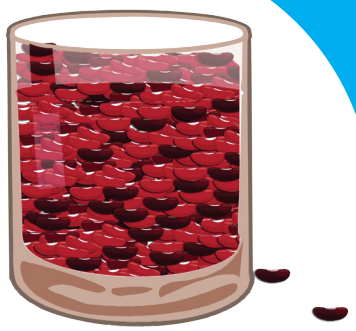
Grade: 6-8 | Time: 2 hours

RENEW A BEAN

Essential Question: **What are renewable and non-renewable energy sources?**



Overview

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

Assessment

Can students

- Give reasons for using renewable energy sources?
- Explain the difference between renewable and non-renewable energy?
- Classify energy sources as renewable or non-renewable?
- Use a simulation to help understand predictions about the use of energy resources?

Vocabulary

- Biomass
- Renewable
- Non-renewable
- Consumption

Alaska Standards Addressed

Science GLEs

The student demonstrates an understanding of:
- the attitudes and approaches to scientific inquiry by [8] SA2.1 recognizing and analyzing differing scientific explanations and models.

Math GLEs

[8] E&C-4 converting between equivalent fractions, decimals, or percent
[7] PS-5 using real-world contexts such as science, humanities, peers, and community.

English/Language Arts and Mathematics Standards (2012)

- RSL.6-8.4, RSL.6-8.6, RSL.6-8.9
- SL.6-8.1

Teacher Information and Procedure

Prior knowledge for students: None.

Source: Adapted from R.E.A.C.T. Teacher's Activity Guide, National Renewable Energy Laboratory Education Programs Home Page: http://www.nrel.govDownload guide from: http://www1.eere.energy.gov/education/science_projects.html#grades6to8 (Graphics from Depositphotos.com & by volunteers)

Materials needed

- Two open containers for every two students,
- Two types of similar shaped beans
- Blindfolds
- Handouts: Background Reading, Renewable Energy Data, Draw charts

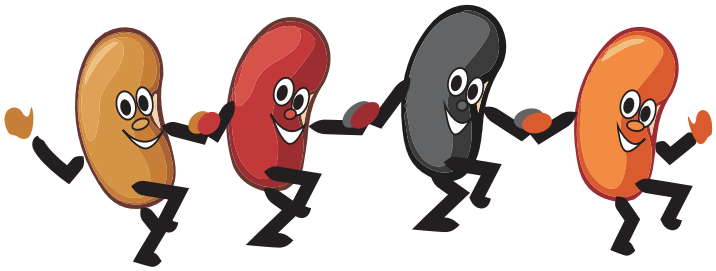
What to do in advance

- Give students the handout on practical sources of energy and read it together or ask them to read it as homework.
- Prepare two containers of beans.
  - ◊ 94% one color; 6% another color (i.e. one container has 94 pinto beans and one has 6 garbanzo beans). Be sure to maintain the 94:6 ratio to represent the ratio of nonrenewable to renewable energy consumption in the U.S.
  - ◊ For the first bean color, count 30 beans into a measuring spoon. Use that measure to put 3 X 30 beans into each student's container.
  - ◊ For the second color, count out 6 beans into the student's second container.
  - ◊ If you have more beans available, adjust accordingly.
- Make copies of handouts.
- Be sure to look the charts over before you begin so the procedure is familiar.

Teaching the Lesson

Gear-up

Review the difference between renewable and non-renewable energy and the classification of different sources by playing "20 questions". Only 20 yes or no questions can be asked to get the correct answer. Lead an example, and then divide students into pairs or small groups to play the game. The student answering the questions could use the handout on Practical Sources of Energy as a reference, if needed. As students play (for about five minutes), have them keep a list of renewable and non-renewable energy sources that they guessed. At the end of the game, ask students to write a paragraph explaining the difference between renewable and non-renewable energy sources.



Explore

1) Divide the students into pairs. Hand out the draw chart, and explain that you will play 5 rounds of the game. The first two rounds will NOT include renewable energy sources and the last three WILL include renewable energy sources.

