Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2010 Volume IV: Renewable Energy

Eco-Kids: How Students Can Help Save the World

Curriculum Unit 10.04.05
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Objectives

This unit is written for use with a 4 th grade classroom but much of it can be adapted for use with students from third to fifth, or even sixth grades.

The objectives of the unit are taken from the Grade Level Expectations of the City of New Haven based on the Connecticut science standards.

Forces and motion:

4.1 The position and motion of objects can be changed by pushing or pulling.

Matter and Energy in Ecosystems:

4.2 All organisms depend on the living and nonliving features of the environment.

Energy in the Earth's System

4.3 Water has a major role in shaping the Earth's surface.

More specifically the unit seeks to accomplish the following:

1. Define energy

2. Identify the need for new energy sources
3. Identify the way to conserve present sources of energy

I plan to teach the unit for six weeks allowing for three periods of an hour each period.

The unit deals with the modern concept of sustainability. As the National Environmental Policy Act of 1969 stated, we want to "create and maintain conditions under which (humans) and nature can exist in productive harmony and fulfill the social, environmental and future requirements of present and future generations of Americans." This goal is no less important today than it was forty years ago. Our energy problems have been exacerbated by our slow and inadequate response to the situation. Even those who purport to be strong environmentalists readily concede that our country still needs fossil fuels and will for some time to come. For our students who are the future citizens of the world, the problem will continue to be relevant.

As I began writing the unit, events have conspired to prove this topic is even more relevant than the somewhat gratuitous introduction I started. Oil continues to spill out of the ruptured British Petroleum oil rig in the Gulf of Mexico, threatening the coastline of the United States. Off shore drilling is now on hold as the controversial effects of this method are being discussed. The sea life, marshlands and very livelihood of many fishermen and others who make their living from tourism in this region are being destroyed. As the hurricane season approaches, the possibility of spreading this oil to other regions has also become a source of worry.

We have seen our technology develop to where oil can be taken from great depths in the ocean, but our technology to solve problems with these advances has not kept up. There is a feeling of panic for many because, so far, all solutions have failed to quell the gushing oil. We can feel first hand that our technology and engineering skills may not be up to this challenge. This is a good lesson for all of us especially for students to experience. Those of us born in the last half century have seen continual advances in science and technology. Every problem seems to come with a quick solution.

This disaster presents a real live problem to show students how science really works trial and error. When we do "experiments", especially in the early grades, students can't often help but think that there is already a correct answer out there which the teacher has up her sleeve. This accident has shown that science usually operates without knowing what will work. The attempts to stop the oil have been tried with hypotheses about what could or should happen. The failure is an example to all of us of the trials that preceded most of the technology and scientific breakthroughs we have grown used to. We do not know the final solution, or the resulting destruction that will be left behind when a solution is found. Again, I notice myself still espousing with confidence that modern technology and science will solve the problem. Perhaps it is a human trait--misplaced hubris; or just the need to believe in our own ultimate survival.

Introduction

As an introduction to the unit, we will begin with a discussion of the question: what is energy? The class will complete a KWL chart in which they will list what they know about energy and what they want to know about energy. The third column, which lists what they have learned about energy, is not filled in until the conclusion of the unit. In talking with my students about this, I found that energy immediately evokes the power and strength that they get from the food they eat. There is also recognition of cars, and their reliance on gas, as well as light bulbs, being powered by electricity.

A few terms need to be defined as the unit begins: energy, work, force, and power. Energy is the ability to do work. In physics, work implies that there is movement. To do work, there needs to be some sort or energy used usually some kind of push or pull. It is energy that keeps us alive and the world moving. Students will learn about two types of energy: stored or potential energy, and working, or kinetic energy. Students can understand these concepts through examples like batteries, and their own bodies which eat food for energy but store the energy until they need it to run or talk, etc.

Using the example of a batter in baseball, we see that before he swings the bat it has potential energy. When the batter does the work of swinging the bat, energy is within the bat. When the bat hits the ball, the bat works on the ball and changes its stored energy into kinetic or working energy. The result is that the bat hits the ball and it flies off. The concept of power would be related to how hard you hit the ball.

