AGRICULTURE – GRIST MILL

(Sharon Scagliotti & Steve Beck)

I. GOAL

Students will learn about agriculture at Sutter's Fort, how a grist mill works, and some of the history of growing grains and making bread.

II. OBJECTIVE

A. Students will learn how to use the grist mill to grind wheat into flour.
B. Students will learn about the grist mill through common school subjects – math, language, history and science.

III. THE PEOPLE

Sutter had a large Native American workforce, but he also hired emigrants from the United States or Europe, especially during the wheat harvest because that required a larger seasonal workforce.

IV. THE PLACE

Wheat was raised in a number of fields near the Fort. Also, fruit and nut trees and an extensive vegetable garden were located north of the Fort.

V. MATHEMATICS – WEIGHTS AND MEASURES

Captain Sutter used a Spanish unit of volume for measuring wheat, the fenega.

1 fenega = 1.6 bushels

One bushel of wheat yields enough whole wheat flour for 90 one-pound loaves of whole wheat bread.

16 oz dry weight	=	1 pound	4 quarts	=	1 gallon
8 oz	=	1 cup	8 quarts	=	1 peck
2 cups	=	1 pint	4 pecks	=	1 bushel
2 pints	=	1 quart	1 bushel	=	32 quarts

VI. LANGUAGE – WORDS AND PHRASES

Grindstone	Specially carved stones used to grind seeds into flour.
Grist	A quantity of grain to be ground. It refers not only to wheat but also to grains such as oats, corn, rye, barley, etc.
Flail	A tool that consists of a wooden staff with a short heavy stick swinging from it to beat the harvested grain and separate the kernel from the inedible chaff.
Mill	A building equipped with machinery.
Grist mill	A mill with machinery designed to grind grain into flour.
Miller	A person who owns or operates a grist mill.
Thresh	To separate the wheat kernel or berry from the inedible chaff by beating with a flail, etc. To beat severely. Straw or dried hay used for livestock or roof thatch.
Threshold	A strip of wood, stone or bundled straw forming the bottom of a doorway and crossed on entering or leaving a building.
Cross the threshold	The threshold is the transition between safety (home and hearth) and the uncertainty of the wider world. The phrase means stepping from certainty to uncertainty.
Flailing away	Swinging or waving about wildly.
It's all grist for the mill	Everything can be made useful or be a source of profit.
Keep your nose to the grindstone	If a grindstone is turned too fast it will build up heat and burn the flour. Millers frequently sniffed their grindstones to make sure the flour wasn't burning. So, this phrase refers to any hard, consistent work.
Run of the Mill	Undistinguished, ordinary, average. That is, the ordinary flour produced by a mill.
Through the Mill	To be exposed to hardship or rough treatment, just like grain being ground.
To have a millstone around one's neck	To have a heavy weight of worry or work weighing one down

VII. BRIEF HISTORY OF BREAD

For centuries the staple food for China was (and is) rice, for the Americas it was corn and beans, and for the Mediterranean and mid-East regions it was wheat. In the early days of what was to become the United States, English colonists planted wheat in Jamestown, Virginia, but met with little success. They quickly changed to other crops such as corn, tobacco and cotton. Wheat was more of a hobby crop. George Washington grew wheat on his plantation and built a grist mill to process the wheat into flour.

Ancients	Ground wild grains between flat stones, mixed the flour with water to make a flat bread similar to tortillas or pita.
Eqyptians	The first to use yeast as a rising (leavening) agent as early as 4,000 BC. They developed a consistent process for grinding.
Greeks	Avid bakers who refined flours to eliminate impurities, and seasoned their breads with honey, seeds, nuts and fruits. They developed the stone oven for baking.
Romans	Introduced “bread” to all the lands they conquered.

VII. SCIENCE AND AGRICULTURE

Wheat is a grass that is grown all over the world. It is a staple food that is ground into flour for bread, cereals, cookies, cakes, and pasta. More foods are made with wheat that any other cereal grain. It all begins with farming:

- Till (plow) the field.
- Sow the seeds.
- Water the plants.
- Harvest the crop, usually in June.
- Remove the stalk (straw) from the seed head
- Thresh the wheat to separate the seeds from the chaff
- Winnow to remove the seeds from the chaff
- Grind the seeds into flour, but remember to save some seeds to plant next year

The wheat kernel or berry is the seed of the wheat plant. Each tiny seed has three parts: the endosperm, the bran, and the germ.

