Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
1981 Volume V: The Human Environment Energy

Creating Our Energy Future

Curriculum Unit 81.05.10
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This unit is designed as an interdisciplinary, ten week, environmental issues course for ninth grade students. The course centers around the energy crises. Its major objective is to provide a series of experiences which would increase student awareness of the environment and the environmental significance of each persons actions.

The course is scheduled for two sessions per week for a total of twenty classes. The unit is roughly divided into three major areas, allowing six or seven sessions for each one.

Since the course is scheduled to be repeated three times during the year, the format used is to present the major ideas in each section by using a. “discussion-card” form followed by an activity list. The discussion-card form allows the major ideas to be available for teachers and in a form that students could use. Since the course will be repeatedly used, the listing of activities could be useful in that each time around one could select different ones and add to and vary the list.

Part one focuses on studying the ecosystem concept and developing sensitivity to a natural environment. Part two covers five basic areas that are crutial to understanding today’s energy situation. Part three begins by considering different possible energy futures and ends with a special student project. This project is planned to develop and expose the level of student awareness of environmental consequences that certain actions bring and of his or her current and potential influence on environmental issues.

Part I: A Natural Environment and Ecosystem Concept

Essential to any significant understanding of environmental issues is an awareness of how the natural forces on Earth operate to support life. Only after awareness is developed in this area can it be understood how these systems are being threatened and what can be done about it. That is, only then can we seriously begin working on “environmental issues”.

This section is planned, to provide: (1) factual data concerning the natural environment, and (2) time to spend in a natural environment. The basic factual data for this part is presented in the discussion-card form as mentioned above. These are followed by a list of activities that provide various ways to obtain more

information and to plan for time in the woods or other natural environment that might be available.

In Part I there are five major topics considered on the discussion cards and eleven activities listed after that. Each topic or activity, except the Knot game, could take one or more sessions. The time allowed for this part, however, is only six or seven sessions. Using an arbitrary guide of two sessions outside and four or five classroom sessions, I'll determine the final nature of the sessions on other factors like student interest and skill, resources at hand and time available to prepare.

Discussion Cards

1: Environment and Ecosystems

Q1: What do we mean by environment?

Q2: What is an ecosystem?

The environment can be thought of as everything all around us. In studying the environment it is often helpful to concentrate on a space with specific boundaries.

An ecosystem is a space with specific boundaries. It includes all living and non living things within its limits. It could be small like a puddle or large like a biosphere.

(figure available in print form)

2: Energy Flow

Q1: What is energy?

Q2: How important is it?

Q3: Is energy found in nature?

Q4: Where does energy come from?

Q5: What does "energy flow" mean?

Q6: What does it mean to say that energy flows one way?

Energy can be defined as the capacity to do work. All life depends on energy for reproduction, growth and maintenance. All living things must work to live and therefore all living things are dependent on energy.

Almost all Earth's energy comes from the sun. The sun sends us only one fifty-millionth of its total energy production and this equals 13 x 10 23 calories per year.

(figure available in print form)

3: Energy Flow (cont.)

The two basic kinds of energy are potential (stored) energy and kinetic (active) energy. Energy also assumes three forms—radiant, chemical and mechanical.

Energy operates under the first and second laws of thermodynamics. The first law states the energy can neither be created nor destroyed but it can change forms. The second law states that every time energy changes form, some energy is lost for further use.

An example of how solar energy functions is as follows. Energy comes from the sun in the form of light and heat and by the process of photosynthesis some of it is stored in plants as sugar. In the process of the energy going from the radiant form of light and heat to the chemical form of plant sugar, some energy is lost for further use.

4: Energy Flow (cont.)

The energy that comes from the sun and is stored in plants cannot go back to the sun. If an animal eats the plant, some of the energy from the plant could be stored in the animal. Once stored in the animal, it cannot go back to the plant.

Almost all energy that comes to Earth eventually leaves Earth again in the form of heat. Energy cannot retrace its path, and it cannot cycle. way. It flows to Earth, may flow through various forms—each time losing some of its force, and then continues its flow away from Earth as heat loss. It is a one way flow.

(figure available in print form)

5: The Hydrologic Cycle

Ql: What is the hydrologic cycle?

Q2: Why is it important to us?