Bat (potential energy) → Batter swings the bat (applies energy) → Bat hits ball (work is done on the ball) →Ball flies out

Renewable and Nonrenewable Energy

There are two kinds of energy sources: renewable and nonrenewable. Nonrenewable includes any energy source that we cannot make more of in a short time. Most non- renewable sources of energy come from within the earth. They include things like oil, gas, coal, and nuclear. Right now our world is powered by mostly nonrenewable energy sources like oil, gas and coal. The fact that there are limited amounts of these fuels makes our energy future uncertain. In order to solve our energy concerns, we are working on ways to utilize the renewable sources of energy. Renewable sources of energy are those that are those whose supply can be easily replaced.

Most nonrenewable fuels like coal, oil and gas were formed over millions of years within the earth. As the sun heated the earth, plant life grew and died. The continual addition of plant and animal remains were buried and over time were covered with layers of dirt. A similar cycle began in the oceans where sea creatures and plankton died and were eventually covered by sand and mud. Heat and pressure over millions of years led to the formation of these so-called fossil fuels.

Throughout the ages the fossil fuel of choice has varied due to economic and technological discoveries. At first, the most popular fuel was wood. It wasn't until much later that people discovered the potential energy use for coal, and oil. Over time these fossil fuels became the primary source of energy used especially in industrialized countries. As more and more land was cleared, people realized that the deforestation of many areas of the earth is a serious concern. Now we also see similar problems arising from our use of fossil fuels. Even though supplies are projected to last for centuries, the immediate concern for us is the impact of fossil fuel use is having on our environment. We must not only look for the energy sources of the future but utilize what we have in the most efficient manner. Some of the current methods that are now being considered include solar, wind, biomass, geothermal, and hydropower.

The unit will begin by having students find some information about our current energy situation. How much oil, coal, and gas do we use? How much of a supply is left in the world? and, Where are these supplies located?

Activity 1: What is the status of our Energy Supply?

Gathering some information about the status of our energy supplies will help students to construct a picture of the current situation. It will require them to do some very simple research, and give them a foundation to begin the unit. This information will also help the class organize their understanding of the problem. I have searched a few resources and found the most current and practical data for my students' use were on the Energy Kids U.S Energy Information. [1] Their information was based on 2008 statistics and it was difficult to find anything more current. This web site is designed for students and the information is clearly presented. Depending on the class, and your access to technology, it may, or may not, be feasible to have students gather this information for themselves. It may be best to have students view some web sites to gather a few bits of information, but also have ready some statistics on a class chart or hand out.

A look at the locations of the world's top energy supplies will soon have students politically engaged. [2] Students will discover that we do not have access to all the nonrenewable energy that remains. Looking at the location of the nonrenewable energy resources [3] one is immediately aware that the United States does not have a significant amount of the reserves within its borders. Therefore, we do not control our energy future. We cannot just take whatever fuel sources we need. Pointing out the huge resources in the Middle East will make it obvious even to young students that we need these countries' friendship in order to maintain our supply of energy. Therefore, we might consider how conservation can help us to use less of the nonrenewable energy sources than we presently do. It is crucial that we have enough energy resources to power our country, while we try to catch up and perfect some of these new renewable energy sources. Students must see that our growing need for energy will make it necessary for us to find other ways to provide energy.

Richard Smalley and the Terawatt Challenge

Before considering some of the more popular forms of renewable energy, I would like to include information on the late Richard Smalley's idea of the "Terawatt Challenge". Smalley was a Noble Prize winner who famously listed the ten most important problems that the world would have to confront in the near future. A safe and cheap form of energy was near the top of the list. Smalley suggested that in the future, for all world citizens to have enough energy to live a comfortable life, we would need to significantly increase the daily amount of energy. Smalley proposed that there be an effort made to increase the daily world energy production from 15TW produced in 2005 to 60TW by the year 2100. [4] Since, not only students, but most adults have a difficult time understanding large numbers, I feel it would be worthwhile for students to pictorially show these amounts as a way of making them somewhat appreciate the size of what we are speaking.

Activity 2: Picturing Our Energy Needs in Dots

There is a web site called A View from the Back of the Envelope [5] , which contains a number of math resources. Among its resources, I found a representation of 10,000 dots in a square no more than 2 inches squared. I chose to use the graphic in this activity. I have seen students do pictorial representations of smaller amounts and the satisfaction they feel as they complete the task is well worth the time.

