

## RENEW-A-BEAN

### STANDARDS

See summary of National Science Education Standards.

Original: <http://books.nap.edu/readingroom/books/nses/>

Standard Concept	General standard	Specific standard	General standard	Specific standard	General standard	Specific standard
Grade Level		K-4		5-8		9-12
Science as inquiry (A)	Abilities ... to do ... inquiry	A.1.4.1	Abilities ... to do ... inquiry	A.1.8.1	Abilities ... to do ... inquiry	A.1.12.1
		A.1.4.2		A.1.8.2		A.1.12.2
		A.1.4.5		A.1.8.4		A.1.12.4
				A.1.8.5		A.1.12.5
				A.1.8.6		A.1.12.6
				A.1.8.7		
	Understandings about ... inquiry	A.2.4.1	Understandings about ... inquiry	A.2.8.1	Understandings about ... inquiry	A.2.12.4
		A.2.4.2		A.2.8.2		
				A.2.8.3		
Science in...Social Perspective (F)	Characteristics and Changes in Populations	F.2.4.1			Population Growth	F.2.12.1
		F.2.4.2				
	Types of Resources	F.3.4.1			Natural Resources	F.3.12.1
		F.3.4.2				F.3.12.2
			Science and Technology in Society	F.5.8.3		
					Science and Technology in ...global challenges	F.6.12.1
						F.6.12.2
						F.6.12.3
						F.6.12.4



## RENEW-A-BEAN

### INTRODUCTION

Resources can be used up if the resources are not renewable. This activity creates a model to illustrate the differences between renewable and non-renewable resources. Prediction of how long various energy resources will last is risky at best. In the early 1970s, it was predicted that we would run out of natural gas by the late 1980s. In the 1950s utilities predicted California would need a nuclear power plant every 10 miles along its coastline to meet the state's electrical energy needs.

It is important to know whether a prediction assumes a constant rate of use or a changing rate. It is also important to know whether a rate assumes that more resources will be found or it assumes use of only known reserves. It is also important to consider if foreign resources are included.

Beans will be used to represent renewable and nonrenewable energy in a simulation where students will understand how, over several years, nonrenewable resources will be depleted.

### OBJECTIVE

Students will increase their understandings of the eventual depletion of non-renewable resources, the effect of changing rates of use on the future, the role of conservation, and the need to develop renewable resources.

### MATERIALS:

- One quart sized open container or tray with sides for every two students
- Lots!! of beans—92% one color; 8% another color (i.e., pinto and garbanzo beans or peanuts and almonds; whatever combinations you use, be sure to maintain the 92:8 ratio to represent the ratio of nonrenewable to renewable energy consumption in the U.S.)
- Renewable energy graph
- Data Sheets
- Blindfolds

### THE ACTIVITY

The point of this activity is not so much to show the actual numbers, but rather to show that nonrenewable resources will be depleted and that conservation (reduction of use/waste) together with the development of renewable resources can extend the availability of nonrenewable resources. It may help to check the definitions of renewable and nonrenewable resources in a dictionary.

The Data Sheets included with the activity indicate the numbers of beans to draw to represent a specific situation of energy use. For example, if use remains constant from year to year, each person draws 10 beans each year. If a student wants to simulate an increasing use of energy, the student would use one of the other charts, increasing



each draw 5 or 10 beans. These represent a 50% and a 100% increase each year, respectively. Have students consider how they could represent other percentage increases. Blank charts are included for other options, and must be used when the student is asked to devise situations that would make the energy resource last longer. Students will predict how many years the energy supply will last, and then fill in the number of beans left after each “year.” Be sure students look over the data charts before they begin so they understand the procedure.