The amount of water we have on Earth remains fairly constant and moves in a large cycle called the hydrologic cycle. The following is an example of how the hydrologic cycle works.

A particle of water falls to the Earth in the form of rain. It is absorbed by the soil and becomes part of the soil solution. The root of a near by tree absorbs the water, and it is transported up the tree to be come part of the moisture in a leaf.

(figure available in print form)

6: The Hydrologic Cycle (cont.)

The water evaporated from the leaf and rises to become part of a cloud. It can then fall to Earth and begin another cycle.

Water is essential to our lives. We need water to—drink, to clean, to grow food and for many other things. Without water we could not live. It is therefore important for us to understand the hydrologic cycle and be supportive of it.

(figure available in print form)

7: The Nutrient Cycle

Q1: What is the nutrient cycle?

Q2: Why is it important to us?

Nutrients are minerals and other things needed to support life. The nutrient cycle refers to the using and reusing of nutrients which, like water, is different from the one way flow of energy. Since nutrients and water cycle here on Earth, we do not need a continuing new supply from outer space—as is the case with energy,

(figure available in print form)

8: The Nutrient Cycle (cont.)

As an example of how the nutrient cycle works, consider the following. A tree root grew near a limestone rock. As the root grew it gave off carbon dioxide which entered the soil solution and combined with it to form carbonic acid. The carbonic acid in the soil solution caused the limestone rock to “weather” and release a calcium ion that had been held fast by it.

The calcium ion was carried in the soil solution and the tree root then absorbed the ion and carried it up to become part of one of the leaves.

(figure available in print form)

9: The Nutrient Cycle (cont.)

All season long the ion remained a part of the leaf. In the autumn the leaf turned color and dropped to the forest ground with all the other leaves.

Once on the ground, the leaf began decaying, releasing its elements. The calcium ion was freed from the leaf and became part of the soil from which it could again be absorbed by the soil solution and be ready to begin another cycle.

The nutrient cycle is important to us because we must eat to live, and all our food is dependent on this cycle. It is important that we understand the cycle so that we may support its proper functioning and not interfer with it.

(figure available in print form)

10: All Things Are Interrelated

Q1: What does it mean to say that all things are interrelated?

Q2: What has this to do with environmental issues?

All things are interrelated. An example of this is as follows.

The water from rain enters the soil and the roots of an oak tree absorb it and transport it up the tree to become part of an acorn. Energy from the sun is stored as sugar within the acorn. Energy from the sun also provided the power for the tree to produce the acorn.

(figure available in print form)

11: All Things Are Interrelated (cont.)

A squirrel comes and eats the acorn. Under the usual conditions of nature, eating an acorn provides the squirrel with nutrients needed to grow and live. Much of the energy, water and nutrients that were within the acorn are now stored within him. They are available for his use.

If, however, the rain or soil have been contaminated, that is, made impure by harmful things such as radioactive material or chemica1 wastes, then the acorn may be contaminated and instead of nourishing the squirrel, it may poison him.

(figure available in print form)

12: All Things Are Interrelated (cont.)

In a similar way the fruit from a tree or fish from the sea may grow in a healthy way and provide nourishing food for people. It could also, in a similar way, become contaminated and provide little or no nourishment, make them ill or even poison people.

The air we breath either is pure or has various degrees of impurities such as particles from industrial smoke, fumes from automobiles or smoke from cigarettes. One way the impurities in the air can cause us trouble is by depositing particles in our lungs which then can block the free exchange of oxygen and carbon dioxide, a process essential to life.

(figure available in print form)

13: All Things are Interrelated (cont.)

Impurities in the air can be picked up by the rain, be deposited in the soil, absorbed by the tree roots, transported up the tree and become part of its fruit. If you eat such a fruit, the impurities can then become part of your body cells.

All things, therefore, are interrelated, Energy, water air, nutrients, plants, animals—which includes people of course, all these things are linked together in the Earth's ecosystem. What happens to one part of the ecosystem affects all other parts.

