



15A Water Quality and Ecosystems

How does surface water quality affect the surrounding ecosystem?

Water is one of our most important *natural resources*. Consequently, many careers involve studying and taking care of our water supply. Some scientists test and monitor the water supply and some study weather patterns to better understand the water cycle. People involved in government agencies, nonprofit organizations, and the media keep track of information about water and make this information available to the general public. In this investigation, you will meet a specialist in the field of water quality testing, and perform water quality tests. As you complete the investigation, think about what causes water pollution. What actions can you take to reduce your water usage and to improve water quality?

Materials

- Water quality test set
- Data sheet
- Clipboard and pencils
- Secchi disk (optional)
- Trash bags
- Moist towelettes for cleaning hands
- Safety goggles
- Disposable gloves

1 Meeting a water quality specialist

1. Before you meet the specialist, write down his or her name and occupation. Prepare three questions that you would like to ask the specialist.

WARNING — This lab contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

2. During the meeting, take notes. Review your notes and write down at least three new things that you learned from the specialist.

2 Preparing for your field trip

As you prepare for the field trip, be sure to record your work in your lab notebook.

On your own:

1. Read about the water cycle and water quality in Chapter 15 of your text.
2. Make sure you are familiar with the procedures for the water quality testing. Each test involves some special steps. Take notes as your teacher outlines the test procedures. The field trip will be more enjoyable if you understand the tests and how they are performed.

With your group:

1. Describe the place that your class will perform water quality testing. Where is it located? What kind of surface water will be tested?

2. Make a prediction about the quality of the surface water to be tested. Will the water in this location be clean or polluted? Justify your answer.

With the class:

1. Create data sheets for collecting quantitative and qualitative data. What information needs to go on the data sheets?

2. Look at a map of the surface water that will be tested. Discuss and decide where samples will be taken. Assign locations to each group.



3 Field trip: Testing surface water

Safety tip: Wear goggles and disposable gloves throughout the testing process. Be sure to wash your hands thoroughly when you have completed the tests.

1. Make general observations about the surface water and the day's weather.

2. Use your data sheets for recording information at each sampling sight.
3. You will be using supplies from a water quality testing kit to perform this investigation. Be sure to follow the directions and safety instructions for using these supplies while you perform the tests.

4 Thinking about what you observed

1. With your group, go over your data sheets carefully and make sure that you have recorded all the observations that you wanted to make.
2. Compile the data with the class. Make data tables for each test.
3. Using the compiled data, each group should create a water quality report for the surface water tested. Be sure to address whether or not the quality of the water at this site matched your prediction. In your report, include a section that addresses what your class can do to maintain the water quality at the test site or help improve the water quality at the test site.

5 Water quality and ecosystems

1. Describe the freshwater ecosystem you observed. Name both living and nonliving parts of the ecosystem. Identify at least three food chains.

2. Choose three of the tests you performed. Predict what would happen to the ecosystem if the result of each test changed. Consider each test separately. (You do not need to predict what would happen if all three changes occurred at once!) If the change is positive, suggest one way that local citizens could encourage this change. If the change is negative, suggest one way that citizens could work to prevent the change from occurring. Use the table below to organize your thoughts.

Table I: Changes to the freshwater ecosystem

Water quality test	Proposed change	Positive or negative?	How can we encourage or prevent this change?
Sample: Water temp	Increased by 10°C	Negative. Less dissolved oxygen available to aquatic animals.	Let local industry know of harmful effects of discharging hot water into the lake.



15B Natural Resources

What resources do we use and how can we conserve them?

Over 600 massive stone statues stand on a remote island in the South Pacific we now call Easter Island. Each mysterious stone statue is approximately 20 feet tall. Who made these statues and what happened to this advanced society? It is believed that when the population of the island reached its peak, resources started to be used at a faster rate than they could be replenished. As the lush forests were cleared for agriculture and to aid in the construction of the massive statues, wildlife began to disappear and the soil eroded away. Unable to sustain itself, the civilization as it had existed for hundreds of years tragically disappeared.



