used on the skin.

At Squire Boone Caverns, soap is made using the cold method. One batch makes about 500 bars of soap. It is good for cleaning, killing chiggers, treating poison ivy, washing hair and removing stains from clothes. During your visit, you will be able to observe the soap-making process.

### Definitions

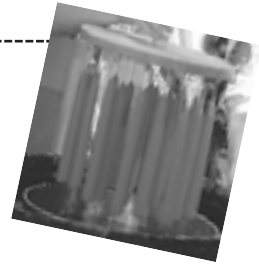
**Saponification** – The process of making soap.

**Tallow** – The firmer fat of cows and goats.



# Post-lesson QUIZ

## Unit 1

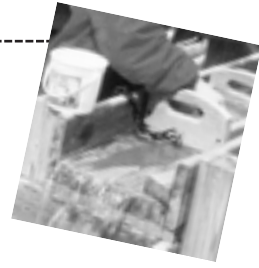


1. The first candles were made of \_\_\_\_\_ and were dipped in \_\_\_\_\_.
2. The Chinese and Japanese used the wax from the \_\_\_\_\_ to make their first candles.
3. The word “candle” comes from the Latin word \_\_\_\_\_, which means \_\_\_\_\_.
4. People who made candles were called \_\_\_\_\_.
5. There were four discoveries made in the 1700s and 1800s that influenced candle making. List three of them and give a trait that made each discovery useful.
  - a)
  - b)
  - c)
6. Pioneers preferred to use the fat of \_\_\_\_\_ to make candles. The fat of \_\_\_\_\_ was their last choice because it was too soft.
7. The pioneers believed that ghosts would walk when the candle turned \_\_\_\_\_.
8. Today, candles symbolize \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
9. At Squire Boone Caverns, it takes \_\_\_\_\_ hours to make a candle.





1. There are four types of wheels that can be used on a mill. Name them.
  - a)
  - b)
  - c)
  - d)
  
2. There are two stones that work together in a mill. They are called \_\_\_\_\_ stones. The top stone is called the \_\_\_\_\_ stone, and the bottom stone is called the \_\_\_\_\_ stone.
  
3. The grooves in the stones are called \_\_\_\_\_.
  
4. A \_\_\_\_\_ had to be built to get the water to the mill. The one at Squire Boone Caverns is more than \_\_\_\_\_ feet long. The portion of this mechanism that includes the floodgate is called the \_\_\_\_\_.
  
5. The part of the mill wheel that catches the water and causes the wheel to turn is called a \_\_\_\_\_.
  
6. Squire Boone first started building his mill in the year \_\_\_\_\_, and it began grinding corn in the year \_\_\_\_\_.
  
7. The type of wheel on Squire Boone's mill is an \_\_\_\_\_.



1. The gold rush began on January 24, \_\_\_\_\_, and most miners found \_\_\_\_\_ gold, which is gold mixed with gravel and mud.
2. The first method of mining gold was called \_\_\_\_\_. Using this method, miners would shake iron washpans and then collect the gold.
3. Four other methods of mining gold were developed later. Name them and tell how many people were needed to operate them.
  - a)
  - b)
  - c)
  - d)
4. After all the gold was gone from the streams, miners then found \_\_\_\_\_ of gold and followed them, drilling through rock, to collect gold.
5. There are many types of rocks and gems to be found while gem mining at Squire Boone Caverns. Name four and tell how you would recognize them.
  - a)
  - b)
  - c)
  - d)



## Optional **ESSAY QUESTIONS**

1. The candles of today were evolved over many years. These candles eventually gave way to electric lights. Imagine if lights were not invented. How would your life be different today if the only light you had in your house was provided by candles instead of electricity. Compare and contrast what activities you do now that you wouldn't be able to do at all.
2. Soap was found accidentally by the Romans around 1000 B.C. If soap hadn't been found, how would we clean ourselves? Would we even take baths? How would life be different if we had no soap?
3. Throughout the years, there have been many ways to mine for gems, from panning to using a sluice to hydraulic mining. Most of these ways are very harmful to the environment. If you found some minerals today, what method would you use to mine them? Would you invent a new method that would be easier and safer to the environment?
4. If you were to build a gristmill today, what type would you build? Give some reasons why. Would you use wood or steel to make the wheel? Explain your reasons. If your area of the country had a severe drought, how would you maximize your grinding production?