(figure available in print form)

Activities

Classroom Activities

(1) The information in this section on ecosystems, energy flow, nutrient cycle, and hydrologic cycle comes primarily from Ferry M. Melillo's *Ecology Primer.* I have a classroom set of these

books which only a few students can use independently but all students can use in part at some level. Activities using these books included the following.
A. Students do independent work on specific areas. The areas can be chosen by students or assigned.
B. Worksheets of varying degrees of difficulty and guidance can be provided. Giving academically limited students the exact page on which they will find the answer to each question usually works well. A page-range may be all other students need. Better students can be left to use the book's table of contents and glossary to find needed information. One negative aspect of this book is that it does not have an index.
C. Students can use the illustrations as models from which to create their own. Under some circumstances copying illustrations such as a food-web or the hydrologic cycle can be helpful.
(2) Work with the class to develop various examples of how all things are interrelated. Possibly asking certain students what they had for breakfast and then tracing the various items back to where they came from and how they were produced, transported and stored. Pointing out the various locations mentioned on a map of the world can be helpful as well as dramatic. A similar thing can be done with clothes.
Another example could be that of a young student who once said that she wasn't sure how much of her was herself and how much was her friend because they shared so many thoughts they were all mixed up together.
(3) Using a classroom set of the discussion cards as a base to work from, many discussions could be started by trying to answer the questions, sharing the reading, trying to generate other examples of both the concept being focused on and its usefulness to us as people.
(4) From the Peabody Museum Public Education Department borrow examples of wildlife found in the area. One very effective demonstration is to have the room dark and listen to a recording of a bird call, then after a few seconds put on a slide picture of the bird. It is best with local birds the students may have seen or can look for.
(5) Draw specific trees, or birds, or plants from examples in books or on charts before going on a field trip. Draw the thing or you want to focus on.
(6) Try the game Knots in *The New Games Book* . It offers a physical example of inter relatedness.

Outdoor Activities

(1) Going for a walk with particular things to look for like how many evergreen trees are there, how many different bird sounds can you hear, and how many different kinds of animal life or

wildflowers you can find.
(2) Drawing a large object such as a tree, in which the students' attention is directed at the form and flow of lines—paying attention to the inter relatedness of things. Next draw a close up of a flower or small group of leaves for studying greater detail. This activity has been successful with most students. See lesson plan #l0
(3) Get an expert to walk in the area with you, He or she can discuss the history, special features and special problems related to it. Such a person could tell you about the wildlife and also help you spot some. The Connecticut Department of Environmental Protection has been helpful in finding experienced people for this.
(4) More capable students can do various types of mapping projects which, as the years go by, could be saved and provide a. kind of history of the area or of a particular location.
(5) Several teachers have mentioned overnight camping and backpacking with their students. I have not yet tried this and mention it only because of the great enthusiasm with which they told of their experiences. However, they all seemed to agree it required a great deal of preparation.

Part II. Five Basic Areas To Be Considered In Understanding the Current Energy Situation

The time allowed for Part II is also six or seven sessions. Each of the five areas could take one or several sessions depending on what is to be stressed. The five areas are (1) an historical perspective on U.S. energy use, (2) electricity, (3) pollution, (4) conservation and (5) the personal-political aspect of energy.

Discussion Cards

14: An Historical Perspective on U.S. Energy Use

Q1: What is energy?

Q2: What were the energy sources for people who lived in 1850? 1900? 1975?

Q3: What does a comparison of these sources illustrate?

Energy is the capacity to do work. The energy mentioned earlier as part of an ecosystem is the same energy that is being discussed here.

In 1850 the largest source of energy was wood. The next largest source was muscles. What was life like in 1850? What was the wood and muscle power used for?

(figure available in print form)

15: An Historical Perspective on U.S. Energy Use (cont.)

In 1900 the largest source of energy was coal with muscle power again second. What was life like in 1900? What were the coal and muscle power used for?

In 1975 the largest source of energy was oil and the second. largest was natural gas. What was life like in 1975? What were the oil and natural gas used for?

What is most important to notice is the change. Through the years our energy sources have changed and so has our way of life . Relating this to the energy situation today, it is important to keep in mind. that it too will change. How will it change? Who and what will cause it to change? More on this later.

(figure available in print form)

16: Electricity

Q1: What is electricity?

Q2: How was it produced traditionally?

Q3: What is the difference between a. traditional steam power plant and a nuclear power plant?

Q4: Name three alternate sources of electricity?