Photo by Captain Albert Theberge, NOAA Corps (ret.)

Materials

- Blender
- Rolling pin
- Measuring cup
- Large shallow pan
- Fine mesh wire screen
- Small cup and stirrer
- Cornstarch and water
- Wax paper
- Old newspaper
- Calculator
- Graph Paper

In some ways, modern society is similar to the inhabitants of Easter Island. We are using resources such as clean water and trees faster than they can be renewed. How can we make sure we don't turn out like the inhabitants of Easter Island? Because we are so dependent on such resources, it is important that we learn how to reduce, reuse, and recycle them. In this investigation, we will discover which resources we are throwing away in landfills and experiment with recycling paper to learn about conserving resources.

1 Stop and think

- a. The majority of our waste is disposed of in landfills. What proportion of the landfill do you think is taken up by paper? a. 4% b. 18% c. 34% d. 56%
- b. Predict how the paper will turn out after being recycled. Will it be similar or will it be different from the original sheet and if so, how?

- c. In this investigation, you will be making new paper by recycling old paper. Read through the lab and explain what is missing from the investigation to make it a scientific experiment.

2 Doing the activity; recycling paper

1. Cover the work area with old newspaper.
2. Tear up $\frac{1}{2}$ of a sheet of newspaper into small 2 cm by 2 cm pieces. Place the pieces in the shallow pan and cover them with water.
3. In a small cup, mix 2 cups of water with $\frac{1}{8}$ cup of cornstarch and stir until cornstarch is dissolved. Pour mixture into the blender and blend for 15 seconds.
4. In the pan, drain the water out and squeeze the newspaper pieces.
5. Put the newspaper pieces in the blender with the cornstarch mixture. Blend for approximately 30 seconds. If any chunks of newspaper remain, continue to blend until they disappear and you have a fuzzy liquid. You have just made pulp.
6. Place the screen in the pan. Pour the pulp mixture over the screen. Lift the screen gently from the pan so that only the pulp remains on the screen. Then place the screen on the newspapers in your work area and drain the pan in the sink.
7. Place the screen with the pulp back in the pan and use your fingers to spread the pulp out to the size of a sheet of paper. Cover the pulp with a sheet of wax paper.
8. Use the rolling pin to press the pulp flat and to press water out of the pulp mixture. Continue to periodically empty the water out of the pan.
9. Once you have pressed as much water as you think possible from the pulp, carefully remove the sheet of wax of paper.
10. Lay the screen with the pulp, screen down, over the newspapers and allow the pulp mixture to dry overnight.
11. Once dry, remove the paper from the screen by lightly rubbing the back of the screen.
12. Examine your recycled paper.





3 Examining a landfill

- a. Examine Table 1. Use a calculator to determine the percent of paper in a landfill. If necessary, ask your teacher for help.
- b. Besides recycling, list three ways we could reduce our paper use?

