The Power of Water

Subject: History/Social Studies/Geography/Science & Technology
Grades: 7-12

Skills:	Materials:
• Research • Geography • Critical Thinking • Hydroelectric Power • Systems • Matter and Energy	• Sheet of Paper • Paper Plates • Paper/Plastic Cups (small) • Pencils • Rubber Bands (large) • Stapler/Staples • Scissors • Masking Tape • Water Source (this can be a faucet or a pitcher filled with water as long as there is a basin to catch the water)

Summary:

The Androscoggin River's Great Falls was the steepest drop in any Maine river and it was logical to harness its power. Hydroelectric power depended on energy from the waterfalls generating power for each mill's power generation station.

The Canals

In 1850, inspired by the success of Lowell, Massachusetts, a group of investors led by Benjamin Bates bought land and built mills alongside the Great Falls. They hired laborers to dig the canals that carried water around the falls and under the mills, turning turbines that pulled belts that drove the looms and spinning frames. Their venture prospered: by 1900, eight different companies were producing cotton and woolen textiles in vast brick complexes between the canals and the river. Lewiston boomed as well, growing from a mill village of some two thousand souls in 1840 to a city of more than 30,000 in 1920.

The canals consist of five interconnected canals: Upper, Lower, and Cross and measure 2.5 miles in length. Upper Canal brings water from the Androscoggin River to the mills. It is 60 feet wide and 11 to 14 feet deep. It is connected to the Union Water Power

Gatehouse, constructed in 1851. This is where the water that flows from the river into the canal is regulated. Once the water enters the Upper Canal it is redirected into two different Cross Canals that flow into the Lower Canal.

Canals are energy transporters; they carry water from the Androscoggin River to the mills.

The Upper Canal is at a higher elevation than the Cross Canals which are higher than the Lower Canal. These elevations create a current in the water flow that moves underneath the mills via mill arches, ultimately spinning the turbines within the mills.

These canals were constructed primarily by Irish immigrants. These immigrants had left Ireland during the potato famine. They were experienced with building the canals in Lowell, Mass. They were brought to Lewiston to build the canals.

Hydropower

Water from canals flowed through an opening in the basement of the mills and into buckets, originally called breastwheels, which rotated as they became full of water.

The weight of the water in the breastwheels propelled the waterwheel in a circular motion. The waterwheel was attached to a vertical shaft through two bevel gears arranged at a 90-degree angle to one another. This converted stored energy into usable kinetic energy.

Machines within the mills were arranged in long lines so that harnessed power could travel the length of the building.

Due to frequent malfunctions and unproductive outcomes, a new design of a belt-and-pulley system was devised in 1828. In this system, a flywheel transferred stored power from the main shaft to smaller shafts and then to individual looms, creating a more efficient, smoother and productive system.

How water wheels work

Water wheels have several important parts that work together.

1. Flowing water (delivered via a channel called a mill race)
2. Large wooden or metal wheels
3. Paddles or buckets (arranged evenly around the wheel)
4. Axle
5. Belts or gears

To produce power, the energy of flowing water pushes against the paddles or buckets and turns the wheel. This causes the axle to turn which drives belts and gears that

power the machinery. The larger the diameter of the wheel, the greater “leverage” and so the greater turning effect on the axle that drives the machine.

The mill race has two parts: the part that brings the water to the wheel is called the “head race” and the part that carries the water away is the “tail race.”

Instructions:

Constructing Your Waterwheel:

1. Hold the two plates together so that the bottoms are back-to-back. Using the point of the scissors, carefully punch a hole in the center of both plates.
2. Take one of the cups. Staple the cup to the inside edge of the plate with the lip facing outward. Repeat with as many cups as are necessary to line the entire edge of the plate.
3. Staple the second plate onto the opposite side of the cups. Be sure that the holes in the plates are located directly opposite of one another.
4. Push the pencil or dowel through the holes in the center of the plates. With masking tape, tape the pencil into place.

Using Your Waterwheel:

1. Have one partner hold the dowel or pencil loosely on each side of the waterwheel. Place the waterwheel under the faucet or water source.
2. Have the other partner turn on the faucet or water source. Your wheel should turn!
3. Try changing the speed at which the water is poured into the water wheel. What happens to your waterwheel as the rate of flow changes?

Harnessing Water Power:

1. Pierce the round piece of paper with the second pencil. Slide the paper about 1/3 of the way down the pencil.
2. Slide your rubber band onto the other end of the pencil.
3. Loosely hold the pencil at both ends, with the rubber band in the middle.
4. Slide the other end of the rubber band onto the water wheel’s pencil. Have a second person loosely hold both ends of the pencil on the water wheel.
5. Have a third person pour the water.
6. Watch what the power generated by the water does.

Extension Activities

Explore how modern hydroelectric power powers our nation with the US Geological Survey