Material: copies of the 10,000 dot square, scissors, two large sheets of paper or poster board, and glue

1. Students cut out and pasted 200 squares and glued 100 on each of two large sheets of paper.
2. We then put in between the following label: 1,000,000 X 1,000,000 = 1,000, 000,000,000 (one million times one million equals one trillion). One trillion is the number of watts in a terawatt.
3. I suggest covering the walls in the halls outside your room with the representation, as it would be a valuable activity, and of interest to other classes and teachers. Students need to know that 15 times this representation would show the number of terawatts the world uses of energy. What Smalley is suggesting is that we will need over five times that much energy by the year 2100.

Students should know that our concern about our energy needs is not a new problem, and many would say we have been reluctant to change our dependency on fossil fuels.

The history of the use of fossil fuels is a long one. In ancient times the primary source of energy was the burning of wood. Until about 300 to 400 years ago there seemed to be a balance between what was cut down and the regrowth of the forests. In places like England the deforestation became a larger problem as the Industrial Revolution began. Coal began to replace wood as the fuel of choice. It was used to run the railroads, make steel, and burn in homes after chimneys became fixtures in home design. In England where the Industrial Revolution was centered, coal was abundant and promised a source of fuel that did not depend on the rest of the world. Even then, coal had a reputation for being a dirty energy source, and the smell and dust from coal was recognized as a potential health hazard. Ironically, coal is now being consumed at a greater amount than ever. In 2005 coal was 27.8 percent of the world's energy. [6] Coal does have its advantages over other fuels. It is one energy source whose reserves are measured in hundreds of years. Coal is safe because it does not explode like natural gas. It is the cheapest source of nonrenewable energy and there is no potential environmental danger as there is with an oil spill. Most coal producing countries do not have to rely on other nations for their supply, so it is a secure energy source. Finally, it can be clean burning with scrubbers to remove impurities such as sulfur, although there are greater carbon dioxide emissions than with oil or natural gas and also production of ash that can cause environmental problems for disposal.

One of the early fuels used for lighting lamps was whale oil. For years, the whaling industry thrived and threatened the future of these animals. As their population decreased, the cost of whale oil rose. Oil was not an unknown product. Centuries ago people like the Egyptians used the tar they found at the surface of the land for the process of mummification. It was long understood that anyone who could find an abundant source of oil would become immensely rich. [7]

In 1859, a large oil deposit was found in Titusville Pennsylvania by Edwin Drake. Kerosene was a bi-product of crude oil that could be used for illumination. With the discovery of a large source of oil in the United States, kerosene gradually surpassed the use of whale oil. As oil deposits were found around the world, the real work of developers like Rockefeller was to find ways to bring oil to markets around the world and make it economically the fuel of choice. In fact, at first gasoline was burned off because it was seen as having little value. With the development of the automobile in the 1920's, gasoline was found to be just the correct fuel for the car engine. [8]

Natural gas is also a product that was utilized for centuries. The Chinese were known to have used bamboo piping to transport gas to where it could be use as a heat source. Natural gas is mostly methane. It is the cleanest of all the fossil fuels with water and carbon dioxide as bi-products when it is burned. On the positive side, gas needs little processing before it can be used by consumers. However, gas can be explosive and asphyxiate people if there are leaks. Another problem is that transporting gas from its origin to the marketplace can be a challenge. Construction of pipelines is expensive and sometimes the terrain makes it next to impossible to harvest the gas. There is also the problem of protecting pipelines from sabotage. [9]

There have been attempts to solve the problem, but as they shall see, there is not one easy answer. Each new technology has its limitations. As we actually begin considering some of the more popular forms of renewable energy, one of the aims should be to give the pros and cons of each form of potential energy.

Wind Power

The wind seems to be an obvious source of potential energy. It is a free and clean form of energy. The problem with this resource arises from the fact that there are few places on the earth where there is a steady and strong enough wind that could be relied on for more than a fraction of the energy we need. The United States is one of the leading proponents of this form of energy and we see proposals for wind farms in places like Rhode Island and Massachusetts. One of the main problems with the wind farms is that many people near these coastal areas fear the blockage of the natural beauty surrounding them. Likewise, the large fans like structures pose potential harm to birds. Many individuals around the world have small wind powered devices but, as has been stated, widespread use of this technology is not practical.

