



## 5<sup>th</sup> Grade Introduction to Energy Resources Renewable and Nonrenewable Energy Sources

**Purpose:** Students will be introduced to the basic concepts of energy sources and the difference between renewable and nonrenewable sources. Students will also become familiar with common household energy uses.

**Time:** (5) 1-hour classroom sessions

**Grade:** 5<sup>th</sup> grade

**Goals:** Students will be able to:

- Identify the main sources of renewable and nonrenewable resources as well as analyze pros and cons of each.
- Analyze uses of solar energy
- Analyze wind speeds
- Understand the process behind the production of biodiesel
- Recognize the need and importance of renewable energy sources and identify realistic substitutions of nonrenewable energy sources for renewable energy sources.

**Objectives:** Students will:

- Compare and contrast the different renewable and nonrenewable energy sources by creating a flyer.
- Construct a simple solar oven to further comprehend solar energy and its uses.
- Observe wind behavior and use the Beaufort Scale, to later determine if their area would be feasible for wind turbines.
- Observe a diagram that illustrates the steps in the production of biodiesel, and analyze mathematical conversion factors.
- Draw an ideal town where all forms of energy used come from renewable energy sources. They will analyze how these can realistically replace nonrenewable sources of energy.

# Renewable and Nonrenewable Energy

## Sources: INTRO☆

### **Program outline**

In-class discussion: *What are renewable and non renewable energy sources?* Students are reintroduced to the basic concepts of energy sources. Concepts of renewable and nonrenewable energy sources are to be discussed more in depth. Further analysis of the differences between the two, examples of each and pros and cons are to be detailed.

### **Classroom Curriculum:**

- **Introduction to energy sources and fuels:** Students are reintroduced to the basic concept of energy and fuels. (See pages 6, 9 of Instructor's Handbook.)
- **Introduction to nonrenewable energy sources:** Students are reintroduced to the concept of a nonrenewable energy source. The formation of fossil fuels is to be restated. Restate how long does fossil fuel take to be formed versus human consumption. Explain the differences in formation between coal and petroleum. Reintroduce natural gas. Review common uses of all three fossil fuels. Focus also on analyzing pros and cons of these resources. Refer also to health and environmental hazards. (See pages 11,12,14,15,19, 22 of Instructor's Handbook.)
- **Introduction to renewable energy sources:** Students are to be introduced to the concept of a renewable energy source. Restate the different renewable energy sources focused on this unit: solar, wind, water, biomass and biodiesel. The way in which humans have used these sources to create energy should be detailed: solar panels, wind turbines, hydroelectric power plants and others. Common modern uses of renewable energy sources should be detailed. Focus also on analyzing pros and cons of these resources. (See pages 24-43 of Instructor's Handbook.)

### **Recommended vocabulary terms:**

Energy, energy sources, fuel, nonrenewable resource, renewable resource, fossil fuels, petroleum, oil, natural gas, coal, gasoline, diesel, solar power, wind power, biomass, water power, biodiesel, turbines, dam, windmill, wind farm, transportation, engine. (See page 44 of Instructor's Handbook for definitions.)

## *Activity: Comparison of Energy Sources*

### *Flyer*

*Students are to compare and contrast the different energy sources previously explained to them.*

**Method:** Students will analyze the differences between the energy sources by creating a flyer promoting the use of renewable energy resources. These flyers must contain specific information on the main renewable resources explained in class and compare and contrast them with their alternate nonrenewable source.

**Materials:** This flyer might be designed using computer-aided tools or art supplies such as magazine cutouts, colored pencils or markers.

**Procedure:**

1. Following the class discussion, ask the students to create a list including:
  - a. Definition of each nonrenewable and renewable energy source.
  - b. Pros and cons of each nonrenewable and renewable energy source.
  - c. Common household and industrial energy uses of each nonrenewable and renewable energy sources.
2. After creating this list, allow the students to compare the uses of renewable and nonrenewable and invite them to find reasonable ways in which nonrenewable energy sources could be substituted by renewable.
3. Create a new list, which includes nonrenewable energy uses substituted by renewable.
4. Using this final list and the pros and cons ask the students to construct a flyer promoting the use of renewable energy sources. Invite them to include the information they have gathered, highlighting the pros and possible substitutions.

