Do What You Water:

The Current and Possible Future of Fresh Water in the United States

Meet Dr. Brown:

I like being a scientist because it is challenging to figure out how to solve a problem or design the right experiment. It is also challenging to gather good *data* and to write about the study so that it is interesting to others. I also like being a scientist because I have a chance to do something useful.

Tom Brown

Thinking About Science

Have you ever said something to someone and had them ask you in return, "What do you mean?" To answer, you have to be more specific about what you are saying. When scientists study something, they answer that question many times.

In this study, the scientist was studying how much fresh water people in the United States use every year. To do this, he had to explain exactly what he meant by fresh water. He also had to explain what kind of uses of fresh water were included in his study:

- Did he include the drinking water that comes from rivers and *reservoirs?*
- Did he include swimming in pools as a fresh water use?

When scientists decide to study something, they have to explain exactly what they mean by everything that they say and do. If they do not do

Glossary

data (**dat** uh): Facts or figures studied in order to make a conclusion.

reservoirs (**rez** ür vôrz): Places where something, especially water, is collected and stored for use.

aquifers (**ak** wuh fürz): Underground reservoirs; Areas of sand, gravel, or bedrock that contain a high amount of water.

irrigation (er uh **ga** shun): The act of watering by means of canals, ditches, pipes, or sprinklers.

natural resources (**nach** ur ul **re** sôrs ez): Things in nature that take care of a human need, such as oil.

conserve (kän **sürv**): To avoid wasteful or destructive use of something.

variables (**ver** e uh bulz): Things that can vary in number or amount.

groundwater (**ground** wa tür): Water that sinks into the soil and is stored in *aquifers*.

surface water (**sur** fus **wat** ür): Water that does not seep into the ground or evaporate into the atmosphere.

analysis (uh **nal** uh sis): Separating something into its parts to examine it.

categories (**kat** uh gôr ez): Divisions of a main subject or group.

livestock (**liv** stäk): Animals kept or raised on farms.

census (**sen** sus): An official count of all the people in a country, including other information such as their sex, age, and occupation.

average (**av** rij): The number gotten by dividing the sum of two or more quantities by the number of quantities added.

assumptions (uh **sump** shunz): Things that are taken for granted.

efficient (e **fish** ent): Bringing about the result wanted with the least amount of time, waste, or materials.

downstream (**down** strem): In the direction in which a stream is flowing.

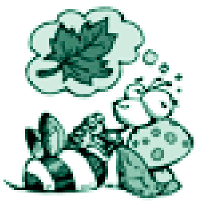
analyzing (**an** uh li zing): Separating something into its parts and examining them.

Pronunciation Guide

a	as in ape	ô	as in for
ä	as in car	u	as in use
e	as in me	ü	as in fur
i	as in ice	oo	as in tool
o	as in go	*ng*	as in sing

Accented syllables are in **bold**.

this, people cannot properly understand the study's findings. Can you think of a situation in which you have been asked to be more specific? Sometimes that is very hard to do!