A local example of individuals utilizing this technology is the Phoenix Press of New Haven, Ct. They have a wind turbine near their shoreline business. Their turbine generates 165,000 kWh of power per year. They state in their literature that the turbine saves the equivalent of the greenhouse gas emissions of 23 passenger cars per year, or CO_2 emissions from burning 276 barrels of oil annually, or the greenhouse gas emissions from 40 tons of yearly landfill waste. [10]

Many of us have made kites or simple pinwheels with our students. There are a few sites where students can also find directions to make an anemometer to observe wind speed, and of course, students can also work with kites. It seems important to me to show students how wind power actually works. I did come across directions for building a model windmill. That activity follows.

Activity 3: How to make a Windmill [11]

Materials: an empty milk carton, a drinking straw, a cork, a tack or paper clip, 2 3 feet of thread, a small pinwheel made from cardboard or paper, and sand

1. Put a few inches of sand on the bottom of the milk carton
2. Make a hole on either side of the carton so you can put the straw straight through the two holes.
3. Put the cork on one side of the straw and the pinwheel on the other.
4. Tie one end of the thread to the tack or paper clip and the other end to the cork.
5. Blow on the pinwheel and as it turns the tack or clip will go up and down.

You might also use a small fan to make it turn. The point of the activity would be for students to see that to do work the wind must reach a certain level of intensity. Of course, even if the strength of the wind is reached, it must occur at the right time or the work cannot be accomplished. Since the wind is more predictable in certain areas of the world and only at certain times, it could never be a total solution to the energy problem.

Because the earth is unevenly heated by the sun, the air surrounding us varies in temperature, density, and pressure. These differences result in cool air masses dropping and warm air masses rising. This results in wind. Harnessing the wind to do work first occurred over 2,500 years ago in China when wind power was used to pump water. Over the centuries, windmills have been tremendously popular throughout Europe and in the United States. Unfortunately, there has to be a back up source of energy where wind energy is used. Ironically, if wind speeds are too high they can damage the turbine and so, they are usually constructed to automatically shut down under these conditions. [12]

There are certain geological areas where wind energy has been found to be most profitable. Ideal locations include formations that funnel wind through narrow passes, as in California, or continuous wind found along the ridge of the Rocky and Appalachian Mountains, and the central and northern portions of the Great Plains (Montana, the Dakotas, and Wyoming). There is also potential in Europe for off shore wind farms. There needs to be an annual average speed of at least 14 miles per hour. The ideal speed would be 25 to 35 miles per hour. [13]

Hydropower

Water power provides only a small per cent of the world's energy. Obviously, only at places where there is water flowing downhill can that energy be captured and utilized to do some sort of work. Falling water is mostly used to produce electricity. There is a short film on YouTube [14] :. It shows how turbines are constructed at the base of the dam, so that the force of the falling water will make it turn and begin the process of generating electricity.

Dams have long been a source of water for people, animals, and the irrigation of crops. The real innovation came when they were used to produce electricity. There are 45,000 dams in the world with a vertical distance of 50 feet or more. The aggressive building of dams for electrical power in the United States began in the 1930s when the Hoover Dam was built. It was part of the government's attempt to jump start the economy during the Great Depression. This period of dam building ended in 1962 with the completion of the Glen Canyon Dam. While it was generally acknowledged that these dams were positive developments, during this time the first environmental group began namely, The Sierra Club. It was begun by the naturalist John Muir, who wanted the Sierra Nevada Mountains to remain in as pristine condition as possible. By the time the Glen Canyon Dam was started, there was already agreement that that would be the last project undertaken. [15]

At this point, hydropower in the form of large dams has reached its limit in the United States and so it is not a potential for expansion. South America and Asia still have some potential for hydropower development. However, environmentalists now regard these projects as serious intrusions into the natural and they are prepared to block the building of any large dams. [16]

The teaching objective would be for students to see that falling water offers another possibility for energy to be produced. It would also be a good chance to do research on dams and how they work. Again, students will see that running water has the potential to do a lot of work. However, they will still see that a flowing river is not available in all areas. It not a complete answer to our energy needs.