As stated before, energy is the capacity to do work. Energy can come from wood, oil, coal, gas, wind, the sun, water, uranium and other sources. Electricity is a form of energy, a very versatile form of energy.

Electricity can be described as a flow of electrons, a fast flow of electrons. They flow at a rate of 186,000 miles per second. Traveling at that rate it would take an electron one second to travel 7 1/2 times around. the world.

(figure available in print form)

17: Electricity (cont.)

Because electricity is so versatile and. convenient, it has become a major power source for our country. The problem with it comes when we begin to consider its production.

How a Traditional Steam Power Plant Operates

Electricity is produced when a magnet turns inside a coiled copper wire. In a traditional power plant usually oil or coal is burned to heat water, that makes steam, which turns the turbine, that turns the magnet in the generator and produces electricity.

(figure available in print form)

18: Electricity (cont.)

How A Nuclear Power Plant Operates

A nuclear power plant operates similarly to a traditional power plant in that water is boiled to produce steam

which turns the turbine which turns the magnet in the generator producing electricity. The main difference is that in nuclear plants the fuel used is uranium which “fissions” instead of burning like oil and coal. In fission a uranium atom breaks apart into lighter elements releasing much heat and one or more free neutrons which then bombard other uranium nuclei causing them to split and continue the process. The released heat causes the water to boil and change to steam.

(figure available in print form)

19: Pollution

Q1: What is pollution?

Q2: How do we contribute to pollution in our daily lives?

Q3: How do electrical power plants contribute to pollution?

To pollute means to make impure. It means to contaminate with some material that doesn’t belong there and might cause a problem.

In a traditional steam power plant the smoke from the plant emits particles into the air causing a certain degree of pollution. The amount of pollution depends on the kind of fuel used, the efficiency of the plant and the scrubber system used to clean the smoke as it rises in the chimney.

(figure available in print form)

20: Pollution (cont.)

The fuel for nuclear power plants, uranium, is a radioactive substance and requires special care from the time it is mined. Plutonium, a waste product from a nuclear power plant, is of concern because it is radioactive, can be used to make nuclear bombs and it is not known how to safely store it for the approximate 500,000 years of its life span.

Both traditional and nuclear power plants use large amounts of water that must be cooled before being allowed to return to the body of water from which it came. Sometimes thewater is not cooled enough and raises the temperature of the water where it enters. This can harm and even kill temperature sensitive marine life.

(figure available in print form)

21: Pollution (cont.)

Some other types of pollution are the chemical wastes from our homes and industries, litter one throws on the street, smoke from cigarettes, exhaust from cars, buying more than one needs and buying things with excessive packaging. Consider plastic alone, it lasts literally forever, is not biodegradable and is now found throughout the world causing such problems as having plastic bags obstruct the stomachs of fish and get caught in the engines intakes of boats. [1]

[1] Dierr, E., “Plastic Is Forever”, *Oceans* . November, 1980

(figure available in print form)

22: Conservation

Q1: What is conservation?

Q2: How can we help preserve and take care of the air, water and soil?

Q3: What has this to do with energy?

To conserve means to preserve, to take care of something. If we want to take care of the air we breath, we will have to limit the pollution of it by ourselves and other individuals and groups. The same is true for our waterways, soil and environment in general.

(figure available in print form)

23: Conservation (cont.)

If we limit the amount of energy we require, then less electricity must be produced. If less electricity is produced, then less pollution will enter the air, waterways and other parts of our environment. Since a significant amount of electricity is currently being produced by nuclear power plants, it would mean less radioactive pollution and less plutonium for which to provide security.

How can we limit the energy we use? By being good consumers and buying only what it needed, choosing items that require the least amount of energy to be produced, by walking and bicycling

(cont.)

(figure available in print form)

24: Conservation (cont.)

more and driving less, using electricity carefully, recycling newspapers, cans and bottles, and using the very minimum amount of plastic that is needed.

Another important thing that can be done is to talk with friends and family about conserving. Together people can share and develop ideas. Conservation is a, social responsibility and requires both individual and group effort.

(figure available in print form)

25: Personal—Political

Q1: What can one person do to help create a better world?

Q2: How does this relate to politics?

Q3: How does this relate to you?

Politics has to do with decision making, power and control. Power can be considered as a form of control. One way to view personal power is to see the amount of control one has over his or her own life.