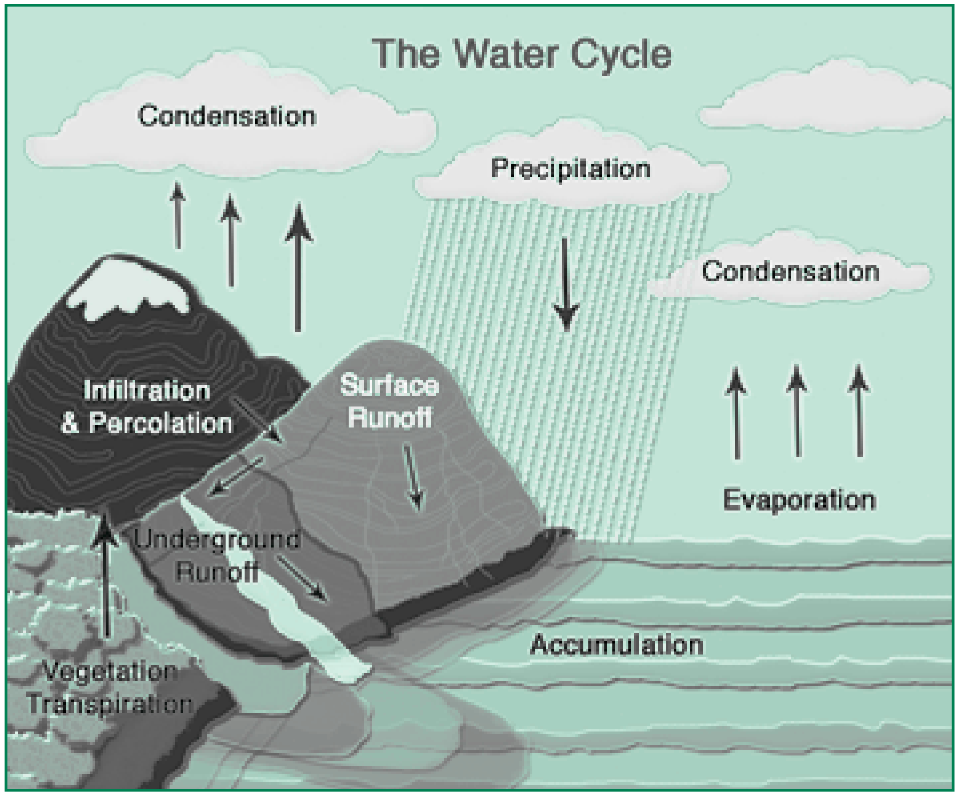


Thinking About the Environment

Life on planet Earth cannot exist without water. Many plants and animals, including humans, need fresh water to live. Fresh water is water that does not have salt in it. The oceans and most coastal waters are made up of salt water. Water farther from the ocean is usually fresh water.

Most bodies of fresh water are rivers and lakes, including lakes built by humans. Fresh water can also be found in *aquifers*. Besides using fresh water for drinking, we also use fresh water for uses in our homes such as washing dishes and clothes, and for bathing. Fresh water is also used for *irrigation*; for washing away the wastes of different kinds of industry, including the food animal industry; and for producing electric power.

As you can see, plants, humans, and other animals must have fresh water. Unfortunately, fresh water may not always be available in the amounts that humans would like to have it. That is why it is important to understand how much fresh water humans will need in the future.



Water moves from the atmosphere, to the surface of and into the Earth, into the oceans and back to the atmosphere.

Introduction

Some scientists in the USDA Forest Service have a special job to do. They have been asked to predict how much of certain *natural resources* people in the United States will use in the years ahead. By predicting this, people who make decisions about how we should use our natural resources will be able to do a better job.

For example, if scientists predict that in the future there will be less land available to grow food, we can *conserve* land today for growing food in the future. In this study, the scientist was asked to predict how much fresh water people living in the United States will use from the year 2000 to the year 2040. (How old will you be in 2040?)

Reflection Section

- What is one barrier to accurately predicting how much fresh water people will use in the future?
- What do you think is one of the most important *variables* affecting how much total fresh water will be used by people in the future?

Methods

The scientist used data from another Federal Government agency to help answer his question. That other agency is called the United States Geological (**ge** o **law** juh kol) Survey, or the USGS. Every 5 years since1950, the USGS has estimated the amount of water being used by Americans (figure 1). The scientist used data about water coming from *groundwater* sources and from *surface water*.

Because people use fresh water for many reasons, the scientist wanted to simplify his *analysis*. He took all of the uses of fresh water and divided them into water use *categories*. He defined water use as any use of fresh water. This included fresh water coming from a steam, river, lake, or surface reservoir. It also included water pumped up from a groundwater aquifer. The water use categories he developed include:

- *Livestock*—Providing water for animals or to wash away animal wastes.

Figure 2. Drinking water, for people or for their companion animals, is a home water use.

- Home and public use—Cooking, washing, or for things like swimming pools or water fountains (figure 2).
- Industrial and commercial—Using water for cooling machinery or cleaning equipment.
- Thermoelectric (**thür** mo e **lek** trik)—Using water to cool power-generating equipment.
- Irrigation—Watering agricultural fields, such as those growing soybeans, corn, or other plants.