#### PROCEDURE (Teacher instructions)

- 1) Divide students into pairs and have them fill an open container with exactly 100 beans; 92% of one kind; 8% of another. This ratio represents the amount of nonrenewable energy to the amount of renewable energy, as indicated by the renewable energy data sheet.
- 2) Hand out and discuss the Renewable Data Sheet. There is an older chart and a more recent chart. On the more recent chart, the student will be required to add up the areas of various types of energy use to determine the percent of renewable energy sources in general. (Explain that more recent information tells us that the total renewable energy percentage has changed from 7% to 8%. One source of energy use data is from the Energy Information Administration, <http://www.eia.doe.gov/bookshelf/brochures/epa/epa.html> .)
- 3) Explain to students that because the U.S. depends on nonrenewable energy and because the human population is growing (thereby demanding more energy), we face the eventual depletion of this nonrenewable resource. But when? It all depends on how quickly and how much we use energy. If all our energy were renewable, we wouldn't have a problem...there would always be energy. This simulation will show the conditions that affect the depletion of nonrenewable resources. Students will experiment with these conditions to see how long they can extend the use of energy resources.
- 4) Hand out and explain the Data Chart. All students should do the first trial together to get the idea of the simulation. Have one student in each pair put on the blindfold. This represents a population that is using energy without thinking about whether it is renewable or nonrenewable. When a student takes beans from the container, he or she won't be making a conscious choice between renewable or nonrenewable.
- 5) Review the rules. Explain that the first trial will be based on a population that is using energy at a constant rate. In other words, there is no growth in population and they use the same units of energy from one year to the next. Have students predict how many “years” it will take to delete the beans in the container. Record it on the Data Chart #1.
- 6) Begin the activity, reminding students that any renewable beans pulled from the container need to be replaced into the container and counted for the year. Continue until only renewable beans are left in the container. Calculate percentages of renewable and nonrenewable resources that remain after each drawing and enter those percentages at the bottom of the data chart.
- 7) Record the number of years it takes to deplete all nonrenewable beans. Compare to predictions.



- 8) Remove blindfolds. Refer students to Data Chart #2.
  - a. The first two rows represent populations with varying amounts of increases of energy consumption. These would be populations much like ours in the U.S. and other “developed” nations. Countries with a high standard of living consume much more energy than developing, or third world nations. Consider the number of cars we drive, the plastic we use, and the fuel we use to heat and condition our homes. All this energy consumption is primarily from nonrenewable resources.
  - b. Remind students, however, that the “consumption” of beans and the years it takes to empty the container are only representative. It doesn’t mean we’ll run out of energy in 7 or 15 years. The simulation is designed to show how quickly a growing consumption level can deplete a resource. You may want to change the time units to reflect a more realistic picture, i.e. each box representing every 5 or 10 years.
- 9) Now, have the other student in the pair be blindfolded. Replace all the beans. Have students choose Data Chart #2 or #3. Repeat the same procedure as above. Be sure they predict before starting.
- 10) At the conclusion of the second round, discuss again the time it takes to deplete a resource when consumption levels increase. This represents an increasing population. More people place more demands on fewer resources.
- 11) At this point, tell students to design a way to extend the use of energy resources for as long as possible. Students should use Data Charts 4 and 5 for these additional trials. The rules remain the same, however. Students are blindfolded, and they must begin by removing 10 beans. They are to establish a change in the rate of increase in consumption that will allow the energy resources to last longer than either of their previous trials. (The students should run at least two trials.)
- 12) When the students have finished these exploratory trials, discuss methods used to extend the energy resources, both renewable and nonrenewable. Consider the situations mentioned in the introduction: access to new energy resources, and access to foreign resources. Have students write a conclusion.

## EVALUATION

- 1) What kind of energy will people be using in the future? Why?
- 2) Why don’t people use more renewable energy sources now rather than wait until the nonrenewable energy sources run out?
- 3) What factors can influence the amount and types of energy use?