2) 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 resource. But when? It all depends on how quickly and how much we use energy. If all our energy was 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.

3) Discuss: Scientists, economists, and politicians frequently make predictions of how long various energy resources will last. In the early 1970's, it was predicted that we would run out of natural gas by the late 1980's! In the 1950's, some electric companies in California predicted that they would need a nuclear power plant every 10 miles along their coastline to meet their electrical energy needs.

Predictions are always based on some kind of assumptions, and it is important to understand those assumptions, when you hear or read a prediction. Maybe the prediction is based on the assumption that we will keep using energy at the same rate as we do now, like the predictions we just made. Or maybe it is assumed that we will use more and more energy each year. When the prediction says that we will run out, are they assuming that no new sources of energy will be found?

We will use some different charts that tell you how many beans to draw if you want to adapt for changes in rate of energy use. For example, if use remains constant from year to year, each person draws 10 beans. If you want to simulate an increase in energy use, you take out more beans each year than you took the year before.

4) Begin the Game

Round 1: The first round simulates a population with no population growth and constant energy needs for all 10 years.

Have the students predict how many years the energy source (beans) will last with 10 units (1 bean = 1 unit) being used each year.

Record the prediction on Data Chart #1.

One student will pull out 10 beans for each year until there is no longer enough to meet the energy needs of 10 units.

They will then record how many years (rounds of 10 beans) they could meet the energy needs.

Round 2: The second round simulates a growing population with growing energy needs each year.

Have the students predict how many years the energy source (beans) will last with the provided units (1 bean = 1 unit), listed on Draw Chart #2, being used each year.

Record the prediction on Data Chart #2.

One student will pull out the listed number of beans for each year until there is no longer enough to meet the energy needs.

They will then record how many years they could meet the energy needs.

Round 3: Add the 6 Renewable Beans to the bowl and blindfold the student that is picking the beans. The third round simulates a population with no population growth and constant energy needs for all 10 years, but with the introduction of Renewable Beans. The blindfold represents a population that is using energy without thinking about whether it is renewable or nonrenewable.

Note: Each renewable bean pulled can count towards that year's energy needs and then be replaced into the bowl.

Have the students predict how many years the energy source (beans) will last with 10 units (1 bean = 1 unit) being used each year, remembering Renewables are now in the mix.

Record the prediction on Data Chart #3.

The blindfolded student will pull out 10 beans for each year, replacing the renewable beans, until there is no longer enough to meet the energy needs of 10 units.

They will then record how many years (rounds of 10 beans) they could meet the energy needs.

Round 4: With the 6 renewable beans in the bowl, switch the blindfold to the other student. The fourth round simulates a growing population with growing energy needs each year, and with the introduction of Renewable Beans. The blindfold represents a population that is using energy without thinking about whether it is renewable or nonrenewable.

Note: Each Renewable bean pulled can count towards that year's energy needs and then be replaced into the bowl.

Have the students predict how many years the energy source (beans) will last with the provided units (1 bean = 1 unit), listed on Draw Chart #4, being used each year, remembering Renewables are now in the mix. Record the prediction on Data Chart #4.

The blindfolded student will pull out the listed number of beans for each year until there is no longer enough to meet the energy needs.

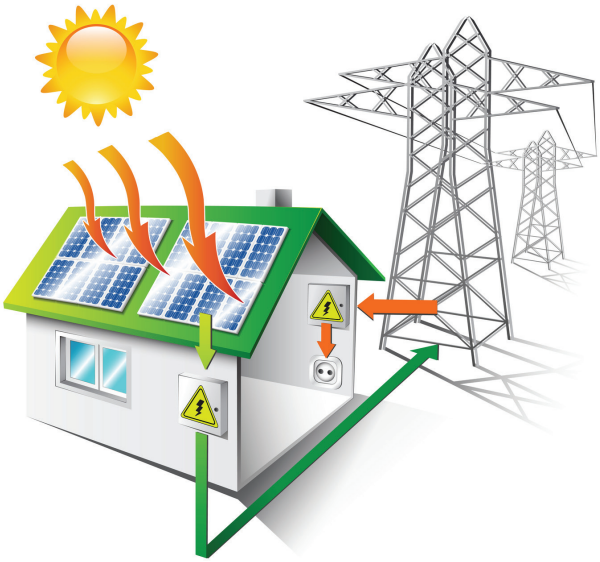
They will then record how many years they could meet the energy needs.

