

Steamboats

Overview: This experiment provides a creative way to see how steam can provide power and offer us insight into how power is generated through this common means.

What to Learn: Many natural resources can meet our energy needs. We need to convert the energy stored in water into energy that we can use as electricity or heat.

Materials

- Copper tubing (1/8"-1/4" dia x 12" long)
- Votive candle
- Foam block
- Scissors or razor (with adult help)
- Bathtub

Lab Time

1. Wrap the copper tubing 2-3 times around a thick marker. You want to create a "coil" with the tubing. Do this slowly so you don't kink the tubing. End with two 3" parallel tails. (This is easier if you start in the middle of the tubing and work outwards in both directions.)
2. Stick each tail through a block of foam. Bend the wires so they run along the length of the bottom of the boat, slightly pointed upwards. (You can also use a plastic bottle cut in half.)
3. Position a votive candle on the topside of the boat and angle the coil so it sits right where the flame will be.
4. To start your boat, fill the bathtub with water. While your tub fills, hold the tubing in the running water and completely fill the coil with water.
5. Have your adult helper light the candle. In a moment, you should hear the "putt putt" sounds of the boat working!
6. Record all observations in the worksheet below.

Steamboat Observations

1. How is your boat using energy?

2. Take the weight of your boat using a scale. Then measure the distance it travels. How much work is your steam engine doing? Show your calculations below.

Your steamboat uses a votive candle as a heat source to heat the water inside the copper tubing (which is your boiling chamber). When the water is heated to steam, the steam pushes out the tube at the back with a small burst of energy, which pushes the boat forward.

Since your chamber is small, you only get a short "puff" of energy. After the steam zips out, it creates a low pressure where it once was inside the tube, and this draws in fresh, cool water from the tub. The candle then heats this new water until steam is produced and POP! it goes out the back, which in turn draws in more cool water to be heated ... and on it goes. The "clicking" or "putt putt" noise you hear is the steam shooting out the back. This goes on until you either run out of water or heat.

Troubleshooting: if your boat doesn't work, it could be a few things:

- The tubing has an air bubble. In this case, suck on one of the ends like a straw to draw in more water. Heating an air bubble will not make the boat move – it needs to be completely filled with water.
- Your coil is not hot enough. You need the water to turn into steam, and in order for this to happen, you have to heat the coil as hot as you can. Move the coil into a better position to get heat from the flame.
- The exhaust pipes are angled down. You want the steam to move up and out of your pipes, not get sucked back in. Adjust the exit tubing tails so they point slightly upwards.

Reading

Solar cells, wind turbines, and hydroelectric power plants (like the Hoover dam) are all examples of alternative energy sources. Although lots of folks still argue about what's considered "alternative" or not, the general idea is that the sources produce the same energy at less cost, both money-wise and environmentally.

Scientists are now working on substitutes for traditional methods of generating power. For example, they have figured out ways to use alcohol instead of fossil fuels, coal instead of wood, and petroleum instead of whale oil.

Since alternative energy experiments in this area require power plants and machinery the size of a small town, we're going to focus on a very specialized form of alternative energy called renewable energy.

Renewable energy is the energy created from natural sources, like sunlight, water, wind, and temperature differences (geothermal). We'll make solar-powered robots, build solar batteries, light up bulbs using a blast from a hair dryer, and capture the energy in light waves on our battery-free radio.

Steam power may seem like an example of traditional energy usage, when in reality it is able to supply a surprising amount of renewable energy as water is heated in a solar collection tower, geothermal plant, or biomass power station.

Exercises Answer the questions below:

1. Name three sources of renewable or alternative energy:
 - a.
 - b.
 - c.
2. Why is it important to look for renewable sources of energy?
3. What is one example of a fossil fuel?

Answers to Exercises: Steamboats

1. Name three sources of renewable or alternative energy: (wind, solar, water, geothermal, wave, tide, biomass)
2. Why is it important to look for renewable sources of energy? (Because other sources like fossil fuels are finite and will run out.)
3. What is one example of a fossil fuel? (coal, oil, natural gas)