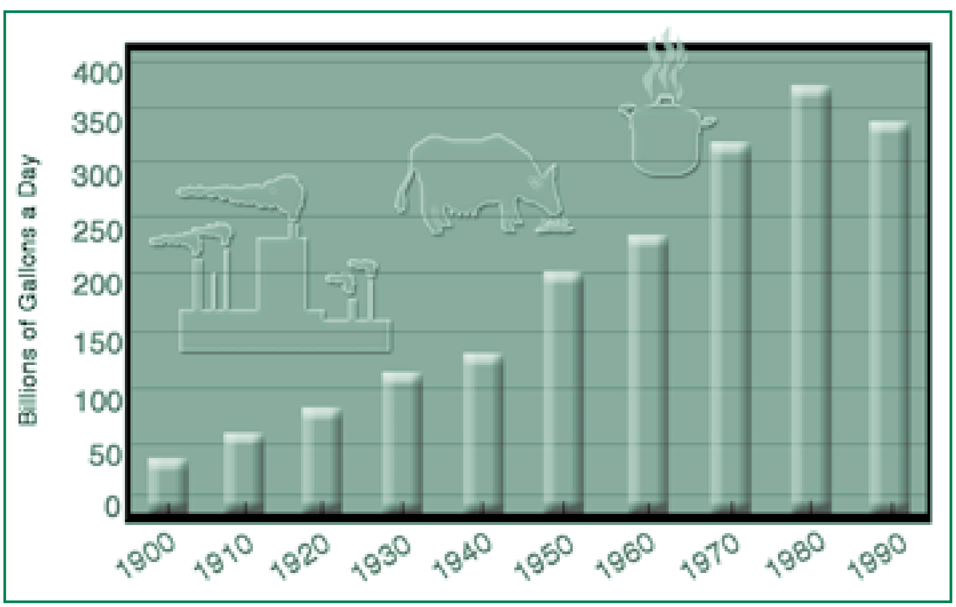


Figure 1: The amount of fresh water used by Americans from 1900 to 1990.

To predict what might happen in the future, the scientist examined how much water people used in each of these water use categories for each year, and compared it with the United States population for that same year (figure 3). Then, the scientist used predictions of population growth to the year 2040 from the United States *census*. Based on past water use and the population for each year, he estimated how much water might be used by a growing population of Americans every 10 years until the year 2040.

Do you remember the fairy tale about Goldilocks and the Three Bears? In that fairy tale, there were always two

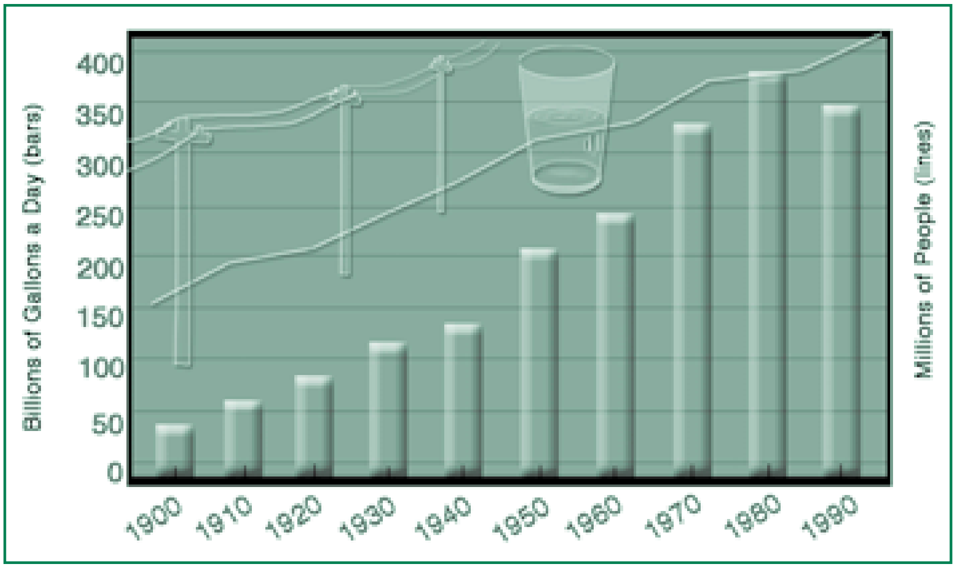


Figure 3: The amount of fresh water used by Americans compared with the United States population, 1900-1990.

extremes and one thing in the middle, such as the hardness and softness of the beds and the temperature of the porridge.

In this study, the scientist looked at three estimates of population growth to the year 2040. The first estimate assumed the highest growth rate, the second assumed the lowest growth rate, and the third was in the middle. In his report, the scientist used the middle estimate of population growth (figure 4).

