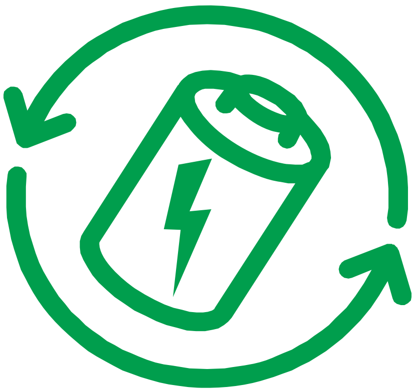
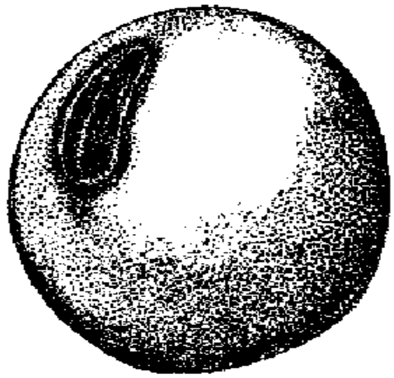
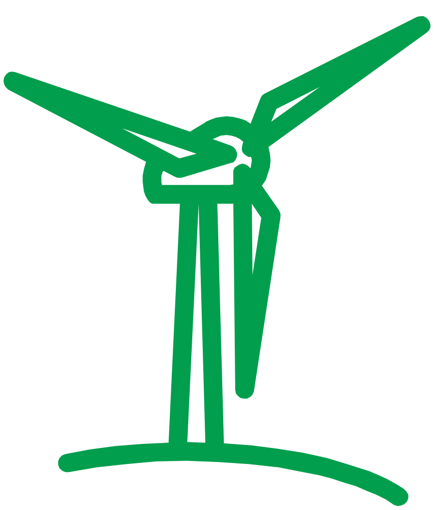




Go Green!

IAITC's lesson booklet designed to complement the Renewable Energy and Tree Ag Mags.



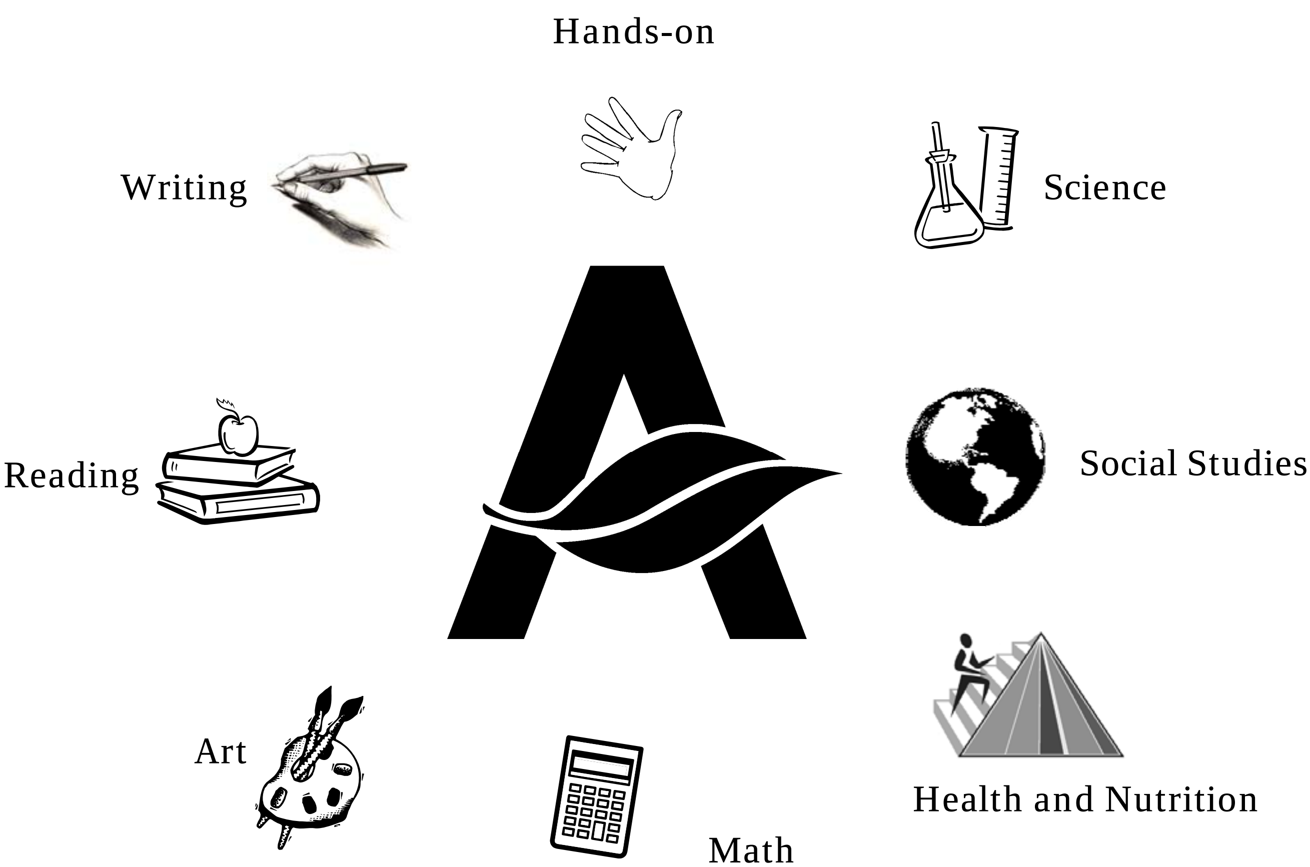
Welcome to the power of renewable fuels! This IAITC booklet was created to help further classroom investigation of renewable fuels such as biomass, solar, wind and water.