The activity that I suggest for hydropower is for students to see how the weight of the water works to produce the force necessary to complete work.

Activity 4: Hydro Power [17]

Materials: Half gallon paper milk carton (empty and washed out), a gallon of water, an awl, or 10p nail, masking tape, ruler, magic marker, scissors, pad and paper to make notes

1. Cut off the top of the milk carton
2. Measure from the bottom of the carton and put a hole in the side of the carton at the half inch, inch, 2 inch and 4 inch mark. (All holes should be the same size)
3. Take along piece of tape and tape up the holes. Mark a line near the top of the carton. Always refill the container to that line.
4. Fill the container with water. Have the container on the edge of a sink. Quickly take off the tape and watch what happens. Measure how far away each of the streams hits the sink.
5. Watch as all the water empties out. What happens as the water level drops. What happens to the stress of water?
6. Tape up the holes again and refill the carton. This time uncover just the bottom hole. Refill the container and cover the holes again; repeat with the second hole form the bottom -- measuring how far the stream goes. Do this for the other 2 holes.

Through this experiment students will find that the hole on the bottom had the longest stream of water. Water has weight and that weight of water exerts a force or pressure from above. The greater the weight of the water is the greater the resulting water pressure. The more water pressure, the further out the stream went.

As was stated earlier, hydroelectric plants are built at the base of dams so that they can utilize this high pressure of the falling water.

Biomass

Biomass is one form of energy that uses plants and waste materials to produce useful fuels such as methanol, natural gas, and oil. The primary argument against generating biodiesel and ethanol has been that this would have a negative effect on the usage of land for agriculture. However, there are fast growing grasses and trees that can be used to augment and resupply the existing forests. This renewable and recyclable energy source does not add to the carbon dioxide emissions. After it is burned, the remaining ash can be thrown back onto the land to restore nutrients. This form of energy production could result in the creation of jobs especially in rural areas. Primarily it is plentiful in large areas of the world covered with forest areas. Still, to produce enough fuel for our present and future energy needs would seriously compromise the use of land for agriculture. Unless there are other technological breakthroughs, advocates see more benefits to the use of biomass for generating electricity. [18]

Activity 5: Energy from Garbage [19]

One of the experiments I found has students placing dried peas or beans in plastic bags and placing them in sunny places, shady places, and in total darkness. Students record their observations. The question here is do the beans (garbage) produce a gas and can it be harnessed for use as a source of energy.

1. Soak some beans in water overnight
2. Place at least 10 beans in each plastic bag. Squeeze the air out of each bag and seal.
3. Put 2 bags in a warm sunny place; 2 bags in a warm shady place; and 2 bags in a totally dark place.
4. Observe the bags for a week and record what you see

The beans will produce a gas. The problem would be what conditions produce the most gas and how can you harness this. In terms of this unit, it is apparent that this method is not a solution to the energy crisis.

Geothermal

Geothermal energy or harnessing the heat found internally within the Earth is another area we will consider. Geothermal energy occurs when magma is close to the top of the earth and when rocks surrounding it are porous and filled with subsurface water. That water is heated and finds its way to the surface. This phenomenon occurs near the boundaries of tectonic plates. Geothermal energy can also originate near volcanoes such as Mount Vesuvius in Italy, on the Hawaiian Islands and in the caldera of Yellowstone. Geothermal is an old source of energy. The Ancient Romans, Chinese and Native Americans used water from underground springs for cooking, bathing, and heating. However, geothermal energy is also limited by where it can be accessed and where natural features like springs and geysers occur. The United States is the leader in this area. We now use geothermal energy to generate electricity. Reykjavik, Iceland gets 95 per cent of its hot water from geothermal sources. [20]

In the following experiment students will compare the effects of geothermal and fossil fuels on air quality

Activity 6: Geothermal [21]

Objective: Students will observe that geothermal fuel is cleaner than fossil fuel.

Materials: candles, a tin plate to stand the candle in, matches, water, hot plate, tea kettle, small mirror, tongs, pot holder, and mitts.

Procedure:

1. Heat water in the tea kettle.
2. As water boils hold the mirror over the steam. The mirror should fog but remain clean.
3. Light a candle and put the mirror near the candle. Some soot particles from the candle should accumulate of the mirror. Try holding a piece of over the mirror close by.

