Energy in Peanuts

Learning Outcomes

Students will measure the amount of energy contained in various types of nuts.

QCC Standards

Grade 7:

Science Process Skills Standards 1 & 2

5. Identifies the role elements, atoms, and molecules play in cell development and functions.

Applied Biology & Chemistry 1:

Science Process Skills Standards 1 & 3

4.1 Identifies and gives examples of natural resources.

4.2 Classifies natural resources by the following categories: a. limited resources b. unlimited resources c. renewable resources d. nonrenewable resources

7.1 Evaluates possibilities for replacing fossil fuels with alternative sources of energy.

Applied Biology & Chemistry 2:

Science Process Skills Standards 1 & 3

12.1 Locates the main vegetative and reproductive parts of plants.

14.1 Identifies the many ways that plants are useful to us.

Biology:

Science Process Skills Standards 1 & 3

19.4 Describes the importance of seed plants for food, medicine, and other products.

Environmental Science:

Science Process Skills Standards 1 & 3

9.1 Differentiates between renewable and non-renewable energy resources.

9.2 Recognizes the need for tapping energy from local resources as alternatives.

Physical Science

Science Process Skills Standards 1 & 3

12.1 Describes some sources and uses of energy such as chemical, thermonuclear, photoelectric, and electromagnetic, etc.

National Standards

All energy can be considered to be either kinetic energy, which is the energy of motion; potential energy, which depends on relative position; or energy contained by a field, such as electromagnetic waves.

The energy for life primarily derives from the sun. Plants capture energy by absorbing light and using it to form strong (covalent) chemical bonds between the atoms of carbon-containing (organic) molecules. These molecules can be used to assemble larger molecules with biological activity (including proteins, DNA, sugars, and fats). In addition, the energy stored in bonds between the atoms (chemical energy) can be used as sources of energy for life processes.

The chemical bonds of food molecules contain energy. Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed. Cells usually store this energy temporarily in phosphate bonds of a small high-energy compound called ATP.

Background & Definitions

Just about everything has potential energy stored in it. The problem is releasing that energy to be able to do some work.

A tiny peanut contains stored chemical energy. When we eat them, the stored energy is converted by our bodies so we can do work. We can also use the energy in a peanut to heat a container of water.

Energy is measured in a unit called the Btu, which stands for British thermal unit. A Btu is the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. Using math, you can figure out how many Btu are in food. Knowing the initial temperature of water and how many degrees its temperature was raised, you can figure out roughly how many Btu are in the food. (Note: This will be an approximate figure because the food will not be completely burned...there is still some chemical energy left inside the partially burned food. In order to measure the heat energy exactly, you would need to use a sophisticated piece of machinery called a "calorimeter".)

For example: If the water weighed four ounces (1/4 of a pound), one Btu would raise the water temperature 4 degrees Fahrenheit. So, if your water temperature increased by 10 degrees (70 degrees at room temperature to 80 degrees), 10 divided by 4 would mean the peanut contained approximately 2.5 Btu. This is only an example of the math and will not be the same as your calculations.

One Btu equals approximately one blue-tip kitchen match or 0.252 kilogram Calories (food calories). 1000 Btu equal approximately one average candy bar (252 kilogram Calories), one hour of bicycling, or 4/5 of a peanut butter and jelly sandwich.

Materials & Equipment

Small bag/can of unsalted, shelled peanuts
Cork
Needle
Large metal juice or coffee can
Small metal can (like a soup can) with paper label removed
Can opener
Hammer
Large nail
Metal BBQ skewer (like the kind for kebobs)
About a cup of water
Thermometer
Some matches or a lighter
A piece of paper and pencil to record your observations

Web Resources

http://www.envirotacklebox.org/teacherguide/module2/2dietlsn2.htm
http://pwp.value.net/fitness/sreport7.htm
http://interactive.usask.ca/skinteractive/modules/agriculture/food/foodnut/foodnut_energy.html

Safety
Take care with the ends of the opened juice can after using the can opener.

Duration
30 minutes

Procedure
1. Push the eye of the needle into the small end of the cork.
2. Push the pointed end of the needle into a peanut at a slight angle. Use another peanut if it breaks.
3. Remove the ends of the large juice can with the can opener.
4. Using the hammer and nail, punch holes around the bottom of the can.
5. Remove the top end of the small can.
6. Using the hammer and nail, place two holes near the top of the small can opposite each other.
7. Push the skewer through the holes of the small can.
8. Pour 1/2 cup of water into the small can and let it sit for an hour (do this prior to the activity to save time) so that the water can come to room temperature.
9. Put the thermometer into the water and record the temperature on your paper.

Place the cork and peanut on a nonflammable surface. Light the peanut with a match or lighter.

10. As soon as the peanut has caught fire, immediately place the large can around the nut.
11. Balance the skewer holding the small can on the top of the large can.
12. Allow the nut to burn for several minutes or until it goes out.
13. Stir the water with the thermometer and record the temperature again.

Extension
Repeat the experiment with different varieties of peanuts (raw, salted, boiled, etc.) or with other types of nuts (cashews, pistachios, etc.)

Activity adapted for the Georgia state curriculum from the California Energy Commission's Website, http://ltpwww.gsfc.nasa.gov/globe/index.htm. Please visit their homepage, http://www.energyquest.ca.gov/index.html, for additional resources in energy education.

Student Sheet

Overview

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Questions

1. How much energy is in the typical peanut?
2. Why do you think peanuts have energy stored in them?
3. How might this suggest alternate energy resources?