Energy has many important roles in our lives, it basically touches almost every aspect of our daily lives. It powers our transportation, it heats and cools our homes and provides us with energy to cook our food.

This booklet is designed with the student audience in mind. These activities can be used in your classroom as supplemental learning in the areas of hands-on, science, health and nutrition, reading , math, social studies, writing, and art.

The following lessons and activities are correlated to the Illinois State Learning Standards and Assessment Framework.

A visual key has also been created and used with each activity to indicate its subject area. The topics include: hands-on, science, health and nutrition, reading , math, social studies, writing, and art.



The Answer is Blowing in the Wind!

Grade Level: 4-12 Science

Learning Objectives: Upon completion of this lesson students should achieve the following objectives:

1) Use directions provided to create a small scale wind turbine.
2) Assess a design to build a prototype.
3) Record results from experiment.

Illinois Learning Standards: 7.A.1a; 9.A.1a; 9.A.1b; 9.A.2a; 9.A.3a; 11.B.1c; 11.B.2c; 11.B.1e; 12.C.1a; 12.C.2a; 12.E.1c

Assessment Framework: 7.3.01; 7.3.02; 9.3.01; 11.4.01; 11.4.02; 12.7.38; 12.7.49

Suggested Reading Materials:

IAITC Renewable Energy Ag Mag

Generating Wind Power by Niki Walker

Vocabulary:

Energy Electricity Megawatt Kinetic Energy Kilowatt

Materials:

1 8 x 10 ½ inch piece of construction paper

3 2 ¾ x 8 ½ inch strips of construction paper in the same color as single sheet

Ruler Tape Hole Punch Scissors

1 Plastic straw with bendable top

Introduction:

Using wind for energy can be traced back as early as the 12oo's. Windmills were used to grind grains and pump water. The windmills of the early days have evolved into more complex machine and are now commonly referred to as wind turbines. These new super windmills function the same way as early windmills but now their purpose is to collect kilowatts to produce energy.

Wind energy is a great resource for our energy needs because it is a wide spread, unlimited resource. 46 out of our 50 states have areas within them that are suitable for a wind energy farm. With statistics that show one wind turbine could eliminate the need for 383,000 gallons of diesel-fueled power, increased wind energy is a good idea.

After reviewing the *Renewable Energy Ag Mag* have students follow directions to create their own wind turbine. Use this activity to learn how wind is created and what forces it takes to make energy.

Instructions:

1. First roll the 8 x 10 ½ inch sheet of construction paper on the diagonal. Make sure not to roll the paper too tight. Tape the seam. This creates the base of your wind turbine.

2. Tape or fold into the inside of the base any uneven pieces. With a hole punch, make a hole in the center of the base at the top (this should be the end that is the smallest).

3. Now create the blades of your wind turbine by rolling the 2 ¾ x 8 ½ inch strips of paper on the diagonal just like you did to make the base. These pieces need to be rolled tighter to make smaller blades. Once they are rolled you can pull on the uneven end to elongate the blade. Once the blade is the correct length tape the seam.

4. On the blades, flatten and crease the square end. Now hole punch one hole on each blade on the flattened paper.

5. Then, position the blades in a triangle overlapping the holes you just made.

6. Glue the blades in this position or tape them together in the triangle position.

7. Next run the bendable part of the straw into the hole that you created on the wind turbine base. Tape the remainder of the straw to the base.

8. When your blades are dry, push the center hole over the small part of the straw at the top of the base.

To help keep your blades from flying off as you are spinning them, cut two small slits in the end of your straw once the blades are on and then fold them back.

Review Questions:

1. Are there any factors in the construction of your wind turbine that make the blades spin faster or slower? Do you think the speed of the blades on a real wind turbine is important. If so why?
2. What factors would you need to consider when choosing a location to place your windmill to ensure that it could operate correctly?
3. What might happen to your wind turbine if we were to increase the size of the blades by 3 inches? Decrease?

Lesson Extenders!

1. Use the students, wind turbines to create your very own wind farm in your classroom. Display the wind turbines on a bulletin board. Label the parts of the wind turbine and its function in making kilowatts. Include information about the crops that are grown around the wind farms, the conditions needed for a wind farm and some of the benefits of a wind farm.

2. Do the research! There are several science kits or instructions on the internet to make your own small classroom wind turbine. A great example can be viewed at *http://www.pbs.org/now/classroom/wind.html*

Is it Hot In Here?

Grade Level: 3-6 Science & Math

Objective: Upon completion of this lesson students should achieve the following objectives:

1) Use directions provided to create a small solar cooker.
2) Assess a design to build a prototype.
3) Record results from experiment.

Illinois Learning Standards: 12.C.1a; 12.C.2a; 12.C.3a; 12.D.1a; 12.D.1b; 12.D.2b;12.E.1c
Assessment Framework: 12.4.17; 12.4.18; 12.4.20; 12.4.21

Materials:

Small pizza box   Scissors   Aluminum foil   Glue

Thin sheet of plastic (a clear overhead projector sheet would work well)

Black construction paper   Classroom thermometer   Stop watch

Seeds (optional)   Supplies for S'mores (optional)

Introduction:

As early as Egyptian times solar energy was playing a key role in supplying energy to our homes. Ancient Egyptians would choose locations to build homes that allowed for the building to collect the sun's energy during the day so the home could be heated at night. Correct placement of the home ensured that it stayed cool during the day and warm during the evening, thanks to the sun!