Reflection Section

- Scientists often use information that has already been collected by other scientists. What are some examples of when you use information that had been collected by others?

- What is the most important variable affecting how much fresh water will be used in the future?

Findings

The scientist reported water use for the five categories listed (figure 5, page 21).

After he looked at each water use separately, the scientist wanted to present an estimate of all water use put together. Overall, water use is expected to rise by 7 percent between 1995 and 2040. The greatest amount of water will be used for irrigation and thermoelectric use. However, the greatest percentage increases are in home and public use and in livestock use.

Reflection Section

- Fresh water use is expected to increase by 7 percent overall. Compare this with the estimate of population growth to the year 2040, which is 41 percent. Does this mean that on the *average* and across all uses, each person is estimated to be using more or less water in the year 2040 compared with our use today?

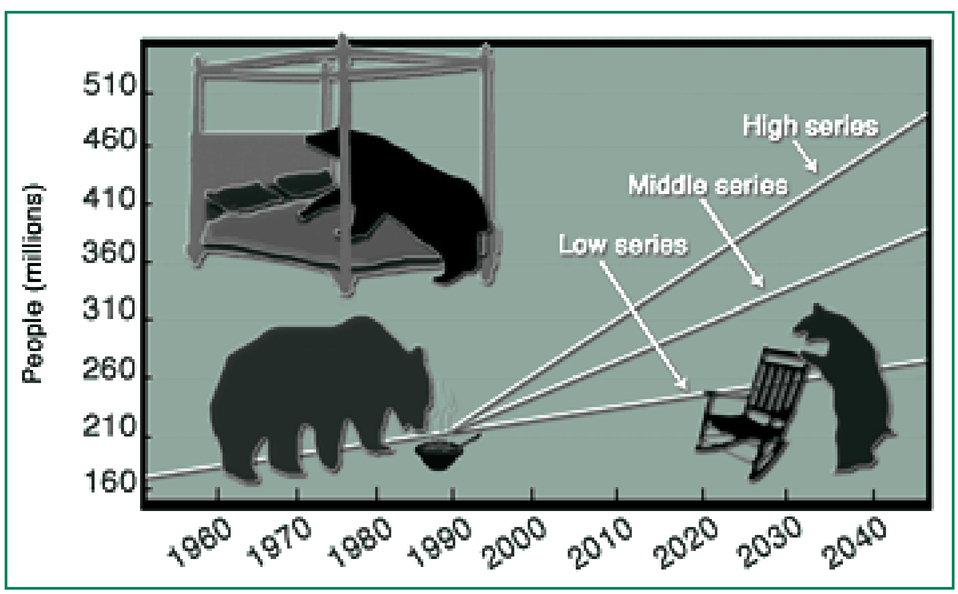
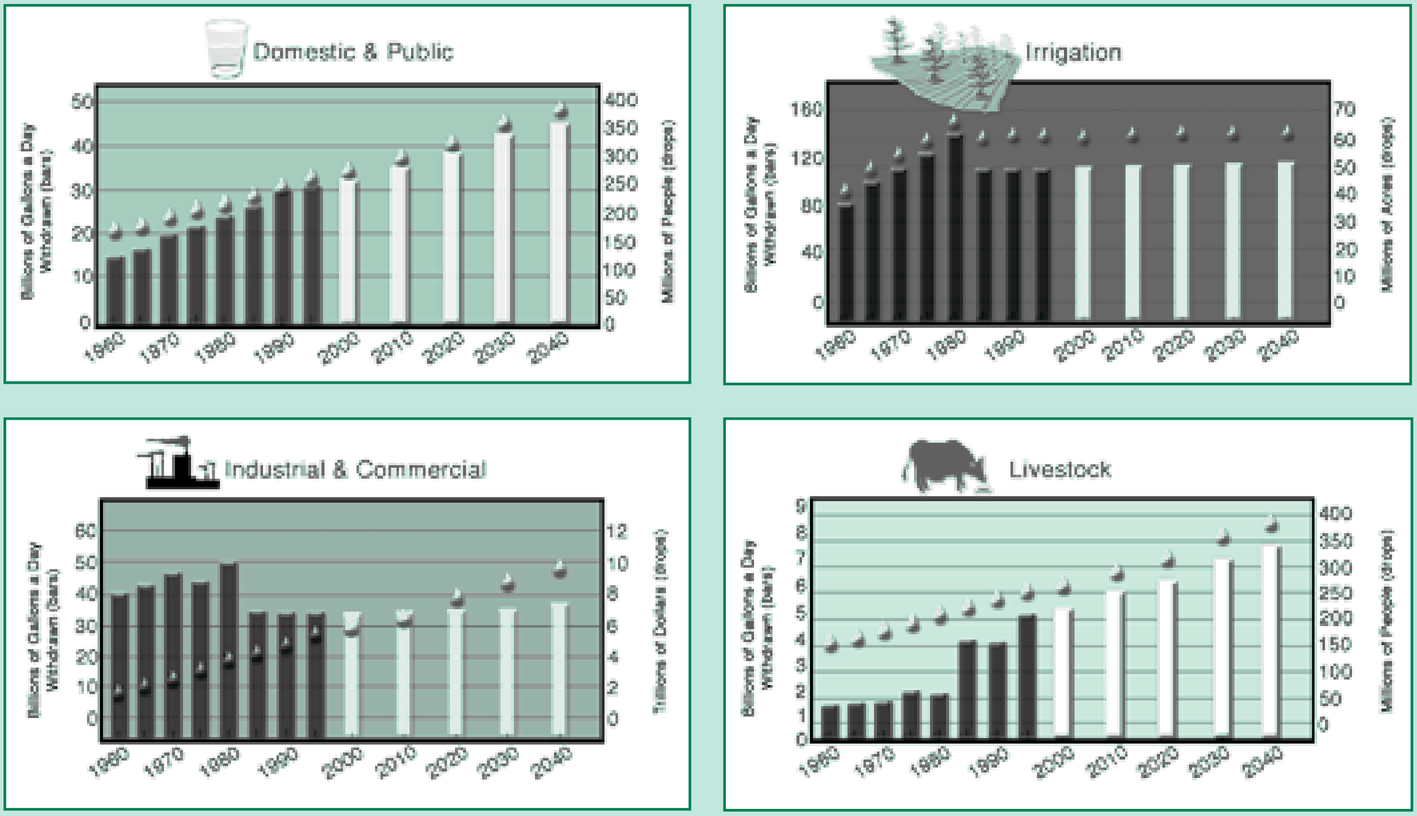