- The endosperm is about 83% of the wheat kernel. It is used to make white flour. To make whole wheat flour you combine the endosperm with the bran and the germ.
- The bran is the outer layers of the kernel and is also used in breakfast cereals.
- The germ is tiny, it is the part that will sprout and grow into a new wheat plant if the seed is planted.

VIII. GRAINS OF TRUTH

One bushel of wheat weighs sixty (60) pounds and contains one million individual kernels.

One bushel of wheat yields:

- 42 pounds of white flour which will make 70 one-pound loaves of white bread
  or
- 60 pounds of whole wheat flour which will make 90 one-pound loaves of whole wheat bread
  or
- 45 24-ounce boxes of wheat flake cereal
  or
- 43 pounds of pasta – spaghetti is the most popular

THEN . . . in the 1840s it took a farmer more than 64 hours to prepare the soil, plant the seed, harvest and thresh one acre of wheat. Most families grew only 2.5 acres of wheat.

NOW . . . with mechanization it takes a farmer approximately 3 hours to prepare the soil, plant the seed, harvest and thresh one acre of wheat. Most wheat farmers grow about 1,000 acres.

In California, before the Gold Rush, flour cost about 1.5 cents per pound, during the Gold Rush about $1.50 per pound.

The average American eats approximately 136 pounds of flour each year.

Approximately 925 million pounds of crackers are sold in the U.S. each year.

Approximately 3 billion pizzas are sold in the U.S. each year.

Every American eats approximately 46 slices of pizza each year.

52% of Americans say the chocolate chip cookie is their favorite cookie.

IX. NOTES ON AGRICULTURE AND THE GRIST MILL AT SUTTER'S FORT

The grist mill may have been the single most important place at Sutter's Fort. It was probably in operation day and night. It not only had to provide flour for the hundreds of people living and working around the Fort, but until 1846 it was the only source of flour for anyone living in the Sacramento Valley. Agriculture was the backbone of Sutter's empire and would have been the key to future riches.

Prior to Sutter establishing New Helvetia, the nearest grist mill was in Sonoma. In 1846 a man named Sheldon opened a grist mill near present day Sloughhouse. The grinding stones were originally cut from a place called Stony Creek, about 25 miles from the Fort. Archaeologists and geologists suspect they probably came from the area of present day Rocklin. There are

still quarries there that produce fine-grained granite and microcrystalline quartzite. Both of these make excellent rock for grinding stones. Of course, before you can grind flour, you have to grow wheat.

Sutter took great pride in his agricultural endeavors. Early visitors to the Fort, such as the French diplomat and dignitary Comte deMofras, wrote glowingly about the limitless potential for agriculture at new Helvetia. The rich soil and the flat grasslands were an agricultural paradise to the trained eye. However, potential does not always translate info production. Sutter had many obstacles to overcome. His large Native American workforce was not initially accustomed in the use of agricultural implements and the tools that were initially available were crude. When Sutter first arrived, the standard for breaking ground was the "California Plow." This was a piece of iron attached to a piece of wood pulled behind an ox. Harvesting tools consisted of barrel hoops, short blades, and bare hands. Nevertheless, by 1848 Sutter was harvesting over 50,000 fenegas (80,000 bushels) of wheat per year. Before 1841, a few hundred fenegas was probably the best he could do.

In 1841 Sutter purchased Fort Ross from the Russians, and he acquired the tools and implements to make his empire burgeon. These included manufactured steel plows, steel scythes, threshing floors and winnowing machines. The Russian outpost had these tools because it was originally established (ca. 1809) as an agricultural outpost to supply food for the large Russian American Fur Company outpost at Fort Sitka, Alaska. Unfortunately for the Russians, the climate along the coast of Northern California is not conducive for growing wheat. After the otter and seal populations were trapped out, Fort Ross became expendable to the Russians, and they sold the fort and all its trimmings to Sutter fro $2,000 cash down, $18,000 to be paid in wheat and other produce over four years, plus a final payment of $10,000 in cash to be paid at the end of the four years. This was a debt that haunted Sutter the entire time he was at the Fort – potential does not equal production (but that's a story for another time). The important point is that Sutter acquired the tools to operate an agricultural empire, but not without incident. The threshing floors (large hardwood floors upon which the wheat is beaten to separate the wheat berry from the stalk), manufactured by Russian carpenters, were so well put together they couldn't be dismantled. John Bidwell and the crew in charge of dismantling Fort Ross attempted to float one of the floors through the Golden Gate and up the Sacramento River. Unfortunately, it was dashed upon the rocks of the Marin Headlands and was a total loss. The other floors were disassembled for shipping and were badly damaged in the process. The prized greenhouse was broken during overland transport and many of the fruit and nut trees did not survive being transplanted. But generally, the purchase of Fort Ross gave Sutter instant credibility as a major player in California agriculture, and nearly all visitors wrote about Sutter's agricultural methods. Wheat was Sutter's primary crop and the process of turning it into flour was unique.