The sun powers Earth in many ways. It warms the equator which in turn helps create wind, it provides energy for plants to grow and feed and it is also collected in solar panels to warm our homes. Solar panels, work to collect the light from the sun and convert it into electricity. The scientific term for energy made from the sun is photovoltaic energy.

Use this hands-on project to investigate how, with simple tools, we can capture the energy from the sun.

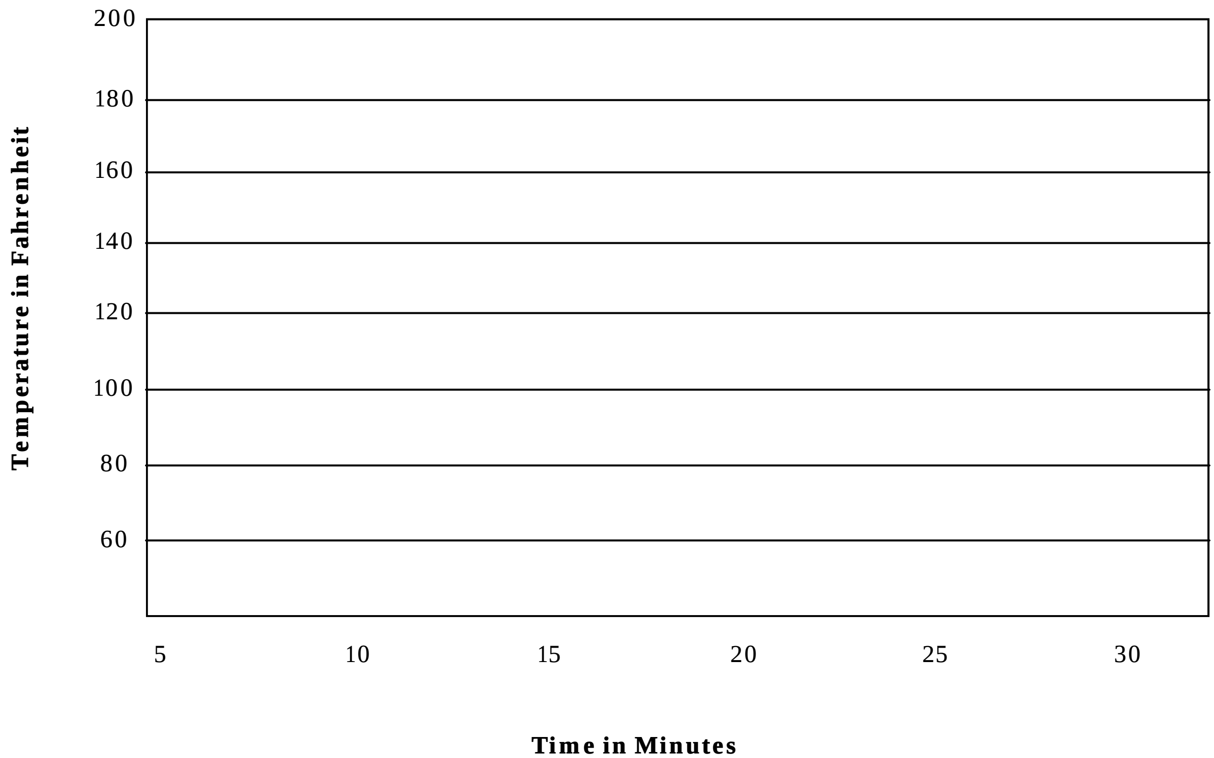
Vocabulary: Solar   Heat   Proton   Conductor   Current

Instructions:

1. Cut a flap into the lid of the pizza box. Cut only three sides, leaving about 1 inch between the edge of the flap and the edge of the lid. Use your overhead projector sheet to measure the size and proportion of the flap, this will ensure the flap is not too large
2. Close the box and pull the flap up.
3. Line the inner side of the flap with aluminum foil to reflect the rays of the sun. Use glue to help the aluminum foil stick.
4. Once the flap is covered, open the box lid and glue the overhead projector sheet on the bottom side of the opening left by the flap.
5. Line the inside of the box with the aluminum foil and then cover the foil with black construction paper.

6. Once your box is constructed it is time to collect the sun's energy. Find a bright sunny place that is not blocked by trees or buildings. On a sunny day the temperature in your box can reach 200 degrees Fahrenheit (^{o}F).

7. Place your thermometer in the center of your box and close the lid. Position the flap to reflect the sunlight into the box. Begin timing as soon as you close the lid. Record your results on the graph.



Review Questions:

1. What would you predict would happen if the cooker did not use aluminum foil?
2. What factors effect the time it took for the temperature to rise in your cooker?
3. Are there any methods to keep the heat from escaping the box? Ig so, explain how you would use them.

Lesson Extenders!

1. Try germinating seeds in the cooker. Wrap quick germinating seeds, like herbs or soybeans, in a damp paper towel. Do experiments with the location of the box and the effect on temperature. Was the cooker too hot, too cold or just right to start seeds growing?
2. Try to melt or warm food in your cooker. S'mores and cheese sandwiches work the best. Track how long it takes to melt your food and take the internal temperature of the warmed food before you eat it.