Students should see that the burning candle left a sooty residue while the steam was clean.

Nuclear

Students will also consider the future of nuclear energy. Since the dropping of atomic bombs at the end of World War II, no other potential energy source has been more controversial. For many, the use of "atomic" power conjures up bombs and nuclear disaster. Still some people advocate this as clean energy. However, there are problems with disposing of nuclear waste, and just who wants to have a nuclear power plant in their back yard? There is much here for students to consider. What are the pros and cons of this power source? We would need to consider the problems that have occurred like Three Mile Island, and Chernobyl. Students will be presented with the usefulness of nuclear, as well as, the potential for devastating accidents that could cause irreparable damage.

Nuclear power depends upon the chain reaction or fission of the uranium atoms. In this process, some neutrons that form the nucleus of a uranium nucleus fly off when it splits (fission) and hit other nuclei. This causes them to split in two releasing more energy and two more neutrons. They in turn will fly off and hit another nuclei splitting that and releasing more energy and two more neutrons. This chain reaction can build up to a dangerous level so rods are inserted in the middle of a nuclear reactor to slow down the reaction. In theory, this nuclear reaction does not have the potential to cause a nuclear explosion. However, there is the potential of danger from nuclear waste, and radioactive materials released unexpectedly from the reactors. Nuclear waste emits harmful radiation over a long period of time. It does not just meld back into the environment.

Activity 7 Nuclear Chain Reaction [22]

The YouTube has quite a few film clips of a demonstration replicating what happens in fission or a chain reaction. The film shows a number of mouse traps in a large closed plastic container. Each mouse trap has a ping pong or tennis ball on it. An extra ball is thrown into the container and immediately hits a trap which sends another ball into the air. The traps keep snapping and the balls keep flying until most have been tripped.

Fission is the process of breaking up the atom but scientists are intrigued with the idea of nuclear fusion which is the connecting of the nuclei of hydrogen atoms. This would require a smaller amount of material and potentially result in the release of more energy than the fission reaction. Fusion, as it is called, is the connecting of two nuclei. It is the basic reaction that is occurring continually on the sun. This reaction is hard to produce and harder to control.

Hydrogen

Hydrogen is a potential energy source for the future. Hydrogen is the simplest known element. It doesn't exist in significant amounts on earth as a gas. It is normally connected to other elements. Combined with oxygen it makes water. Hydrogen can be one of the bi-products of biomass. Hydrogen is used by NASA to power the space shuttle. Huge tanks of hydrogen lift the shuttle into space and hydrogen fuel cells provide it with electrical power. The only waste product is pure water, which the astronauts use for their drinking water.

The problem with hydrogen is that it is expensive to make, but the technology is improving. The following activity gives you the chance to split water molecules (Electrolysis) into oxygen and hydrogen molecules.

Activity 8: Electrolysis [23]

Materials: 100 (ml) of warm water, 2 cubic centimeters of salt (salt helps the current move through the water), 6-volt battery, 2 sets of alligator clips and wires, 2 large metal

1. Paper clips, small flat plastic dish, safety glasses
2. Mix salt and water in dish until it dissolves.
3. Bend the outer part of each clip up so it forms a handle
4. Connect one alligator clip to each battery terminal.
5. Place the 2 paperclips into the water so they don't touch.
6. Observe the paper clips.

In this experiment, only hydrogen bubbles will appear unless a non-corroding metal is used. There should be bubbles forming around each of the paper clips. There will be more hydrogen bubbles because each atom of water contains 2 hydrogen molecules. Hydrogen bubbles will form around the negative wire from the negative terminal; while the positive terminal will produce oxygen molecules.

Solar

The final area which the unit would consider is solar. This seems to be the best chance for solving our future needs. The unit will lead to the conclusion that solar offers the best possibility for a solution to the energy needs of the planet. Solar energy is also basically a free source of energy but it depends on the hours of daylight, and absence of cloud cover. There are two basic ways to use solar energy. One is to heat hot water so it can make steam to generate electricity. The other is to directly change solar energy into electricity. The problem has always been to find ways to harness the energy and use it efficiently. One way we are gathering this energy is now being done using solar panels. However, this is relatively still an expensive source of energy for most households.

