

## NATIONAL SOCIAL SCIENCE STANDARD

- Economics: Increases in productivity result from advances in technology and other sources

## NATIONAL SCIENCE STANDARD

- Science: Transfer of energy

## OBJECTIVES

The student will:

1. identify the type of energy used when burning biofuels.
2. understand that it takes energy to turn corn into fuel.
3. understand the methods used to provide a positive energy balance in biofuels production.
4. be able to chart the flow of energy from the sun to the end use.

## BACKGROUND

Energy changes form. Biofuels use solar energy transformed during photosynthesis into chemical energy and released through burning in a combustible engine. Biofuels provide us with energy to fuel our cars.

Processing corn into biofuels also takes energy. Most ethanol is created through fermentation of the starchy parts of plants, primarily corn. The corn is finely ground and separated into its component parts of starch, corn germ, fiber and gluten. Microscopic yeast cells break down the starch and water, creating ethanol and carbon dioxide gas.



Planting, growing, harvesting, and processing the corn into ethanol all take energy.

Examples of the energy required are:

- Planting and harvesting require fuel to run the machinery.
- Growing requires fertilizers and chemicals to control the weeds and insects.
- Transporting the corn to processing plants require fuel.
- Processing the corn into ethanol requires electricity and heat.

## FAST FACTS

Energy is defined as the ability to do work. That work can be divided into five main tasks:

- Give light
- Give heat
- Make things move
- Make things grow
- Make technology work

## BACKGROUND, CONTINUED...

The question is: do we get more energy from the ethanol than it takes to produce it?



A 2004 study by the U.S. Department of Agriculture determined ethanol yields 34% more energy than is used to grow, harvest and process the grain. Improvements in technology allow more corn to be produced with less energy inputs.

The amount of corn that can be grown on fertile land increases all the time. Between 1995 and 2005 farmers increased the amount of corn grown per acre from 110 bushels to 130 bushels. By 2015 farmers will increase corn output to 180 per acre. The machinery does the same amount of work and uses the same amount of fuel as 10 years ago, but farmers gets a 75% increase in the amount of corn produced.

By using biotechnology to develop seeds that are drought resistant, crops can be grown in places that were previously unable to support crop growth. At the same time, these biotech seeds require fewer fertilizers and chemicals.

Fast growing native, nonfood crops that produce the same starch components necessary for ethanol will soon be an option. Native plants require less intensive farming practices and supplies; therefore, it takes less energy to produce them. Crops such as switchgrass and poplar trees are examples.

## INSTRUCTIONAL PROCEDURE

1. Complete Activity 1.
2. Complete Activity 2.
3. Discuss the biofuels timeline.

## ASSESSMENT

Have the students discuss the long-term impact of using renewable energy sources.

## WORD POWER

**acre** *n.* A measurement of land. One acre is approximately the size of a football field.

**bushel** *n.* A unit of volume or capacity equal to 4 pecks

**chemical energy** *n.* Energy that results from a chemical reaction

**energy** *n.* The ability to do work.

**native crops** *n.* Crops that grow naturally in an area. For example, corn is native to North America..

**peck** *n.* A unit of volume used in dry measurement. A peck is equal to 8 quarts

NAME \_\_\_\_\_

## ACTIVITY 1 — GO WITH THE FLOW

### FLOW CHARTING

Chart the energy needed starting with the sun to run a car.



### DISCUSSION

Is the flow of energy from sun to fuel similar to the energy flow needed to fuel the human body?

NAME \_\_\_\_\_

## ACTIVITY 2 — ALTERNATIVES MATTER

### THINK OUTSIDE THE OIL FIELD

Farmers are becoming more productive all the time.

Studies show that with the advances made in crop productivity that 34% more energy is obtained from ethanol than is required to produce it. Part of that is due to alternative crops that can be used in ethanol production.

1. Assign students to look up the alternative crops from the box at right and report to the class.



### ALTERNATIVE CROPS

- Switchgrass
- Small woody plants
- Poplar trees
- Corn Stover (left over stalks after corn is removed from the plant)
- Willow trees

2. For each alternative crop, do the following:
- Describe the crop
  - Describe the conditions in which it can grow
  - Describe the effect of crop on the environment
  - Tell how much can be grown per acre
  - Tell how much time it takes to grow to maturity and be ready for harvest
  - Provide pictures of the energy source