Comparing Fuels

Gasoline

What is gasoline?

Gasoline production requires oil or petroleum. Petroleum is a non-renewable resource as it comes from fossil fuels that were formed millions of years ago during the Carboniferous Period. As trees and plants died, they sank to the bottom of oceans and swamps. This formed layers of spongy materials called peat. Over time, the peat was covered with sand, clay, and rocks. As more rock piled on top, the peat was squeezed until it turned into petroleum or oil. To find oil, companies drill through the earth and pump the oil out. Then, it must be changed or refined into other products before it can be used.

Gasoline is the fuel designed for spark-ignition internal combustion engines. Conventional gasoline is a mixture of compounds, called *hydrocarbons*, derived from petroleum crude plus a small amount of a few additives to improve its stability, control deposit formation in engines, and modify other characteristics. Gasoline is most often produced by the fractional distillation of petroleum, also known as crude oil (it is also produced from coal and oil shale). Gasoline was not invented, it is a natural by-product of the petroleum industry, kerosene being the principal product. Numerous processes and agents improve the quality of gasoline to make it a better commodity.

What is the environmental impact of using gasoline as a fuel?

Gasoline as a Fuel

When the history of the automobile headed in the direction of becoming the number one method of transportation, automobile engines required fuels that needed petroleum as a raw material. Refineries could not convert crude oil into gasoline fast enough as automobiles were rolling off the assembly line.

On September 5, 1885, the first gasoline pump was manufactured by Sylvanus Bowser of Fort Wayne, Indiana and delivered to Jake Gumper, also of Fort Wayne. The gasoline pump tank had marble valves and wooden plungers and had a capacity of one barrel. On January 1, 1918, the first U.S. gasoline pipeline began transporting gasoline through a three inch pipe over 40 miles from Salt Creek to Casper, Wyoming.

Today, the U.S. imports 62 percent of its petroleum needs. By 2025, the Energy Information Administration projects the U.S. will import 77 percent of its petroleum. Two-thirds of the world's known oil reserves are located in the Middle East. The U.S. spends $50 billion each year for military protection of Middle East oil supplies.

Information taken from: http://www.chevron.ca/FAQs/FAQsGasolines.htm, http://chemistry.about.com/cs/howthingswork/a/aa070401a.htm, http://inventors.about.com/od/gstartinventions/a/gasoline.htm; http://www.energyquest.ca.gov/story/chapter08.html

Biodiesel

What is biodiesel?

Biodiesel is a clean burning alternative fuel. It is made through a process called transesterification. This process makes animal fats or plant oils such as soybean oil into esterified oil. This oil can be used as diesel fuel with no modifications. It also can be blended with petroleum diesel to create a biodiesel blend.

One bushel of soybeans makes 1.5 gallons of biodiesel and 48 lbs. of soybean meal for animal feed. Illinois farmers produced over 3 billion bushels of soybeans in 2005. After the soybean is harvested, the beans are crushed and the oil is extracted. This oil is sent to a biodiesel plant for processing.

Soybean and rapeseed oil have been tried as biodiesel because they are less expensive than most other types of vegetable oil. Although soybean and rapeseed oil are more expensive than regular diesel fuel, most other vegetable oils are too expensive to be considered for use as diesel fuel.

What are the benefits of using biodiesel?

A positive feature of biodiesel is that it is made from plants and animals, which are renewable resources. Sulfur, used as a lubricating agent in diesel fuel, is considered harmful to the environment. The sulfur content of diesel fuel was reduced by law in October 2006 from 500 to 15 parts per million.

The high oxygen content in biodiesel leads to more complete combustion and fewer emissions. By using biodiesel as a fuel additive, diesel fuel soot exhaust is decreased by 60%. Additionally, biodiesel has a positive energy balance. For every unit of energy needed to produce a gallon of biodiesel, 3.2 energy units are gained. Biodiesel is biodegradable and therefore is much less harmful to the environment if spilled.

Biodiesel as a Fuel

The first diesel engines, invented by Rudolf Diesel in the late 1800's, were actually designed to run on plant oils. Diesel's goal was to provide an option so that farmers grew their own fuels for their tractors, increased profits from their crops and were energy independent. After his death, his designs were modified to run on petroleum diesel. Soy biodiesel acts both as a cleaning and lubricating agent for diesel engines, which helps vehicles run more efficiently with less wear and tear. Additionally, biodiesel increases engine production by increased cetane number, which means that the fuel ignites in an engine more quickly.

Ethanol

What is ethanol?

Ethanol is a clean-burning, high-octane fuel that is produced domestically from renewable sources. Ethanol is made through the fermentation of sugar by yeast. Ethanol is generally made in the United States from corn. It can also be made from biomass, which includes agricultural crops and water, plant material left from logging, and trash including cellulose. Brazil, as the largest ethanol producer in the world, makes ethanol from sugar cane. Anything that can be changed into a simple sugar can be used to make ethanol.

Ethanol Continued....

One bushel of corn can produce 2.8 gallons of ethanol, 16.1 lbs of animal feed and 1.5 gallons of corn oil, all from the same bushel. Illinois farmers produced over 1.7 billion bushels of field corn in 2005. After ethanol production, most of the corn kernel remains, leaving the protein and valuable co-products to be used in food production and livestock feed.

What are the benefits of using ethanol?