**Assessments:**

Was the class discussion successful? Was student participation active?

Has each student developed a list including definitions, pros, cons and uses of each renewable and nonrenewable energy source?

Can the students, as a class and individually, classify the different energy sources?

Can the students discuss the factors of cost, contamination, scarcity and abundance of each energy source in their own words?

Using the list created, were the students able to compare the uses of renewable and nonrenewable energy sources?

Were the students able to find ways in which nonrenewable energy sources could be replaced by renewable energy sources, and compile a new list?

Have the flyers been successfully created? Do they include the desired information in a clear and relevant format?

# Solar

## Program Outline:

In-class discussion and experiment: *Solar energy*. Students are further introduced to the concept of solar energy by the creation of a small solar oven.

## Classroom Curriculum:

- **Further introduction to solar energy and energy uses:** In a quick overview the students will be asked to lead a small class discussion about solar energy as a renewable energy source. What is solar power? How is energy from the sun used by humans when it comes to transportation? Is solar energy used in homes? If so, how? Explain how cooking requires abundant energy, and how by use of solar energy, a lot of fuel can be saved. (See page 31 of Instructor's Handbook)
- **Introduce the principles involved in the process of cooking with solar energy:**
  - Introduce the concept of "solar gain": 'solar gain' can be defined as arranging for sunlight to enter a device as a source of energy. In this case, the gain is accomplished both by reflection and direct gain. This principle also includes using dark colored surfaces to absorb the solar energy that enters a device.
  - Introduce the concept of "insulation": 'insulation' can be defined as containing heat by trapping air inside and around a device to contain heat, and reflecting thermal radiation back into a device.

## Recommended vocabulary terms:

Solar energy, transportation, solar gain, insulation, solar oven. (See page 44 of Instructor's Handbook for definitions.)

## *Activity: Creation of a solar oven*

*Students will construct a simple solar oven to further comprehend solar energy and its uses.*

**Method:** Using cardboard pizza boxes, aluminum foil and construction paper, students will construct a simple solar oven that will later be used for cooking.

**Recommendations:** After the construction of the oven the students will cook an uncomplicated meal such as a hot dog, pizza or 's'mores'. For this activity further out-of-class time will be required, provided the climate permits. This solar oven box design can heat up to 200° on a warm sunny day. By implementing other optional features, the oven

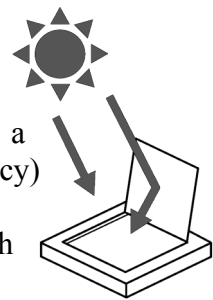
may reach higher temperatures, which might be advantageous in cooler weather. Ample time for cooking should be allowed, roughly twice as long as would take in a conventional oven. It is not recommended to try to use the oven outside in temperatures below about 60°; for lower outside temperatures, try inside on a sunny windowsill. In the same manner, cooking takes time, and the sun will change position during that time. Therefore, someone may need to align the solar oven now and then to keep the sunlight entering.

**Materials:** (for a single oven): 1 large size pizza box oven, several feet of aluminum foil, 1 sheet black construction paper, 2 ½ feet of clear plastic wrap, 4 feet of masking tape, 2 feet of string, Scissors (teachers or older students may also want to have an Exacto knife on hand, to better be able to cut cardboard with), ruler, marker

Note: Avoid materials that you think might become toxic when heated.

### Procedure:

1. Assemble the pizza box, and open it up.
2. Glue aluminum foil to all inside surfaces of the sides except the top of the box, with the shiny surface facing in. This will create a "radiation trap" that will trap, by reflection, invisible (low-frequency) radiation that is radiated by the food and air inside the box.
3. On the top flap of the pizza box draw a square with a marker with edges spaced 1" from the four sides of the box.
4. Cut along three of the lines, on the sides and on the front edge of the box, leaving the fourth line along the box's hinge uncut. Then fold open the flap, making a crease on the fourth line (see the figure above). Note: Extra supervision may be needed during this step, because students often cut along the fourth line as well by mistake.
5. Glue aluminum foil to the inside surface of the top flap, with shiny side visible! This will form reflector, to reflect sunlight into the oven. Be careful to make as few wrinkles as possible, and smooth out whatever wrinkles occur.
6. Tape the black construction paper to the bottom of the box. This will help to absorb the incoming sunlight.
7. Carefully stretch the plastic wrap over the opening of the box, sealing the edges with tape to seal the air in.
8. Cover any air leaks around the box edges with tape, making sure that the box can still be opened so you can place food inside the box and remove it later.
9. Ask the students to write their names on their solar oven box with a marker.
10. Go outside in the sunlight and place oven on a flat, level surface.
11. Place food on some foil (or a paper plate) and place inside the oven.
12. Use string and masking tape to tie back and adjust the reflector, so that sunlight is reflected into the oven, and especially onto the pie tin.
13. Place a thermometer inside the oven to watch temperature increase.
14. Let food cook, and check reflector angle now and then to make sure sunlight is getting inside the oven.