# Answers to QUIZ QUESTIONS

## Unit 1

1. vine fibers, resins/wax
2. cocus insect
3. candere, "to shine"
4. chandlers
5. a) beeswax: gave off a more pleasant odor  
b) spermaceti: solid wax that wouldn't bend in hot weather  
c) plaited candle wicks: gave off a brighter, more even light  
d) paraffin: colorless, odorless, easy to mold, clean burning, inexpensive
6. cows (or beef), pigs
7. blue
8. peace, calm, warmth
9. 3-5

## Unit 2

1. overshoot, undershoot, breast, tub
2. burr, runner, nether
3. furrows
4. raceway, 400, mill run
5. bricket
6. 1804, 1809
7. overshoot

## Unit 3

1. 1848, placer
2. panning
3. a) cradles – 4  
b) Long Toms – 3-6  
c) sluice – 20  
d) hydraulic mining – less than 4
4. veins
5. (List of stones found on page 5.)

## Unit 4

1. saponification, saponin
2. false
3. Animals were sacrificed on the Sapo Hill near Rome. The fat of the animals mixed with the ashes at the base of the altar, and this mixture would be washed down the hill when it rained. Women who came to the Tiber River at the base of the hill to wash clothes noticed that their clothing became cleaner when rubbed in this mixture.
4. a) water  
b) lye  
c) fat (lard)
5. hot, cold, cold
6. cleaning, killing chiggers, treating poison ivy, washing hair, removing stains from clothes

# Can you find **THE ANSWERS?**

This is like a scavenger hunt, but instead of objects, you search for information. Bring these questions with you on your field trip and see how many you can answer.

1. What can be found both in the cave and in your soft drink?
2. What do the cave and the gravel in the parking lot have in common?
3. What was your tour guide's name?
4. How old was Squire Boone when he died? How many bones are in his coffin?
5. What color candles were they making in the candle shop?
6. What is the purpose of the metal clips on the ends of the candle wicks?
7. What happens to the metal clips when the candles are finished?
8. How long does it take to dip a batch of large candles?
9. What are the three ingredients in lye soap?
10. Where did the pioneers get their lye?
11. When was the original gristmill built?
12. How tall is the waterwheel?
13. What is the source of the water for the mill?
14. Bring back an oak leaf or an acorn.
15. How long does it take to get here from your school?
16. Try to find a rock shaped like the state you live in.
17. Bring back an example of chlorophyll.
18. What is so special about the carvings on the stones in the gristmill?
19. What was Squire Boone's father's name?
20. What was Squire Boone's profession?
21. How many steps are there to exit the cave?
22. How tall is the exit staircase?
23. Bring back a leaf from a maple tree (or from the state tree of the state you live in).
24. What do bats eat?
25. Why do bats hang from the ceiling?
26. Where do bats go in the winter?
27. Where do the streams in the cave come from?
28. Where do the streams in the cave go?
29. What are the formations called that grow from the floor?
30. What are the formations called that grow from the ceiling?
31. What are they called when they grow together?
32. What are the formations called that grow in streams?

## BONUS:

What is the difference between a cave and a cavern?

# Things **TO DO**

Cross out one word in each group of words that doesn't belong.

1. Overshoot      Undershoot      Breast Wheel      Mill Run
2. Lard      Salt      Water      Lye
3. Dirt      Fool's Gold      Agate      Ulexite
4. Cradle      Sluice      Panning      Gold Veins
5. Beeswax      Paraffin      Plastic      Spermaceti

Unscramble the following words.