Overall, ethanol blends can decrease harmful tailpipe emissions and increase fuel octane ratings. The use of ethanol as a fuel additive improves the environment because its high level of oxygen increases the efficiency of the combustion process, which results in lower emissions and higher air quality.

Ethanol as a Fuel

With a vision for the future, Henry Ford, in 1908, designed his Model T as a flex-fuel vehicle, able to run on any mixture of ethanol and gasoline. Car manufacturers, such as Ford, General Motors, DaimlerChrysler, Mazda and Nissan, are now offering vehicles with flexible fuel engines that can use everything from standard gasoline to gas/ethanol blends that are 85% ethanol (E85 fuel).

Ethanol is appearing at more pumps and in more locations every year. In 2004, about one third of all gas in the U.S. was an ethanol blend. The most common ethanol/gasoline blends are:

E10 - 10% ethanol / 90% unleaded gasoline: This most common blend of ethanol is approved for use in any make or model of vehicle sold in the U.S., with no modifications necessary to the engine.

E85 - 85% ethanol / 15% unleaded gasoline: This alternative fuel is for use in flex-fuel vehicles (FFVs) - currently numbering more than 6 million on U.S. roads, with auto manufacturers producing more each year. To accommodate this increase in the number of FFVs, more E85 pumps are available nationwide. Where E85 is not available, FFVs can operate on straight gasoline or any ethanol blend up to 85%.

Because ethanol contains less stored energy than petroleum fuel, the use of flexible fuel vehicles can currently result in a drop in gas mileage of up to 15% depending on driving habits and conditions. For example, a gallon of gasoline contains approximately 111,500 Btu, while E85 contains 81,000 Btu/gallon. The lower energy content of ethanol results in fewer miles per gallon or a shorter driving range. However, ethanol is pursued as a vehicle fuel to help our country become more petroleum-independent, and to reduce harmful environmental emissions.

Information from Clean Fuels Ohio: Ethanol Lesson.

Crops for Fuel

Biofuel... a term that has been all over the news lately. So what is a biofuel? A Biofuel can be broadly defined as an alternative fuel source in a solid, liquid or gas that is made from biological matter, like corn. To the surprise of many, biofuels have been used from the very moment man started using wood to create fire. From wood we moved into using fossil fuels and now the next generation of fuels are emerging from corn, soybeans, sugar cane and even animal fat.

In order to be classified as a biofuel the fuel must contain over 80 percent renewable materials. The use of biofuels has been a much debated issue recently. There are many pros and cons to using biofuels as an energy source. Review the following statements and have students place an X in the column after they determine if the statement is a positive or negative reason for using biofuels.

	Positive	Negative
1. Advances in battery technology may one day help to solve our energy crisis.		
2. Third World production of biofuels endangers the livelihood of small farmers.		
3. Ethanol from corn grain and Biodiesel are the only biofuels produced in the United States on an industrial scale.		
4. E85, a biofuel, can be used as a substitute for gasoline in vehicles that have been modified to use this type of fuel.		
5. The United States consumes more gasoline than any other country.		
6. One gallon of ethanol cannot replace one gallon of gasoline.		
7. Ethanol cannot be transported through the same lines as gasoline.		
8. Solar power has zero emissions and pollutants.		
9. E85 gas makes vehicles hard to start in winter months because of water content.		
10. Wind turbines create energy without creating greenhouse gases.		
11. To produce biofuels the products must go through several steps before gas is produced.		
12. Biofuels, managed correctly, are renewable resources.		
13. The more solar power wanted, the more solar panels needed to collect the energy.		
14. Producing wind energy through wind turbines requires tons of space.		
15. Our need for gasoline exceeds biofuels ability to replace gasoline completely.		

Tassel to Tank

Grade Level: 4-12 Science, Social Studies & Reading

Objective: Upon completion of this activity students will be more familiar with the process of raising alternative materials for fuel.

Illinois Learning Standards: 1.B.2b; 1.C.2b; 1.C.2d; 2.A.2b; 12.A.2a; 15.A.2a; 15.D.2b
Assessment Framework: 1B 1.4.09; 1.4.10; 1.4.13; 1.4.14; 12.4.03; 12.4.04; 12.4.05; 12.4.31

Materials:

Tassel to Tank information slips

Illinois AITC's Corn Ag Mag and Renewable Energy Ag Mag

Corn by Gail Gibbons

Anna's Corn by Barbara Santucci

Vocabulary:

Barge Elevator Fermentation Distillation Processing

Instructions:

1. Learn about corn by reading the Corn and Renewable Energy Ag Mags. Explain the processes involved in taking corn from the field and producing ethanol for automobiles.

2. Divide students into groups or for smaller classes give each student their own Tassel to Tank information slip.

3. Have students brain storm about the process of making ethanol and answer the questions on each card.

4. After adequate time for brain storming have students place the cards in the order from the beginning of growing corn to the process of making ethanol. Explain to students they should be forming a timeline that involves all the processes of production, processing, packaging and distribution of corn to ethanol.

Extended Response Question

Transportation is vital for ensuring the United States' food source is delivered and distributed to everyone. Discuss how your diet might be affected without our elaborate transportation system. Use examples you learned from the Tassel to Tank activity.

Farmer

What decision making skills are needed for the farmer in the first step of planting a crop? What types of decisions need to be made? Explain how these decisions might effect the crop.

Planter

What are the factors that could effect the farmer in this stage of his job? What impact could this have for the rest of the growing season?