Figure 4. The scientist used the middle series of estimates of population growth.



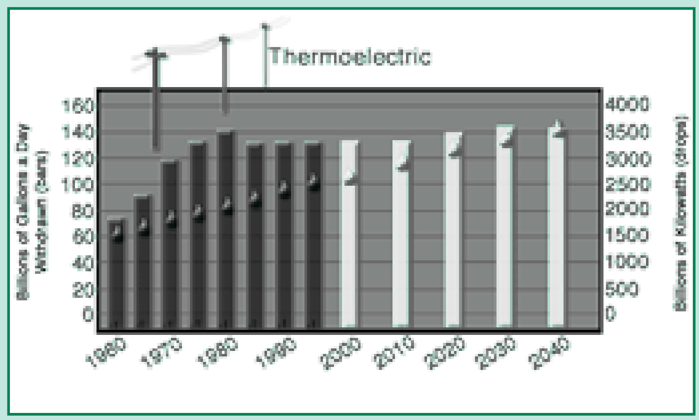


Figure 5. Water use estimates for water use categories from 1960 to 2040.

- Look at the percentage increases for home and public use and for livestock use (table 1). What other percentage is similar to those percentages? (Hint: See the previous reflection question.) Do you think that it is just a coincidence (k<u>o</u> **in** suh dens) that these percentages are so close? Why or why not?

	Low Series	Mid Series	High Series
Population	9%	41%	74%
Withdrawal			
• Livestock	9%	41%	75%
• Domestic/Public	10%	42%	76%
• Commercial/Ind.	-17%	6%	32%
• Thermoelectric	-17%	9%	36%
• Irrigation	-3%	-3%	-3%
Total	-8%	7%	24%

Table 1: Estimates of changes in fresh water use from 2000 to 2040.

Implications

When the scientist developed his water use estimates, he made *assumptions* about things like population growth and the availability of water in the future. These assumptions may not be accurate. If the assumptions are not accurate, the estimates may not be accurate.