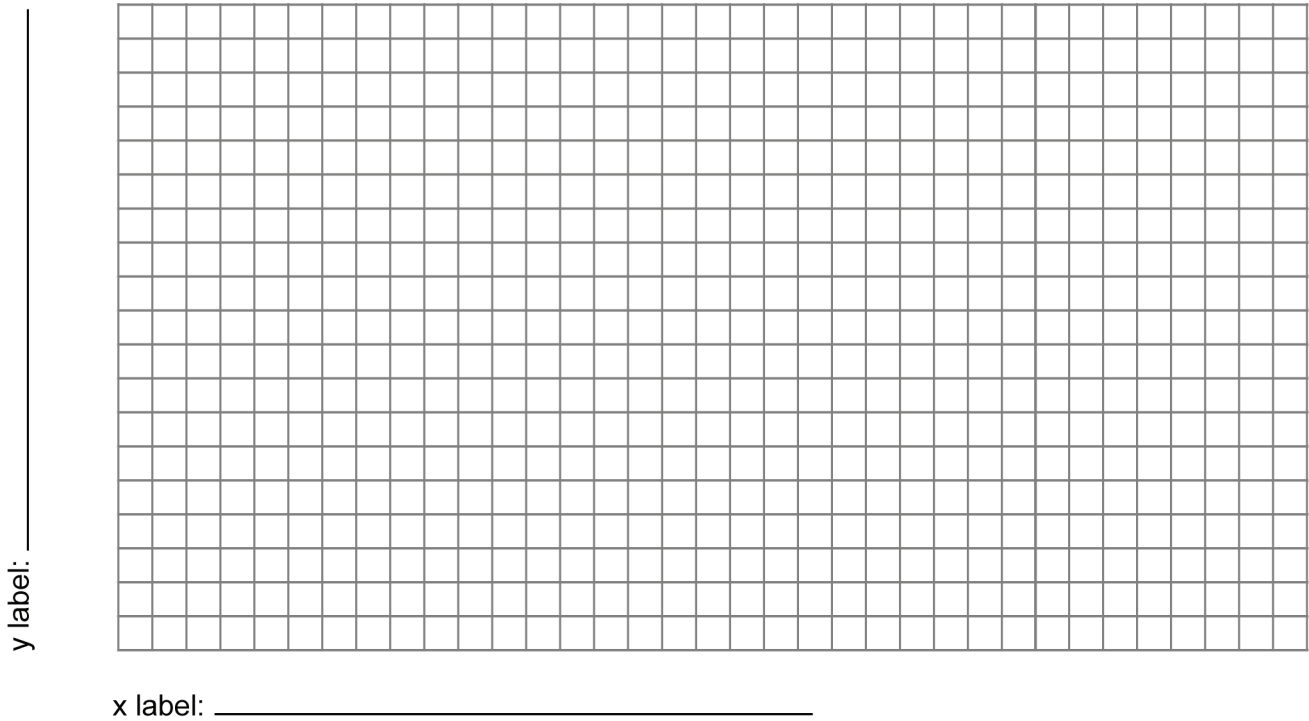
- c. If all yard trimmings and food scraps were composted, how much space would we save in landfills?

Table 1: Landfill Amounts

Item	Percent in Landfill
Paper	?
Yard Trimmings	13.1
Food Scraps	11.9
Plastics	11.8
Metals	7.6
Rubber, leather, and textiles	7.3
Wood	5.7
Glass	5.2
Miscellaneous	3.4

d. On graph paper, create a bar graph or a pie graph to represent the data in Table 1.

Title: _____



4 Thinking about what you observed

a. Examine your sheet of recycled paper. How is it different than the sheet of paper you started with?

b. What is the difference between a renewable and a nonrenewable resource? Give examples of each.

c. Besides the original paper, what other resources were necessary for the process of recycling?



d. Why do you think conservationists argue that reducing is a better alternative than recycling?

e. Think about the words reduce, reuse, and recycle. Explain the difference between each and give an example of each.

5 Exploring on your own

a. How much waste does your family create in a day? In a week? In a month? Design an experiment to find out how much waste is produced. Check with your teacher before conducting the experiment.

b. Can you influence your family to produce less trash? Design an experiment to find out. Check with your teacher before conducting the experiment.

c. What are people's attitudes toward recycling? Design a survey to find out. Check with your teacher before conducting the survey.

d. Research - Besides reducing the amount of material in our landfills, what other benefits are associated with composting? Is there some way composting may be of value to you or your family?



16A Non-Renewable Resources

How fast are we using non-renewable resources?

As the world population and demand for energy increases, having a variety of energy sources becomes more and more important. We consume energy quickly, so we need sources of energy that are long-lasting, efficient, and as clean as possible.

In this investigation, you will model the depletion of resources over time at a constant rate of use. Then you will model the depletion of resources when the rate of use increases. Next, you will make a physical model of an oil seep. This will help you understand how we find oil in the ocean.