Corn

What are some of the precautions a farmer needs to take with the crop as it is growing?


Harvester

Farming equipment is expensive. Are there any ways for farmers to offset their equipment cost? If so what are they?

Transportation (All)

List all the types of transportation that are needed to make corn into ethanol. Explain how rising fuel cost could affect the cost of products, how can these be avoided?



Elevator

What services does a grain elevator supply to the farmer? List all the services and determine why they are important.

Manufacturer (Ethanol Plant)

What type of corn is processed into ethanol? Why is this type of corn used verses other types of corn?

Grinder

Grinding corn exposes the starch from the corn. Do you think the ethanol process would work if we didn't grind the corn? Why or why not?

Cooker

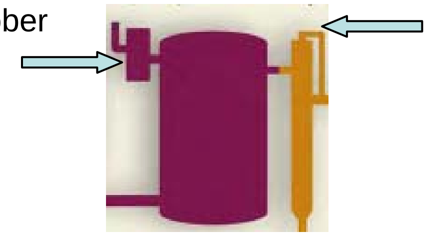
The ground corn is mixed with water, cooked briefly and then enzymes are added. The enzymes convert the starch into sugar. Why is heat used instead of cold water?

Fermentation

Yeast is added to the cooked mixture of corn. Yeast is the important ingredient to create fermentation. Define-fermentation.

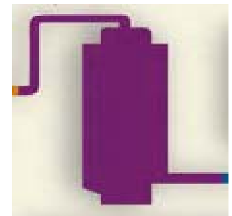
CO2 Scrubber

Distillation



Fermentation Tank

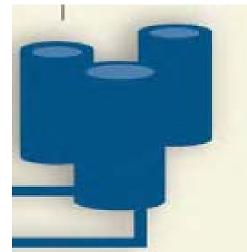
Molecular Sieve



Ethanol has been used by humans for thousands of years, in part because it is easy to make. Ethanol can be produced from any biological plant that contains sugar.

What types of plants, other than corn, do you think ethanol could be made from?

Ethanol Storage



Over 4 billion gallons of ethanol are produced in the U.S. each year and many new plants are currently under construction. Name two positive impacts additional ethanol plants could have on Illinois.

Delivery

Illinois uses 470 million gallons of ethanol each year. This fuel is delivered in specialized fuel trucks. How could an equipment break down or drivers strike effect the delivery of fuel?

Retail

All cars sold in the U.S. are factory warranted for the use of gasoline containing up to 10 percent ethanol. Since most cars are already running on some ethanol, what advertising tactics need to be done to encourage people to use E85 fuel?

Illinois Ethanol Facts

- Illinois is one of the leading producers of ethanol in the U.S. and about 90 percent of the gasoline sold in Illinois contains 10 percent ethanol.
- Illinois uses about 470 million gallons of ethanol for fuel each year.
- There is currently no Illinois sales tax on E-85.
- Illinois turns out over 1 billion bushels of corn each year, of which 1/6 is used to produce ethanol.
- One bushel of corn yields 2.8 gallons of ethanol and 18 lbs. of Distillers Grains from dry mill ethanol plants.

Apple Chemistry

Grade Level: 6-10 Science

Objective: Upon completion of this lesson students will:

1) Identify vocabulary words relating to the renewable fuels.
2) Identify starch amounts in different varieties of apples.
3) Understand how sugar converts into starch and starch into fuel.

Illinois Learning Standards: 11.A.1a; 11.A.3a; 11.A.2b; 12.C.1b
Assessment Framework: 11.4.02; 11.4.03; 12.4.07; 12.7.47

Suggested Reading Materials:
AITC Renewable Energy Ag Mag
AITC Apple Ag Mag
Renewable Fuels Association: Video of making ethanol: http://www.ethanolrfa.org/resource/made/

Materials:

Brown Iodine	Apple (recommend using a variety of apples to expand the lesson)
Knife	Paintbrush

Introduction:
The ethanol that is poured into cars is made from corn. Corn is the main resource for making ethanol in the United States, but really the process of making fuel can be very versatile. Most sugar-containing plants can be transformed into a fuel. Plants such as sorghum, sugar cane, wheat and potatoes can be made into a renewable fuel.

For corn to become a renewable fuel it must go through different stages of break down. One of the first steps involves grinding the corn into a consistency of corn starch. Once the corn is ground down it will allow the carbohydrates in the corn to be made into sugar. The sugar goes through a fermentation process that allows it to turn into an alcohol. After a few more steps the alcohol base turns into what we call Ethanol.

Apples naturally contain a carbohydrate known as starch, just like corn. As apples ripen, the amount of starch decreases as it turns to sugar. Starch is converted to sugar near the core of the apple first, and next to the skin last. Apples are ripe when most of the starch becomes sugar. An iodine test is a simple way to see whether an apple is truly ripe.