Round 5: With the 6 Renewable Beans in the bowl and NO blindfold.

Have the students see how many years they can make the energy last for a growing population with growing energy needs, but without the blindfold so that they can strategize how they would use their resources.

Challenge them see who can make their energy last the longest!

Discuss each group's strategy.



Generalize

1. At this point, tell students to design a way to extend the use of energy resources for as long as possible. The rules remain the same, however. Students are blindfolded, and they must begin by removing 10 beans. They are to establish a rate of consumption that will last longer than either of their previous trials. Have them record their trials in the remaining data boxes. (They should run at least two trials.)
2. When finished, discuss methods used to extend the energy resources, both renewable and nonrenewable. Have students write a conclusion about the use of renewable and nonrenewable energy.

Ask new questions

- What kind of energy will people be using in the future? Why?
- Why don't people use more renewable energy now?
- Are there reasons to use more renewables now rather than wait until the non-renewables run out?

Assess

Evaluate students' records from the trials that they designed, and the conclusions they wrote, using the rubric that is included.

Extensions, adaptations, and more resources:

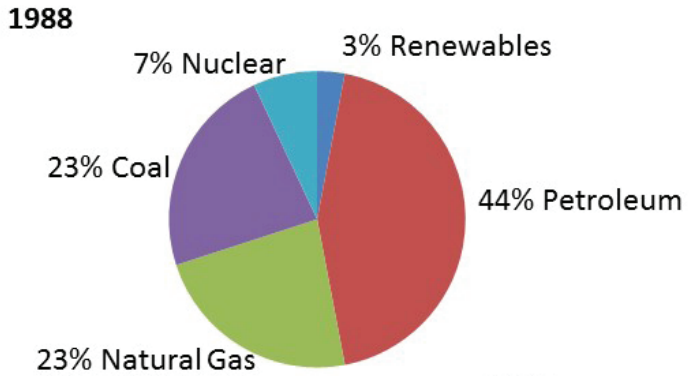
Make a plan to reduce the consumption of non-renewable energy sources in your daily life, your home, and/or your community.

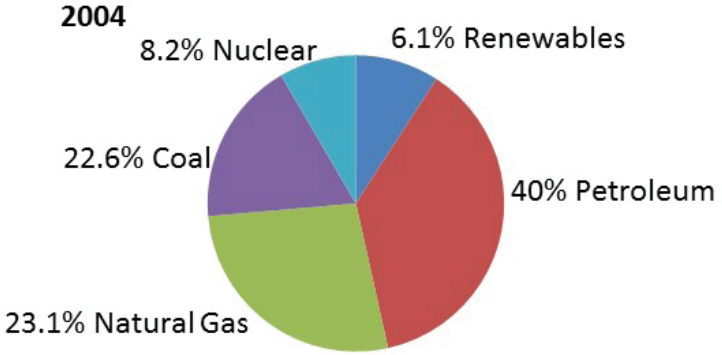
Learn about renewable energy sources that are being developed in different parts of Alaska.

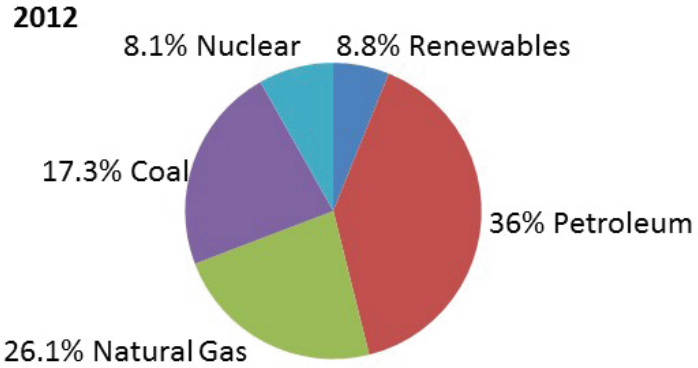
Do research on oil and gas reserves in Alaska.