Materials

- 1 open container per two students
- 2 types of dried beans or nuts—100 beans per pair (90% one color/type, 10% another color/type)
- Blindfold
- Large clear cup or glass
- Small mixing bowl
- 2 mL cooking oil
- 10 mL sand
- 30 mL soil
- 1 stick of modeling clay
- Water

1 Stop and think

- a. What is the difference between renewable and non-renewable resources?

- b. What are some examples of each of these resources?

- c. What type of resource do you expect will be depleted first?

2 Activity A

In this activity, you will learn how non-renewable resources get depleted over time, especially as rate of use increases.

1. Fill your container with 100 beans (90 of one color type, 10 of another color/type). The 90 beans represent the fact that the United States currently uses non-renewable

fossil fuels for 90% of our energy needs. The other 10% of our energy needs are met with renewable resources.

2. One student in each pair will put on the blindfold. This student will choose beans from the container.
3. For the first trial, the situation is as follows: The population is NOT growing and the demand for resources stays exactly the same from one year to the next. The blindfolded student will randomly pick 10 beans out of the jar. Any “renewable beans” can be put back in the jar. After replacing these beans, count how many beans remain in the jar. Record this information in the “Year 1” column of Table 1. How many years do you think it will take to deplete the non-renewable beans?

4. Repeat the process for year two. Continue until only renewable beans are left. Record all your data in Table 1. You may or may not use all of the columns available. You might even have to add more columns. Calculate the percentage left after each drawing. How many years did it take to run out of non-renewable resources?

Table 1: Renewable and non-renewable energy use

Consumption Level	Year														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Remove 10 beans each year (constant use)	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
# of beans remaining in container															
% renewable															
% non-renewable															

5. Now, remove the blindfold. Put it on the other student. Place all the beans back in the container. This time, you will be modeling a situation where the population is increasing and so is the demand for energy.
6. Predict again how many years it will take to deplete the resources.



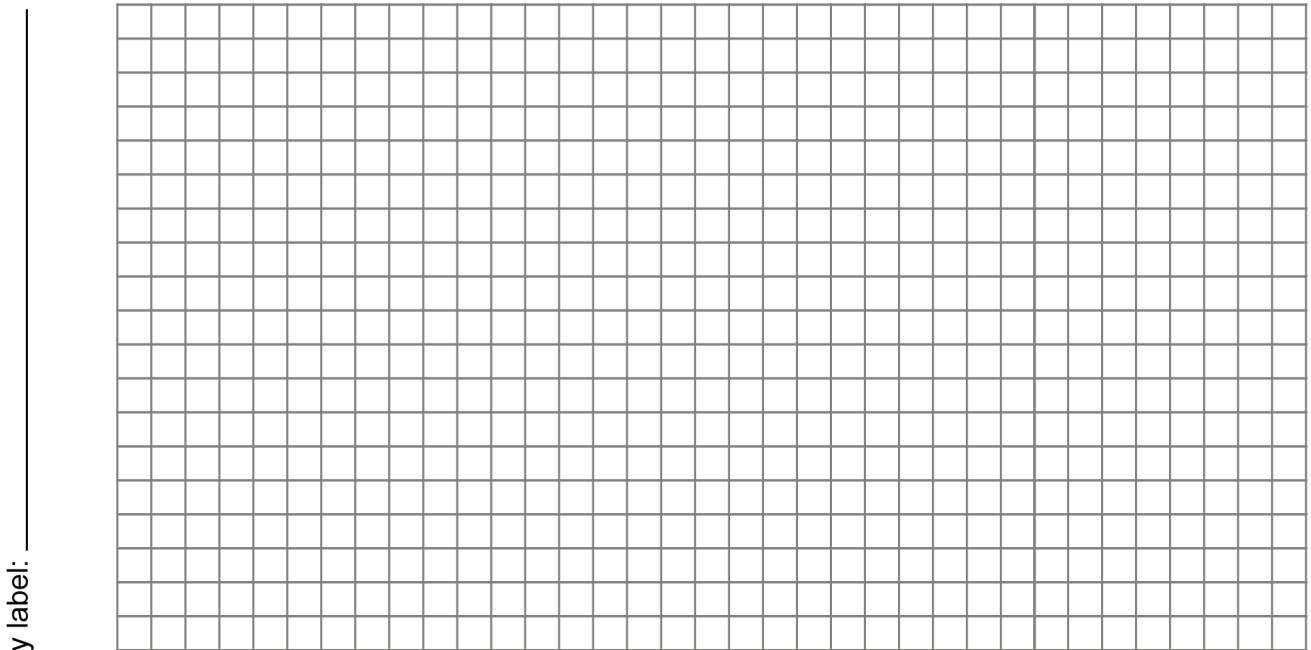
7. Proceed in the same way, except follow the table to see how many beans to pull out each year.