Vocabulary:

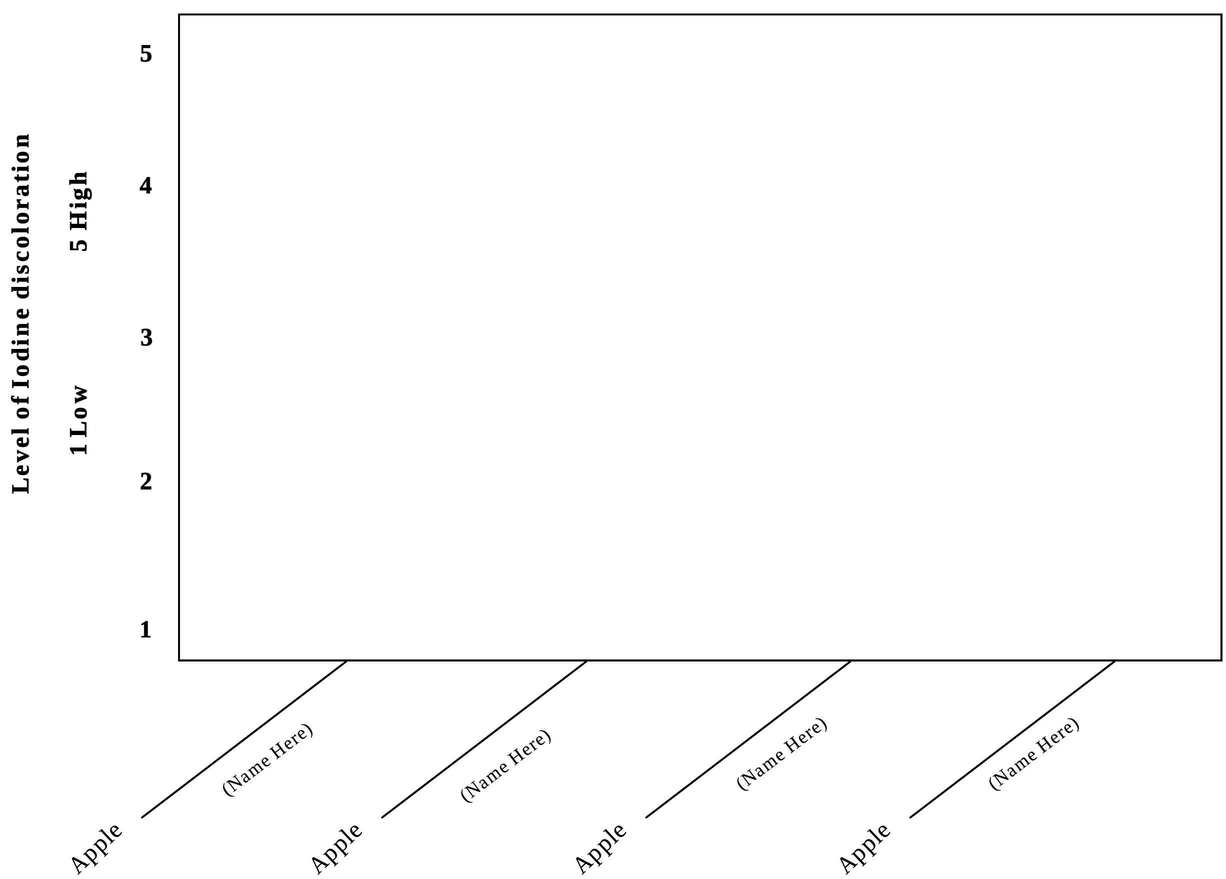
Carbohydrates Dehydration
Enzyme Solid Vapor

Instructions:

1. Cut the apple in half and brush some iodine onto the cut surface. If there is starch in the apple, parts of the apple become a dark purple color. The amount of purple found on the apple after completing this test indicates the amount of starch remaining in the apple.
2. Rate the level of ripeness by the darkness of the Iodine and record answer on graph provided. If the apple has only a little bit of purple, it is probably ripe and ready to eat.

You may want to do a starch-iodine test on a potato, too. Potatoes are high in starch and will turn mostly purple. Compare the starch in a potato to the starch in an apple.

Note: Do not use apples that have been kept in storage for this experiment because most of their starch has already disappeared.



RENEW-A-BEAD

(Activity Adapted From R.E.A.C.T)

Grade Level: 6-10 Science, Math & Social Studies

Objective: Upon completion of this simulation students will understand how, over several years, nonrenewable resources will be depleted.

Illinois Learning Standards: 11.A.1d; 11.A.2d; 12.E.1c; 12.E.2c; 12.E.3c
Assessment Framework: 11.7.01; 11.7.02; 11.7.04; 12.4.32

Suggested Reading Materials:

AITC Renewable Energy Ag Mag
Michael Recycle by Ellie Bethel

Materials:

One open container for each group
Draw chart (provided)
Pony beads: 92 of one color, 8 of another color
One blindfold for each group

Introduction:

Prediction of how long various energy resources will last is risky at best. In the early 1970's, it was predicted that we would run out of natural gas by the late 1980's. The point of this activity is not to show the actual numbers, but rather 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. Explain to students that because 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 energy we use. 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.

Instructions:

1. Divide students into pairs and have them fill an open container with exactly 100 beads: 92% one color; 8% of another. 92% of our energy consumption is from nonrenewable resources 8% comes from renewable resources.
2. The "Draw Chart" tells you how many beads 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 beads. If you want to simulate a 4% per year increase in energy use, you go to the column marked 4% per year. Students will predict how many years the energy supply will last, then fill in the number of beads left after each "year." Be sure to look the chart over before you begin so you understand the procedure.
3. Hand out the "Draw 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.

5. 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 deplete the beads in the container. Record it on Data Chart #1.

6. Begin the activity, reminding students that any **renewable beads pulled from the container can be replaced and counted for that year**. Continue until only renewable beads are left in the container. Calculate percentages of renewable and nonrenewable resources that remain after each drawing.