There are a few demonstrations that students can do to imitate a solar panel as well as a solar cooker. There are small solar cells that students can use to try powering model cars and/or heating model homes.

Activity 9: Make a Solar Cooker [24]

Materials: A sunny day, black construction paper, aluminum foil, sheet of clear plastic laminate, non-toxic glue, tape and scissors, ruler and magic marker, one wood dowel rod

1. Draw and cut out a window in the top of the pizza box. Leave one side connected so you can fold it back.
2. Cut 2 pieces of foil to fit on the inside of the lid and to line the inside of the box. Smooth out any wrinkles, and glue.
3. Tape a piece of plastic to the underside of the opening you cut. Make sure it is tightly sealed because this is the oven window.
4. Glue corners of a piece of black construction paper to the bottom of the inside of the box on top of the foil.

Place the items you want to heat on the inside of the box. Use the dowel to open the window and position the oven so that the lid reflects the maximum amount of sunlight through the window. Try heating up s'mores, hot dogs, or melt some cheese on nachos

Energy Conservation

One of the main objectives of the unit has to be to give students recognition that our energy future is not secure, and that we need to take care of the resources we presently have while our energy needs and other technologies are explored and expanded. Our dependency on fossil fuels will end in the foreseeable future, and this next generation has to take energy conservation seriously. While it is acknowledged that we have a limited supply of fossil fuels, the challenge for us and the next generation is to ration the use of these fuels while we try to wait for advances in technology that will help solve the problem of our future energy needs.

To that end, there are a number of sites that include calculations of your carbon footprint. Students are asked to enter in their daily use of water, phones, appliances and computers, etc. The calculator figures out how much carbon is produced as well as, energy used and the average cost for that energy.

Culminating Activity

Usually, the ending of any unit of study requires students to show, in some tangible way, that they have grasped some of the main objectives of the unit. A good culminating activity for this unit would be energy fair. This would give students a chance to explain their findings to other classes. There are also a number of field trips that could enhance the unit such as a visit to a local power facility, or perhaps to visit the Phoenix Wind

Turbine in New Haven. Students will read about things they can do to conserve energy. They will also design a pamphlet and posters to express what they have learned. Part of the learning fair would allow students to recreate some of the experiments they have seen for other students.

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Web Sites

1. EIA Energy Kids--Energy Kids: Energy Information Administration,

http://www.eia.doe.gov/kids/index.cfm

2. Energy Star Kids

http://www.energystar.gov/inex.cfm?c=kids.kids_index

3. Bobbie Big Foot web site for Earth Day -- helps students calculate their carbon footprint

http://www.kidsfootprint.org/

4. US Dept of Energy--Energy Efficiency and Renewable Energy Kids Saving Energy

http://www.eere.energy.gov/kids/index.html

5. Planetpals.com-- friends for earth

http://www.planetpals.com/

6. Climate Change: Kids Site

http://www.epa.gov/climatechange/kids/

Endnotes

[1] EIA Energy Kids: http://www.eia.doe.gov/kids/energy.cfm?pages=stats

[2] Oil Reserves Pie Chart:http://en.wikipedia.org/wiki/File:World_Oil_Reserves_2005.png

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[4] The Terawatt Challenge: http://thebreakthrough.org/blog/2009/03/want_to_save_the_world_make_cl.shtml

[5] A View from the Back of the envelope: http://vendian.org/envelope/dir2/lots_of_dots/

[6] Nersesian, p. 68

[7] Nersesian, p. 104-105

[8] Nersesian, p. 105-107

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[10] Phoenix Press Wind Turbine facts: Http://phoenixpressinc.com/index.php/name-the-turbine

[11] How to Make a Windmill: http://library.thinkquest.org/3611/choices/howt

[12] Nernesian, p. 307-308

[13] Nernesian, p. 310-312

[14] How Hydroelectricity Works : http://www.youtube.com/watch?v=rnPEtwQtmGQ

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[19] Making Energy from Garbage: http://www.need.org/needpdf/IntGarbageEnergy.pdf

[20] Nernesian, p. 304-307

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[23] Harris, p.27-28

[24] Making a solar oven with a pizza box; http://www.solarnow.org/pizzabx.htm

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