Everyone has some control and choice on what they eat, buy and do. Learning personally to think in terms of

choosing the most wholesome and least energy consuming items is a good way to begin cutting down on pollution, helping to conserve Earth's resources and making ones life healthier all at the same time. This is the first level of action.

(cont.)

(figure available in print form)

26: Personal—Political (cont.)

The next thing one could do is to get involved with other people discussing pollution problems, how to save energy what can be done about it. As a group you can help each other learn to conserve, to pollute less, make more of an impact on the energy used in your area and have a good time doing it.

Extending this idea further, you and your group could plan a particular action. It could be to develop a recycling project, form questions and ask all candidates running for office what their positions are on specific environmental issues or work on getting rid of a local pollution problem.

(figure available in print form)

27:Personal—Political (cont.)

Many people feel helpless as if there is nothing they can do to solve an environmental problem. This is not true. They can go to the proper town officials, form a group, get all the facts they can, get the media to help them get the facts and publish their concerns, get legal advice and, if the problem remains, go to the Connecticut Department of Environmental Protection as a group.

Living in a democracy each person has certain freedoms and responsibilities. Along with the respecting of each persons rights, there is the expectation that each person will do his or her best toward creating a healthy and wholesome future for himself or herself and other people too.

Activities

1. Bring in samples and list on chalk board the names of various common items one might buy in the supermarket like a bag of potato chips, a gallon of milk, some apples. Using a scale of 1 to 5 with 5 as the highest, rate how much energy it takes to a) produce, b) package, c) transport and d)score each item. Compare results.
2. Use the slide show *A Single Voice* , with or without speaker. It is put out by the Connecticut Fund for the Environment and helps to explain how people have been, are and can be effective in solving environmental problems.
3. Make a scrapbook or class bulletin board collecting current newspaper articles on pollution, energy, conservation or environmental law and discuss if each is a local, national or international issue.
4. Show and discuss the Dr. Seuss film *The Lorax* . It is an environmental film on conservation, pollution and hope for the future. It is based on his book, *The Lorax* . Free from the U.S. Environmental Protection Agency, John F. Kennedy Building, Boston MA 02203.
5. From the local electric company request material on current cost of electricity and determine cost for running various appliances such as the television and refrigerator.

6. Schedule a tour of the local power plant.
7. Coordinate a class with the production of electricity, the social studies teacher at election time or the math teacher on problem solving to determine bills or the amount of electricity used under certain situations like watching a colored television set for five hours.

Part III. Our Energy Future and Specia1 Student Projects

What life will be like tomorrow is being determined in large part by what is being done right now. By developing skill in projecting various possible futures and then reasoning backward to the present, we will have a better chance to make decisions that will lead us to a future that we want.

Discussion Cards

28: Our Energy Future

Q1: What are some possible energy futures?

Q2: What kind of future way of life would you like to see in the year 2020? What kind of energy base would it have?

Q3: What can you do to help create such a future?

As mentioned above, our energy situation has changed with time and our life styles. Where once we used mostly wood and muscles, now we use mostly oil, natural gas and nuclear energy. It is important to keep in mind that the energy situation will continue to change. The question is, how will it change and who will control that change.

(figure available in print form)

29: Our Energy Future (cont.)

The items being bought, the pollution being produced, the way we choose to live and travel, the effort we are willing to make to understand both the current energy situation and our real energy needs, the degree to which we are willing to get involved to get the information needed to see if we agree with how our local, state and national resources are being spent—all these decisions are constantly influencing our energy future. They all go together and are forming the energy situation of tomorrow.

Two contradictory predictions as to the world's energy supply for the future are given below. As you read them consider what you think about each and ask yourself how it happens that serious, intelligent, educated people come up with contradictory information and predictions.

30: Our Energy Future (cont.)

"By the mid—1980's, rising costs and public concern over safety would halt nuclear plant construction, including the contruction of breeder reactors, already plagued by technological problems, concern over the threat of nuclear proliferation and problems of cost." [1]

"For the long term, and on a world-wide basis, it is projected that the fraction of electrical energy supplied by nuclear resources will tend toward 45% by the year 2000, and toward 60—65% by the year 2020." [2]

[1] 1Steinhart, J.S. *Pathways to Energy Sufficiency Pg. 48.*

[2] Nesbit, W. *World Energy* pg 49.