7. Record the number of years it took to deplete all nonrenewable beads. Compare to predictions.

8. Remove blindfolds. Refer students to Data Chart #2. This chart represents countries like the United States that have high nonrenewable energy consumption. Remind students, however, that the "consumption" of beads and the years it takes to empty the container are only representative.

9. Next blindfold the other student in the pair. Replace all the beads. 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 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 the energy resources for as long as possible. The rules remain the same, however. Students are blindfolded, and they must begin by removing 10 beads. 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.)

12. When finished, discuss methods used to extend the energy resources, both renewable and nonrenewable

Review Questions:

1. Define renewable and nonrenewable resources.

2. What kind of energy do you think people will be using in the future? Why?

3. What reasons can you think of as to why people don't use more renewable energy now?

4. Are there reasons to use more renewable resources now rather than waiting until the nonrenewable resources run out?

5. What effects did population growth have on energy consumption in this trial? Why?

Name ____

DRAW CHART

This chart tells you how many beads to draw out of the container depending on the energy consumption rate you choose to simulate. Before beginning each year, predict how long it will take to remove all NONRENEWABLE beads. Complete the chart by recording the number of all beads left after each draw. Then, calculate the percentage of nonrenewable and renewable beads that remain after each draw.

RULES:

1. Remove only the number of beads indicated on your chart.
2. Always remove 10 beads in the first year.
3. Put renewable beads back in the container after each pull. Count ONLY the beads left in the container. NOTE: You may not be able to fill in all the boxes to year 12 **or** you may have to extend this chart on the back.

Consumption Level	Prediction: Years to Deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total Years
Constant: Remove 10 Beads Each Year		10	10	10	10	10	10	10	10	10	10	10	10	
Record # Beads Remaining in Container														
% Nonrenewable % Renewable														

Data Chart #2

Consumption Level	Prediction: Years to Deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total Years
Constant: Remove 10 Beads Each Year		10	15	20	25	30	35	40	45	50	55	60	65	
Record # Beads Remaining in Container														
% Nonrenewable % Renewable														

Consumption Level	Prediction: Years to Deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total Years
Constant: Remove 10 Beads Each Year		10	20	30	40	50	60	70	80	90	100			
Record # Beads Remaining in Container														
% Nonrenewable % Renewable														

Data Chart #4

Consumption Level	Prediction: Years to Deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total Years
		10												
Record # Beads Remaining in Container														
% Nonrenewable % Renewable														

Consumption Level	Prediction: Years to Deplete	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total Years
		10												
Record # Beads Remaining in Container														
% Nonrenewable % Renewable														

Starting From Scratch

Grade Level: 2-6 Reading, Math & Science

Objective: After completing this activity students should be more familiar with the origin of everyday items and their food.

Illinois Learning Standards: 11.A.1d; 11.A.2d; 12.E.1c; 12.E.2c; 12.E.3c
Assessment Framework: 11.7.01; 11.7.02; 11.7.04; 12.4.32

Suggested Reading Materials:
AITC Renewable Energy Ag Mag
AITC Nutrition Ag Mag
AITC Beef Ag Mag

Materials:

Four large containers	Labels	Scissors	Magazines
Writing utensil	Paper		

Directions:

1. Together have the students think about their daily routines. Break the class into pairs and record items and food used in their daily activities.

2. After making a list of their daily activities, instruct the students to cut out pictures from magazines to show activities, items, or foods from their list.

3. As a class discuss the pictures the students have cut out. Compare the pictures to see how many were similar and different.

4. Next, divide the pictures into categories: food, clothing, health, shelter, transportation, education and recreation.

5. Discuss with the class how we can trace each of these items back to their original source. Collect all of the pictures, removing duplicates, and combine into two piles.

6. Show the class all four large containers, labeled "Store," "Factory," "Natural World," "Farm."

7. Next, split the class into two groups, forming two separate lines. Place the containers on the opposite side of the room from the lines of students. Place the pictures between the containers and the lines.

8. Next, explain the rules for the relay race.

Relay Race:

1. One student from each line starts by picking up a picture and sorting it in the container they think it originated from.
2. Run back to the line and tag the next person in line.
3. Continue until all the pictures have been sorted.
4. The first team to sort all the pictures first wins!
5. After the relay race, review each picture in the bins and decide as a class if that is the correct container or could it be traced back further?

Here is what you should end with in each bin.

- **Store:** most items should be traced back further than the store. Yes, we purchase most items from the store but they originate from somewhere else.
- **Factory:** the factory makes a lot of the items we use everyday, but the materials come from different places.
- **Natural World:** this bin should have a variety of pictures. (ex. Wooden objects, metals, plastics and synthetic materials.) What categories do these objects fit in? (ex. Clothing, health, shelter, transportation, education or recreation)
- **Farm:** this bin will also have a variety of pictures. Most of the pictures should be examples of food products. There could be a few examples of natural fibers, like wool, cotton, and silk.

Lesson Extenders!

1. Discuss the importance of our natural world and farmland with the class. Discuss how these resources impact our daily lives. After seeing what products originate from farms and the natural world, do you think we could we live without them?
2. Have each student pick one of the items from the Natural World or the Farm bin and research the steps it takes to bring the item to the store.
3. Make a bulletin board that traces the steps of wood becoming a piece of paper and a pencil to your students' desks. Highlight the important words like sustainability and recycling.

Illinois Agriculture in the Classroom[SM]

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