After wheat was harvested, the seed head was removed from the stalk. The stalks were bundled and used as straw. The heads were then threshed, the process by which the chaff and the wheat berry are separated. This was accomplished by two different methods. The preferred method was to line the floor of the corral outside the southeast bastion with the wheat heads. Then a caballada of horses (a herd roughly consisting of twenty-five mares and one stallion) was let into the corral and chased around, thereby trampling the wheat. Whenever a running horse began to slow it was removed from the corral and replaced with a

fresh horse. This was done for two reasons: (1) there was no reason to exhaust the horses, and (2) a running horse doesn't poop but a standing horse does. Obviously during the rainy season this method was not an option. During the rain, the wheat heads were laid out on the threshing floors or on the floors of the bastions and beaten with a flail.

The next step in preparing the wheat was to winnow it. This is how the chaff is removed, leaving just the edible wheat berry. Sutter wrote frequently in the *New Helvetia Diary* about whether it was a good day to winnow the wheat. Again, Sutter found a unique way to accomplish this. First, the combined, but threshed, chaff and berry were shoveled into handbarrows and carried to the tops of the bastions. Canvas from sail cloth was laid on the ground outside the Fort beneath the bastions. The chaff and berry were then shoveled out of the bastion windows and the wind would blow the lighter chaff away and the heavier berry would fall onto the canvas. Naturally, a good day to winnow wheat meant there was some wind. Small amounts of wheat could be winnowed in winnowing baskets. Once the berry is cleaned of chaff, it is ready to be ground into flour.

The cleaned wheat berry is poured into the hopper (the large funnel) that puts the wheat into the grinding stone. The grinding stone, or mill stone, consists of two individual stones between which the wheat is ground into flour. The bottom stone is the bed stone and it remains fixed in place. The top stone is the runner stone and it is what is turned. The axle is slightly off center so that the runner stone turns in an ellipsis over the bed stone. This forces the flour out into the catch box as the stone turns. The wheat is pulverized because of troughs and ridges cut into the stones. The troughs are called furrows, and the ridges are called lands. The furrows and lands are different lengths, which also aids in forcing the flour out from between the stones.

The runner stone is turned via a wooden lever to which a mule is harnessed (in a grist mill – the runner stone would be turned by various cogs moved by water). It is important that the grinding be done at a constant, but not too fast rate. If the stone is turned too fast, the friction will create heat, which will burn the flour. If that happens, the bread will taste burned even if it is not. Because of this it was important for the miller to frequently bend over and sniff for the smell of burning flour, hence the saying "keep your nose to the grindstone." The grinding actually consisted of a couple of different grindings. The first grinding was done with a runner stone with deep lands and furrows, producing a coarse mixture of flour and bran. A second grinding was then done with a finishing stone with shallow lands and furrows to produce a finer mixture of flour and bran. The mixture was then sifted in large buckets to separate the flour from the bran. The flour has a fine light texture and color and is used to make bread, ship's bread, cakes, cookies, etc. The bran is much tougher and must be softened before eating. During planting and harvesting time, hundreds of workers needed to be fed at the Fort. Also, during the harvest, several rooms in the Fort became granaries for storing the wheat until it could be threshed, winnowed, and ground. Sutter bagged wheat that was not ground and used it as cash or to trade for manufactured items.

These are just the basics of agriculture at the Fort, but should be enough to interpret the grist mill station. Sutter also had fruit trees, an extensive vegetable garden, and produced wine and a form of brandy called aguardiente, translated as "water with a bite."