31: Our Energy Future (cont.)

The Steinhart study predicts a significant change in the way people live and gives many specific examples. Several of these examples follow.

1. Because so many environmental problems are caused by size, there will be less large cities and an increase in medium-size cities separated by farmland and forest.
2. There will be a, significant increase in regional agriculture as opposed to the large-scale, energy intensive farming of today. When considering the energy needed for gasoline, machinery, fertilizer and pesticides—it takes fifteen energy calories to produce one food calorie.
3. The American diet will be significantly different Beef consumption will be half what it is today and people will eat more whole grains, dried beans, potatoes and vegetables. A large number of families will have home gardens.

32: Our Energy Future (cont.)

4. Food chains like McDonald's will phase out largely due to the energy cost of packaging.
5. By developing more efficient cars, public transportation and cities of a somewhat circular design with a one or two mile radii and convenient walking and bicycling paths—our current energy use in transportation will be cut to 25% of its current level. With this there will be no reduction in social interaction or accessibility—even, perhaps, an increase.
6. By changing the economy's mix of goods and services there will be a significant decrease in the industrial use of energy.
7. Considering conservation, efficient designing, the above mentioned items and other such possibilities, Steinhart's group believes there will be a per capita energy consumption decrease of

64%.
8. The energy used would come from mixed sources. As mentioned above, nuclear power plants would

(cont.)

33: Our Energy Future (cont.)

be phased out because of the cost and technological problems. Energy would be produced from various sources and each area would use the sources most appropriate for its circumstance. An area might use solar, wind, oil, gas, geothermal, tidal power, traditional hydropower or a combination of any or all of these.
9. A thirty-hour work week will prevail. The extra available time could be profitably used by caring for a family garden and doing other services for oneself more cheaply than if they had to be paid for.
10. Crutial to such a future is the continual development and implementation of government policies and laws in this area,. Policy areas such as transportation, energy and fuel supply, economic reform, energy and conservation and environmental protection are some of the areas currently being worked on for policies and laws that could help create such a future.

Special Student Project

Each student is expected to choose one of the following projects.

Project #1. Answer the question “Should Connecticut build more nuclear power plants? Yes _ No_.” be between two and four pages long and include (l) reasons why you selected the answer you did, (2) personal and social consequences of this course of action and (3) what can you do to help Connecticut follow this action.

Project #2. Write a play or skit two to four pages long depicting life as you would like it to be in the year 2020. As part of the play or skit or in addition to it, make clear some aspects of its energy base.

Project #3. In a group of from two to six students, write and act out a play, skit or puppet show on what life could be like in the year 2020 or 2050 and reveal in it its energy base.

Activities

1. Use discussion card for class discussions.
2. Use the special projects.
3. Read and discuss parts or the entire article “Energy Obesity”, by R.E. Miles Jr. [1]
4. Assign the reading of part or all of *Pathways to Energy Sufficiency: The 2050 Study* and *World Energy: Will There be Enough in 2020* ? These two short books present and interesting contrast in predicting what the future energy situation will be like. They also offer a chance to discuss the significance of future studies and interest group predictions.
5. on the class and on what one wants to focus, using the slide presentation *I have Three_Children of My Own* [2] by Dr. Helen Caldicott and the movie *What Time Is The Power On Today* ? [3] by United Illuminating would give powerful examples of extreme views. *I Have Three Children Of My Own* is strongly anti-nuclear and *What Time Is The Power On Today* is just as heavily in favor of allowing the power companies greater freedom to do as they want.
6. Plan and hold a debate on a controversial, current environmental issue stressing the possible future consequences of the opposing vies.

[1] iles, R. E., Jr. “Energy Obesity”, *The Futurist* , Dec. 1980

[2] Available from the New Haven Peace Center. Fee requested.

[3] Available from United Illuminating in New Haven. Free

Lesson Plans

Lesson Plan #1: Drawing in the Woods.

This activity is to be used as part of the first section on developing sensitivity to the natural environment. It will follow classroom work on the ecosystem and hydrologic and nutrient cycles.

The three objectives of this lesson are (1) to spend time in the woods, (2) to help students become better observers and (3) to produce some interesting drawings.