## TEACHER HINTS

### Engage:

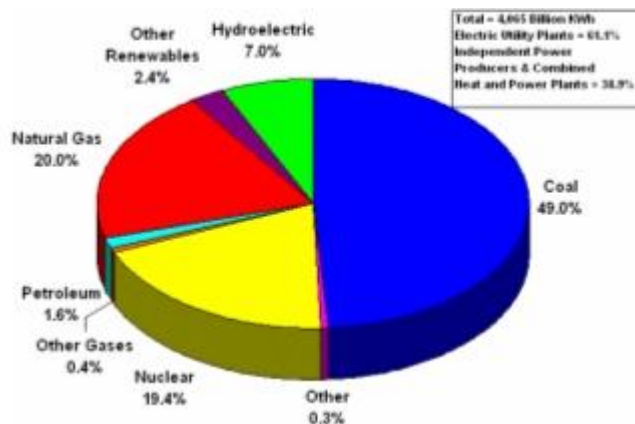
- Ask students what renewable and nonrenewable mean.
- Have students calculate how many beans go into the jars if the students are given 200 beans and 92% must be of one kind.
- Ask what would happen if the students filled the vending machine only once at the beginning of the school year...how long would the products last?



## ENERGY USE FOR GENERATION OF ELECTRICITY

Energy Information Administration,  
<http://www.eia.doe.gov/bookshelf/brochures/epa/epa.html>

**Figure ES 1. U.S. Electric Power Industry Net Generation, 2006**



Sources: Energy Information Administration, Form EIA-906, "Power Plant Report;" and Form EIA-920 "Combined Heat and Power Plant Report."

The three primary energy sources for generating electric power in the United States are coal, natural gas, and nuclear energy. These three sources consistently provided between 84.6 and 88.6 percent of total net generation during the period 1995 through 2006. Petroleum's share of total net generation peaked at 3.6 percent in 1998. It has declined thereafter to a low of 1.6 percent in 2006. Conventional hydroelectric power's contribution has declined from 9.3 percent in 1995 to 7.1 in 2006. Renewable energy sources, other than hydroelectric, contributed 2.4 percent of the Nation's net electric generation in 2006. Since 1995, renewable generating capacity, on average, has accounted for 2.1 percent of net generation. In that time, 2001 was the only year in which net generation by renewable resources was less than 2.0 percent of total net generation (1.9 percent).

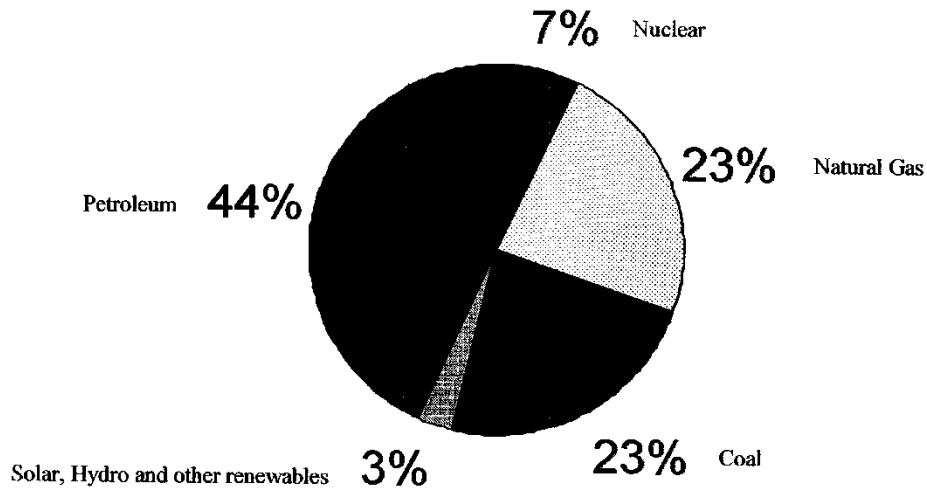
Renewable energy, other than hydroelectric, grew 10.6 percent and accounted for 2.4 percent of net generation in 2006. The greatest growth in the renewable sector was in wind generation, which contributed 95 percent of the growth in renewable energy. Wind generators produced 26.6 million MWh, 49.3 percent higher than in 2005.



## RENEWABLES DATA SHEET

The United States derives approximately 97% of its total energy from nonrenewables sources. About 3% of our energy comes from renewable resources. From 1986 to 1988 energy consumption increased by 12%.

PIE GRAPH OF ACTUAL CONSUMPTION BREAKDOWN  
(1988 figures)



(note: these figures do not include direct solar-gain heating and lighting, which is a major energy source).

