# STEAM POWER IN THE 19TH CENTURY
# (Introduction by Ron James, Lesson by Camille Stegman)

## Introduction

***The Comstock Mining District was one of the most technologically innovative places in the world during its 1860-1880 heyday. Dynamite, air compressed drills, spectacular water systems, flat-wire cable, and many other inventions originated or were first tested in Virginia City. In spite of the diversity of the inventions, every working machine on the Comstock was powered either by muscles or by steam. The internal combustion engine was one innovation that would have to wait for a later day. Because of this, steam was critically important to nineteenth-century mining. Understanding how to generate, harness, and manipulate this source of energy was of primary importance for the Comstock and for the industrial world of the time.***

***For mining, steam ran the hoisting works that lifted and lowered cages, the elevators that transported miners, supplies, tools, and ore. It also ran ventilation to keep the air breathable. In the mills, it powered the crushing of ore, the transport of ore through the milling process, and it generated the heat needed to help extract gold and silver. It even ran printing press for newspapers and helped operate steam laundries such as the Pioneer just north of Virginia City, cleaning thousands of pieces of cloth each week. Finally, steam ran the locomotives that provided transportation for people, ore, bullion, lumber, and supplies, connecting the remote mining district to the outside world.***

## Lesson on Steam Power

**Anticipatory Set:**

Choose a student, wad up a piece of paper, and place it on the table in front of the student. Ask the student to move the paper without touching it with his hands or anything moved by his hands. Hopefully, the student will blow on it. If this occurs let the student know that he has done well, but can he do it any faster? Keep this up for a few times, telling him/her to move the paper faster each time. (Is that all the faster you can go? Etc.). Hand the student a tube (PVC, copper tubing, etc). Ask 'Can you move the paper any faster with this? Hopefully, the student will use the tube like a spitball launcher and place the paper in one end, cover it with his mouth and blow really hard, thus launching the paper across the room.

Ask "Why?"

Return the student to his seat and have everyone turn to a partner and discuss "why?"

Students should be able to determine that all his/her air was in the tube and forced the paper out the other end.

**Explanation:**

Explain that if an object is placed between an area of High Pressure and Low Pressure, the High Pressure will push the object into the Low Pressure.

## Activity:

**Materials**:

Several Putt-Putt Boats (available from Grahamco Trading - previously at www.hilgartdata.com/grahamco/index.htm)

Olive Oil
Several shallow, long pans
Matches
Materials to make rudders (optional for a contest of which boat goes the farthest)
Tape, aluminum foil, etc.

Ask students if they know the difference between water and water vapor (hopefully the answer includes, less dense, water heated up to gas state, really hot water makes steam)
**Say NO more.** Let the kids explore with the boats.
**Give one direction:** You need to tell me how these boats work.

Each boat comes with directions, however, if need be the directions are as follows:

*To operate:*

*Step1: Cut off 1" of wick and tread it through the wick holder, leaving approx. 1/8" of wick sticking out the top of the holder.*

*Step2: Place the wick holder in the fuel holder, wet wick with olive oil and add oil to fuel holder till ½ full.*

*Step3: Pour water in one of the pipes at the rear of the boat using the provided dropper (any dropper will work). Fill pipe with water until it flows out the other pipe. Float the boat in a shallow pan.*

*Step4: Test the wick. If black smoke appears, cut the length of the wick till it burns cleanly. Place the flame as far as possible under the boiler in the boat.*

*DO NOT put the flame in the boat until it is floating in the water. The boat is metal and conducts heat very well.*

*Wait about 60 seconds and a pulsing sound will begin and the boat will move. (If this doesn't happen, go back to step 3 and try again).*

*Boats will move in a circle, this is because one pipe is longer than the other pipe. It can be fixed with a simple rudder attached to the bottom of the boat, let the students figure this out.*

*To stop the boat, remove the fuel holder and extinguish the flame. DO NOT touch the boat for a few seconds to let it cool down.*

**Discussion:**

Ask, "How do you think the boat works?" Hopefully one answer will be: The flame heats the water; it expands and pushes out the back pipes.

**Explanation:**

When the water in the coil boils, the steam expands. This pushes the water out of the tubes. The reaction, according to Newton's Third Law (equal and opposite reaction) pushes the boat forward. As the steam continues to expand, it encounters the section of tubing that used to be full of water. This tubing is cold and the steam condenses back into water. This causes a vacuum to form, which pulls more water back into the tubes. Because it comes in contact with the hot boiler again, it quickly turns back into steam. This is what makes the putt-putt noise.

This is similar to how a steam engine works.

**Demonstration:**

A demonstration of a steam engine will be done by the Railroad Museum.