Teacher preparation. Read, pages 5—20 in Nicolaides’ *The Natural Way to Draw* and try the contour and gesture drawing exercises described. Materials needed are pencils, papers and either cardboard or books for students to use as support for papers. A site also must be selected.

Students should be told ahead of time to dress appropriately—no heels and preferably clothes in which they would feel comfortable sitting on the ground. Before going, point out the following. (1) It is very important to

look and *see* . Trees usually do not meet the ground at right angles—look and see how ground. Do not draw from imagination. (2) Each student is expected to make two drawings. The first one is to be a gesture drawing of a tree and done on large white paper. Here they are to look at the lines, the flow, the gesture of the tree. The second drawing is to be a contour drawing of a flower, leaf or small cluster of leaves done on small colored paper. (3) Walk respectfully in the woods. Do not pick plants or break branches. (4) Stay with the class. Do not go far ahead or lag behind,

Give students paper and support boards, Walk together to site. Help students select the trees they want and point out some interesting lines and how certain trees have a particular gesture or flow. Possibly do one for an example. If a student draws from imagination rather than observation, it will usually look “flat”. After this do the contour drawings. Return to school. Students put boards and drawings, with names and dates on them where each belongs. Put up any or all drawings. Possibly submit some to the school newspaper,

Lesson Plan #2: The Production of Electricity

Lesson Plan #2 is to be used as part of the second section of this unit. The objectives are (1) to stress that electricity is a form of energy, a convenient form of energy made from other less convenient forms of energy, and (2) to discuss some ways of producing electrify.

Materials used include the discussion cards 16—18, a map of the world.

Class. Go through cards 16—18. On card 17 ask the questions, “What fuel does the New Haven Harbor Station use? Where does it come from?” It uses oil and the oil comes mostly from OPEC countries. Here use the world map and show where the OPEC countries are located. Discuss a path the liners might take to get the oil to the Harbor Station. Turning on a light in the classroom, thus, uses electricity produced from oil which came to New Haven from the referred OPEC countries.

On card 18 show that uranium comes mainly from Wyoming and Colorado. Almost all the power we use in this area comes from either oil or uranium.

Discuss the positive and negative aspects of oil, coal, nuclear, wind and solar production of electricity. Each is a form of energy being changed into another form of energy. Relate to the first and second energy laws of thermodynamics.

Project. Have some students and others write paragraphs describing the positive and negative aspects of one of the above methods. Form into a large school display.

Lesson Plan #3. Special Student Project,

This plan is part of the third section and teacher preparation here is for the entire section, not just this lesson.

Teacher preparation. Read *The Futurist* article “Energy Obesity”, *Pathways to* Energy Sufficiency, *World Energy* and *No Limit to Learning* . Prepare worksheet for project. (see end of third section.)

Student preparation would depend on the class. Assign part of one or parts of all three of the first three readings listed under teacher preparation.

Materials needed are discussion cards 28 through 33, worksheets for project and adequate number of copies of whatever reading students are to do.

Class. (1) Discuss why it is important to study future possibilities? The first idea is that if we drift, a lot is left to chance. The second point would be to develop skill in projecting consequences of various actions. (2) Discuss the assigned reading. Depending on group, this might take a couple periods or only part of one. (3) Go over discussion cards 28 through 33. (4) As a class, create a future way of life that would seem fun. Set a date, possibly 2032. Decide a setting, possibly New Haven with a family that has three children. They share a duplex. Decide what the people do for work and play. Determine the energy needs for each person or activity. Discuss transportation and the source of energy. (4) Give out and discuss project worksheet and time allowed.

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3. Fluegelman, A., *The New Games Book* , Garden City, New York: Dolphin Books/Doubleday and Co., 1976. An exciting book with many ideas for games to try with students.

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7. Nesbit, W., *World Energy: Will There Be Enough _ in 2020?* Washington, D.C.: Edison Electric Institute, 1979. Presents how the utility people view the future energy situation.

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9. Steinhart, J.S., DeWinkel, C.C., Gates, R.W. , Lipp, K.B., Thornsjo, M. and Kabala, S., *Pathway to Energy Sufficiency: The 2050 Study* , San Francisco: Friends of the Earth, 19790 A good book to help generate ideas about possible future ways of life.