- |                 |                       |
|-----------------|-----------------------|
| CNLSADE_____    | PSOA_____             |
| MGE NGMIIN_____ | LLGSTIRMI_____        |
| FPFARAIN_____   | OLOFS LGDO_____       |
| WRAEYCA_____    | SUOODRHNET LWEEH_____ |

Draw a line connecting the words in the first column with the related word in the second column.  
(Words in the second column may have more than one related word in the first column.)

- |                |               |
|----------------|---------------|
| Cocus          |               |
| Furrows        | CANDLE MAKING |
| Agate          |               |
| Saponification | GRISTMILL     |
| Burr Stone     |               |
| Cradle         | GEM MINING    |
| Candere        |               |
| Nether Stone   | SOAP MAKING   |
| Saponin        |               |

# More ANSWERS

## Scavenger Hunt

1. soda straw
2. limestone
3. (tour guide's name)
4. 70 – 20 bones plus skull
5. (candle color)
6. weight
7. The wax is melted off and the clips are reused.
8. 2½ to 3 hours
9. water, lye and lard
10. potash and water
11. 1804-1809
12. 18 feet
13. cave spring
14. (Collect an oak leaf or acorn.)
15. \_\_\_\_\_ minutes/hours
16. (Try to find a rock shaped like your home state.)
17. green leaf
18. They were done by Squire Boone.
19. Squire Boone Senior
20. minister, gunsmith, miller, statesman, explorer and many others
21. 73
22. 60 feet
23. (Collect a maple leaf or leaf from your state tree.)
24. mosquitoes, moths, night-flying insects
25. Their muscles are designed for hanging this way, and the ceiling is a safe place for them to sleep.
26. deep in caves
27. a field three miles from the cave
28. They exit at the gristmill.
29. stalagmites
30. stalactites
31. column or pillar
32. rimstone dams

### BONUS:

A cave is a single room; a cavern consists of several rooms that are connected.

## Things To Do

1. cross out Mill Run
2. cross out Salt
3. cross out Dirt
4. cross out Gold Veins
5. cross out Plastic

CANDLES	SOAP
GEM MINING	GRISTMILL
PARAFFIN	FOOL'S GOLD
RACEWAY	UNDERSHOOT WHEEL

Cocus _____	CANDLE MAKING
Furrows _____	GRISTMILL
Agate _____	GEM MINING
Saponification _____	SOAP MAKING
Burr Stone _____	GRISTMILL
Cradle _____	GEM MINING
Candere _____	CANDLE MAKING
Nether Stone _____	GRISTMILL
Saponin _____	SOAP MAKING



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

Find and circle the following words in the table above regarding candles and gristmills. Words are found horizontally, vertically, diagonally, forward and backward.

- |              |           |                 |                  |
|--------------|-----------|-----------------|------------------|
| BEESWAX      | COCUS     | NETHER STONE    | TALLOW           |
| BREAST WHEEL | FURROWS   | OVERSHOOT WHEEL | TAPERS           |
| BRICKETS     | GRISTMILL | PARAFFIN        | TUB WHEEL        |
| BURR STONE   | LINKS     | RACEWAY         | SPERMACETI       |
| CANDERE      | MILL RUN  | RUNNER STONE    | UNDERSHOOT WHEEL |

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

Find and circle the following words in the table above regarding soap and gem mining. Words are found horizontally, vertically, diagonally, forward and backward.

AGATE  
 AMETHYST  
 CRADLES  
 DRY WASHING  
 FOOL'S GOLD

HYDRAULIC MINING  
 LARD  
 LONG TOMS  
 LYE  
 PANNING

PLACER GOLD  
 PUMICE  
 QUARTZ  
 RIPPLE BOX  
 SAPONIFICATION

SAPONIN  
 SLUICE  
 SULFUR  
 ULEXITE  
 WATER