Consumption Level	Year														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Remove 5 more beans each year (increasing demand)	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
# of beans remaining in container															
% renewable															
% non-renewable															

8. Remove the blindfold. How many years did it actually take to run out of non-renewable resources?

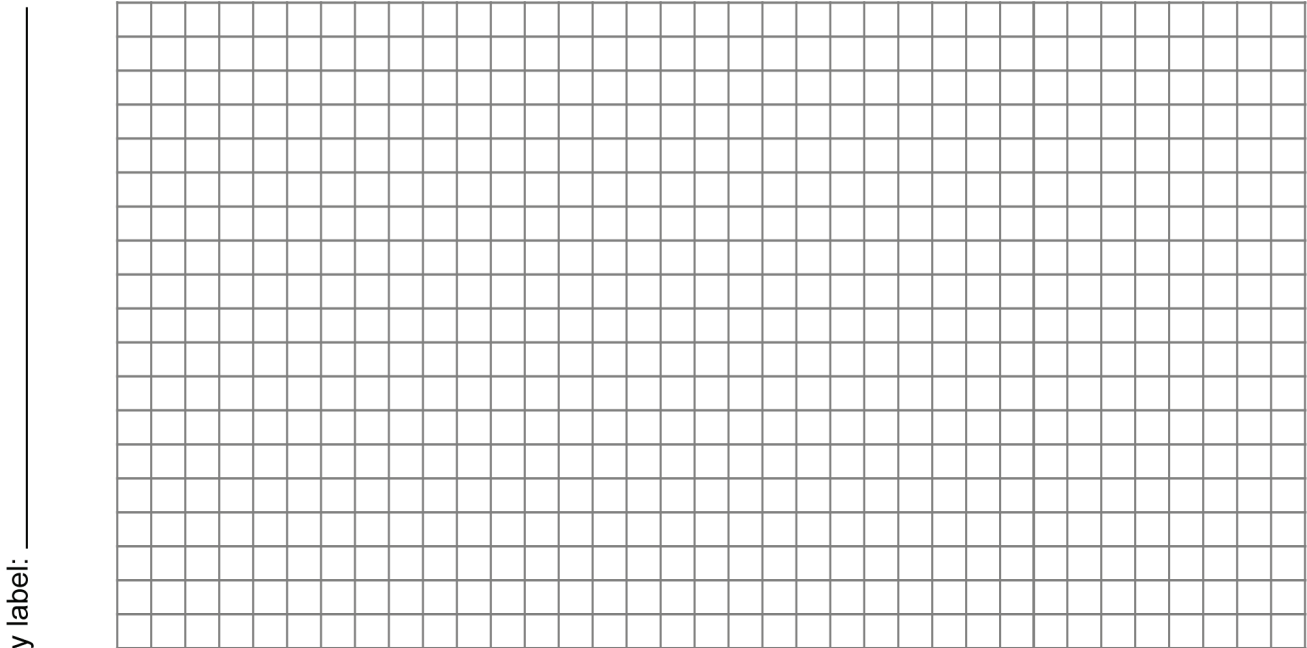
9. Make two graphs—one for each table. On the *x*-axis put the year. On the *y*-axis, put the percent renewable and non-renewable remaining.