Renewable Data Sheet

The United State derives approximately 97% of its total energy from nonrenewable resources. From 1986 to 1988 energy consumption increased by 12%.







(Note: Renewables are Solar, Hydro, Wind and other renewable resources.

These figures do not include direct solar-gain heating and lighting which is a major energy source.

Source: U.S. Department of Energy)

	In Progress	Meets Expectations	Exceeds Expectations
Students' simulations	Student designed and completed the simulation, but had some errors in their understanding of energy resource depletion.	Students were able to design and complete a simulation that made their beans last longer.	Students designed and completed more than one correct simulation, and were able to make sophisticated predictions based on different conditions
Students' conclusions	Correctly use the terms non-renewable and renewable, with examples OR explain reasons for using renewable energy	Correctly use the terms renewable and non-renewable and give examples of each. They give credible reasons for using renewable energy	Give many accurate examples of renewable and non-renewable energy sources, use data, and can give multiple reasons for using renewable energy.

Background Reading

WHAT ARE THE PRACTICAL SOURCES OF ENERGY?

- The practical sources of energy include fossil fuels such as natural gas, petroleum (or oil), and coal.
- Fossil fuels are referred to as nonrenewable energy sources because, once used, they are gone.

Scientists are exploring the practicality of other sources called renewable energy sources. These include sun, wind, geothermal, water, and biomass. The renewable energy resources are important in long range energy planning because they will not be depleted.

Natural Gas Sometimes natural gas is confused with gasoline, the fuel in cars. Gasoline is a mixture of liquids, while natural gas is mainly methane and is piped into buildings where it is used as a source for heating, cooking, washing, and drying. It is material to make other chemicals and is the cleanest-burning fossil fuel, which means it creates little environmental pollutants when burned.

Petroleum or Oil This is the black, thick liquid pumped from below the earth's surface wherever you see an oil rig. It is refined for use, which separates the gasoline portion that is used in transportation. Products from the remaining portions include synthetic rubber, detergents, fertilizers, textiles, paints, and pharmaceuticals.

Coal Coal is the most abundant fossil fuel. It supplies over half of the electricity consumed in the United States. Coal is mined from underground and from large surface excavations called open pits or strip mines. Most coal is transported from mines to power plants by trains and ships. While large amounts exist, it is non-renewable.

Solar The sun is 93 million miles away and yet this ball of hot gases is the primary source of all energy on earth. In the high temperature of the sun, small atoms of hydrogen are fused; the centers of the two atoms are combined. Fusion releases large amounts of energy. Without sunlight, fossil fuels could never have existed. The sun is the supplier of energy which runs the water cycle. Solar energy can be used to cook food, heat water, and generate electricity. It remains the cleanest energy source and it is renewable.

Wind The unequal heating of the earth's surface by the sun produces wind energy, which can be converted into mechanical and electrical energy. For a long time, the energy of wind has been used to drive pumps. Today windmills can be connected to electric generators to turn the wind's motion energy into electrical energy, and wind over 8 miles per hour can be used to generate electricity. It is a renewable energy source.

Hydroelectric (Falling Water) When water is collected behind dams on large rivers, it provides a source of energy for the production of electricity. The enormous power of falling water is capable of turning giant turbines. These turbines drive the generators, which produce electricity. The amount of power is determined by the amount of water and the distance it falls. Hydroelectric power plants do not cause pollution, but there are few places to build dams. Water is a renewable energy source.

Ocean Tides The currents created by daily tides are a form of kinetic energy that can be used to generate electricity. Channels and bays that focus tidal currents and surface motions created by waves can be used to run turbines and generators. Electricity generated from tidal movements is being used in places like Norway and is being investigated at many places along the world's coasts. Tidal energy is a renewable resource.