One assumption made by the scientist is that we will continue to become more *efficient* in our use of water for things like irrigation, in industry, and even in our homes. A second assumption is that we will have enough rainfall to meet our needs for water. If areas of the United States experience below average rainfall for a few years in a row, two things could happen.

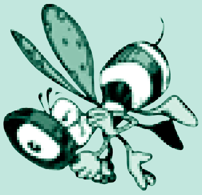
First, there may not be enough fresh water to meet the need, causing people to have to conserve water. Second, plants and animals *downstream* may be affected. When people remove water from streams and rivers for their use, there may not be enough rain to make up for the water that people take out. Lower water levels affect the plants and animals that live in and around the streams and rivers. We need to protect the health of streams and rivers, and to make sure people have enough fresh water. To do this, we need to find more ways to conserve water now and into the future.

Reflection Section

- The assumptions made by the scientist may not be accurate. What is one thing the scientist can do in the future to improve our understanding of water use into this century? (Hint: What has he already done? Should he do it again in 5 years and 10 years?)
- What might happen to plants and animals living downstream if the water level goes down?
- What are some ways that you could conserve water in your home?

For more information on this study, visit www.fs.fed.us/rm/value/docs/projecting_freshwater_withdrawals/. This Web site presents a short version of the results of this study.

From: Brown, Thomas C. 1999. *Past and future freshwater use in the United States: A technical document supporting the 2000 USDA Forest Service RPA Assessment.* Gen. Tech. Rep. RMRS-GTR-39. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station, 47 p.



FACTivity

The question you will answer in this FACTivity is: How much fresh water do you use during a typical day at home? The method you will use to find the answer is completing and *analyzing* the following questionnaire. Each person in your class should complete the questions below. Then, using the guide given below the questions, each person will calculate the number of gallons of fresh water he or she might use in a typical day while at home. These numbers are not exact. For example, you might turn the water off while you brush your teeth, while your classmate might leave the water running. You might decide to wash the car or water your flowers.

Remember that you are calculating an estimate, not an exact amount. Then, your class will calculate an estimate of the total number of gallons used by the whole class in a typical day, and an estimate of the *average* number of gallons used by each person in the classroom. Answer only for your own activities. Answer the questions below for a typical day spent at home on a Saturday. Write your answers on a blank sheet of paper. Number your paper from 1 to 11.

- How many baths do you take?
- How many showers do you take?
- How long is each shower in number of minutes?
- How many times do you brush your teeth?
- How many times do you wash your face and/or hands?
- How many times do you shave your legs or face?
- How many dishwasher loads do you run?
- How many sinks full of dishes do you wash by hand?
- How many loads of clothes do you wash?
- How many times do you flush the toilet?
- How many 8-oz. glasses of water do you drink?

Now, use the guide below to estimate how much fresh water you use on a typical Saturday.

- Multiply the number of baths you took by 50 gallons.
- Add the total number of minutes you spent in the shower, then multiply that number by 2 gallons.
- Multiply the number of times you brushed your teeth by 1 gallon.
- Multiply the number of times you washed your face or hands by 1 gallon.
- Multiply the number of times you shaved your legs or face by 1 gallon.
- Multiply the number of times you washed a load of dishes in the dishwasher by 20 gallons.
- Multiply the number of times you washed a sink full of dishes by 5 gallons.
- Multiply the number of times you washed a load of clothes by 10 gallons.
- Multiply the number of times you flushed the toilet by 3 gallons.
- Multiply the number of 8 oz. glasses of water you drank by 8. Then divide that number by 64 to calculate how many gallons of water you drank.

Now, add the numbers you calculated using the guide to get an estimate of your fresh water use in number of gallons on a typical Saturday. To find out how many gallons your whole class used, add every student's total gallons together. To calculate the classroom average, divide the classroom's total number of gallons by total number of students.

Now hold a class discussion about fresh water usage. Are you surprised at how many gallons you probably use on a typical Saturday? Is your personal total greater or lower than the average for the class? Can you think of ways to reduce the number of gallons you use? Remember, it is important to bathe regularly, wash your hands frequently, and brush your teeth after every meal. As you look for ways to conserve water, do not cut out any of these activities.

This FACTivity was adapted from the "Water Science for Schools" Web site: wwwga.usgs.gov/edu/sq3.html. You can do this activity on-line by visiting the web site.