Title: _____



x label: _____

Title: _____

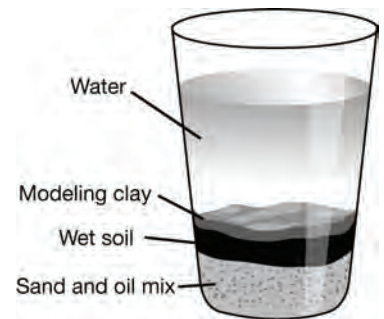


10. Answer the questions in Part 4.

3 Activity B

In this activity, you will make a model of an oil seep, like those in the Santa Barbara Channel off the coast of California. There, cracks in rock layers of the ocean floor allow oil and gas to ooze or seep through the water to the surface. The gas dissipates in the air, but the oil floats on the ocean surface. Oil and gas are both fossil fuels.

1. Pour the sand into the bottom of the glass or cup.
2. Pour the oil into the sand. Add 1 mL of water.
3. Mix the soil and water so that the mixture is very wet. Pack it tightly into the glass on top of the sand/oil mixture.
4. Take the clay and flatten it into a circle that can fit into the glass. Stick it into the glass, making a thin seal over the mud mixture.
5. Fill the rest of the glass with water.
6. Time how long it takes the oil to seep through the layers to the top of the water.





4 Thinking about what you observed

a. Which graph in Activity A is more realistic? Why?

b. Which type of resource lasts for a longer time? _____

c. Compare your predictions for the number of years it would take to deplete the resources to the actual number of years that you measured. How close were you? How did you come to your prediction?

d. What did you learn about the rate of depletion of the two types of resources?

e. How long did it take for the oil to seep to the top of the water? Do you think it would take longer if there was more water on top of the clay? Why?

f. In the future, what should the United States try to do for energy consumption? Why?

5 Exploring on your own

1. Try the oil seep experiment with a taller glass so that you can add more water. Also try it with salt water. Did it take more or less time for the oil to seep to the surface?

2. Research some ways that oil and natural gas are removed from the ocean floor.

3. How is coal created?



16B Renewable Resources

How do we produce electricity using fossil fuels and geothermal energy?

One way to make electricity is to burn fossil fuels like petroleum. When we do so, a chemical reaction occurs which creates soot, an air pollutant. Additionally, fossil fuels are non-renewable, which means we will eventually run out of them. Another way to make electricity is to use geothermal energy. This method uses steam created by magma-heated water underground. This steam turns a turbine that is connected to a generator, producing electricity.

In the Geysers area north of San Francisco, a lot of electricity is produced using geothermal energy—enough for a city of about one million people! In San Bernardino, California, hot water from below ground is used to heat some buildings during the winter.

In this investigation, you will light a candle and examine the products of burning the wax. Common candle wax is made from paraffin, a petroleum product, so the products are similar to those produced when fossil fuel is burned to make electricity. You will compare these products with those produced by geothermal energy use, represented by a beaker of boiling water. Next, you will learn how steam can be used to turn a turbine.

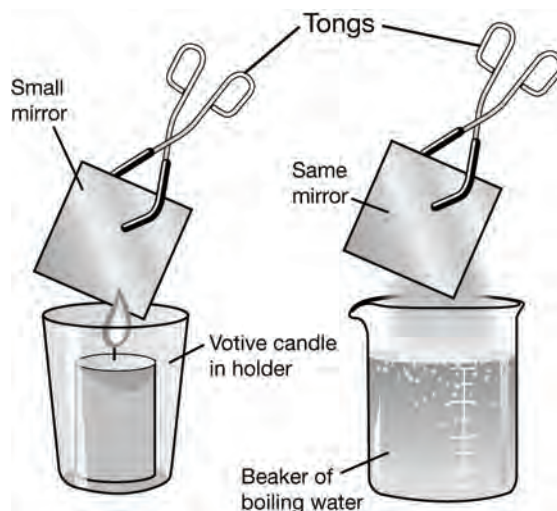
Materials

- Safety goggles
- Apron
- Pot holder (flame-proof mitten type)
- Paraffin candle
- Candle holder
- Matches or lighter
- Small mirror
- Kitchen tongs
- Water
- Heavy duty aluminum foil
- Two 50- mL beakers
- Hot plate
- 10d nail
- Pinwheel
- Masking tape
- stopwatch

1 Doing Activity A

Safety tip: Put on your goggles, apron, and flame-proof oven mitt. Review all safety procedures for working with open flames, hot plates, and hot water.