Geothermal The interior of the earth is very hot. This heat is left over from when the Earth first formed and from the decay of radioactive elements within it. There is a gradual increase of temperature with depth everywhere, but in some places the rocks are extra hot. Hot rocks are common around volcanoes, for example. Hot springs and geysers form where water comes in contact with hot rocks. Electricity can be generated by controlling the flow of hot water or steam through hot rocks. This is done several places around the world, including California. Iceland gets most of its electricity (and heats many of its facilities with hot water) from geothermal sources. Geothermal energy is not exactly a renewable resource, but there is a tremendous amount of it and it will last a very long time.

Biomass Biomass is living or recently living material that can be used for fuel. Wood is the principal biomass fuel, but other biomass energy sources include garbage and fuels such as ethanol (an alcohol distilled from plants) and biodiesel (fuel from animal or plant fats and oils). In some places, wood is still an important source of energy for individual families. Many biomass energy projects focus on the use of decaying organic matter in garbage as a source of methane or use garbage as part of the fuel burned in power plants. Biomass is considered a renewable resource.

Nuclear Fission In the 1930s scientists found that splitting the nucleus of an uranium atom releases a tremendous amount of heat energy. This knowledge was used to make atom bombs. Today, power companies use the heat produced by nuclear fission to produce electricity. Some countries (like France) supply most of their electricity from nuclear fission. Uranium is not a renewable resource.

Currently, nonrenewable resources supply the majority of our energy needs because they have been inexpensive and we have designed ways to transform their energy on a large scale to meet consumer needs. Regardless of the source of energy, the energy contained in the source is changed into a more useful form – electricity. Electricity is sometimes referred to as a secondary energy source. All the other sources are primary.

DRAWING A CHART

The following chart tells you how many beans to draw out of the container depending on the energy Before beginning each year predict how long it will take to remove all the NONRENEWABLE beans .

Complete the chart by recording the number of all beans left after each draw.

RULES:

1. Remove only the number of beans indicated on your chart
2. Always remove 10 beans in the first year
3. Put renewable beans back in the container after each pull. Count ONLY the beans left in the container.
NOTE you may not have enough beans to count to year 12; or you may have to extend this chart on the back!
4. The student pulling the beans out must be properly blindfolded. Consider it cheating to pick beans based upon how they "feel".
5. Keep all beans where they can be counted and returned to the container.

Data Chart #1 **ONLY NONRENEWABLES**

CONSUMPTION LEVEL	Prediction of years to deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total Years energy needs were met
Number of beans to be removed		10	10	10	10	10	10	10	10	10	10	
Energy Needs Met? (Yes or No)												

Data Chart #2 **ONLY NONRENEWABLES**

CONSUMPTION LEVEL	Prediction of years to deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total Years energy needs were met
Number of beans to be removed		10	12	14	18	22	25	30	32	36	40	
Energy Needs Met? (Yes or No)												

Data Chart #2 **ONLY NONRENEWABLES**

CONSUMPTION LEVEL	Prediction of years to deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total Years energy needs were met
Number of beans to be removed		10	12	14	18	22	25	30	32	36	40	
Energy Needs Met? (Yes or No)												

Data Chart #3 **WITH RENEWABLES** Blindfolded

CONSUMPTION LEVEL	Prediction of years to deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total Years energy needs were met
Number of beans to be removed		10	10	10	10	10	10	10	10	10	10	
Energy Needs Met? (Yes or No)												

Data Chart #4 **WITH RENEWABLES** Blindfolded

CONSUMPTION LEVEL	Prediction of years to deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total Years energy needs were met
Number of beans to be removed		10	12	14	18	22	25	30	32	36	40	
Energy Needs Met? (Yes or No)												

Data Chart #5 **WITH RENEWABLES** NO Blindfold

CONSUMPTION LEVEL	Prediction of years to deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total Years energy needs were met
Number of beans to be removed		10	12	14	18	22	25	30	32	36	40	
Energy Needs Met? (Yes or No)												