1. Place the candle into the candle holder. Make sure it is secure.
2. With your teacher's supervision, light the candle.
3. Use the tongs to hold the mirror in the candle flame for five seconds.
4. Take the mirror away from the flame and describe what you see.
5. Wash and dry the mirror well.
6. Put 300 milliliters of water in the beaker and place it on the hot plate. Heat the water to boiling. Then turn off the hot plate.
7. With oven mitt on, use the tongs to hold the mirror above the beaker for a few seconds.
8. Take the mirror away from the steam and describe what you see.
9. When the water has cooled, remove the beaker from the hot plate.

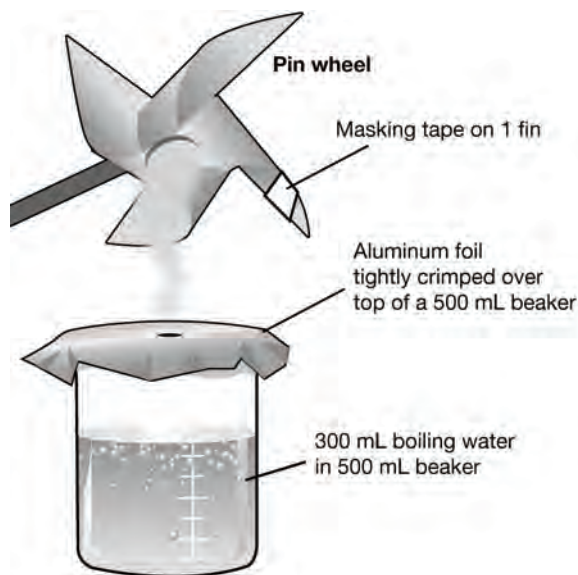


2 Setting up for Activity B

1. Put 300 milliliters of water into the second beaker.
2. Cover the top of the beaker with two layers of aluminum foil. Make a good seal around the edge by tightly crimping the foil.
3. Carefully punch a hole in the center of the foil (going through both layers) using the nail. Put the beaker to the side.
4. Use a small piece of masking tape to mark one fin of the pinwheel. This will make it easier to count the pinwheel's turns.

3 Doing Activity B

1. **Goggles, apron, and flame-proof oven mitt must be worn throughout Activity B.**
2. Using your hot plate, bring the beaker of water to a boil.
3. When steam starts to come out of the hole in the foil, hold the pinwheel (with your pot holders) over the hole. Slowly change the angle of the pinwheel until it begins to turn.
4. Count the number of turns the pinwheel makes in 10 seconds. Calculate the pinwheel's speed in turns per second.



5. Using the oven mitt, remove the beaker from the hot plate and carefully take off the foil. Add more water to the beaker up to the 300-milliliter mark.
6. Replace the foil. Punch ten more holes all over the foil with your nail.
7. Repeat the experiment by putting the pinwheel over only one center hole once the water is boiling. How fast did the pinwheel turn? Record your answer in turns per second.

4 Thinking about what you observed

- a. Explain how the burning candle and steam in Activity A represent types of energy sources and air pollution.



b. In the Geysers area of California, there has been a decrease in the amount of geothermal energy being created. It is thought that perhaps there are too many holes through which steam is escaping. Would your findings support that hypothesis? Why or why not?

5 Exploring on your own

What other places in the United States use geothermal energy to produce electricity? See if you can find four locations outside the Geysers area.