### Optional Features



- Add additional flaps to reflect sunlight into the oven. This can substantially increase the heat gain of the oven. This will require some extra cardboard, foil, glue, and string to adjust the flaps.
- Crumple up some sheets of newspaper and stuff them around the inside of the box to provide extra insulation.

### **Assessments:**

Did the students understand the concepts of solar gain and insulation?

Can the students recognize other solar energy uses in the household?

Were the solar ovens successfully created?

Was the temperature increase significant?

Could the students relate the effective cooking with the created oven to the use of energy from the sun?

Could the students recognize the possibility of replacing household electric appliances with those that use energy from the sun?

### **Reference:**

New Mexico Solar Energy Association 'Make a pizza box solar oven' [Online] Available. [http://www.nmsea.org/Curriculum/4\\_6/pizza\\_box\\_oven/pizza\\_box\\_ovens.htm](http://www.nmsea.org/Curriculum/4_6/pizza_box_oven/pizza_box_ovens.htm) (December 15, 2004)

# Wind

## Program Outline:

In-class discussion: *Wind speeds and energy*: Students are further introduced to the concept wind power, specifically concerning wind speed.

## Classroom Curriculum:

- **What is wind?** Restate that wind is caused when warm air rises and air from cooler areas flows in to take the place of the heated air. (See page 25 of Instructor’s Handbook.)
- **Wind and energy** Explain to the students that winds move turbines to produce energy. State that a minimum average wind speed of 13 mph is needed to produce electricity economically throughout the year. (See page 26 of Instructor’s Handbook.)
- **The Beaufort Scale**

Beaufort Scale	Description	Observation
0	calm (0-1mph)	smoke rises vertically
1	light air (2-3 mph)	smoke drifts slowly
2	slight breeze (4-7 mph)	leaves rustle, wind vane moves
3	gentle breeze (8-12 mph)	Twigs move, flags extend
4	Moderate breeze (13-18 mph)	branches move, dust & paper rise
5	fresh breeze (19-24 mph)	Small trees sway
6	strong breeze (25-31 mph)	Large branches sway, wires whistle
7	Moderate gale (32-38 mph)	Trees in motion, walking difficult
8	fresh gale (39-46 mph)	Twigs break off trees
9	strong gale (47-54 mph)	branches break, roofs damaged
10	whole gale (55-63 mph)	Trees snap, damage evident
11	storm (64-72 mph)	widespread damage
12	Hurricane (73-82 mph)	extreme damage!

## Recommended vocabulary terms:

Wind, wind power, turbines, windmills, wind farm, energy, speed. (See page 44 of Instructor’s Handbook for definitions)

*Activity: See the wind*

*Students will make observations about the wind and try to determine wind speeds.*



**Method:** Students will determine wind speeds by using observation and the Beaufort Scale, to later determine if their area would be feasible for wind turbines.

**Materials:** Compass, string, handbook with the Beaufort Scale.

**Procedure:**

1. Cut out and hand out copies of the Beaufort Scale page to the students and ask them to paste it in their science notebooks.
2. Read the chart along with the students and make sure they comprehend what is being stipulated.
3. If possible as a class, go outside to practice wind observations around the schoolyard.
4. Go to different parts of the school, such as fields and around buildings.
5. Ask the students to record their observations. These observations also include wind direction using a compass and a piece of string.
6. If desired, the students could then make and record observations about wind characteristics for five days and answer the following questions:
  - a. What are the wind speeds in the: morning, afternoon, evening
  - b. What time of day do the fastest winds occur?
  - c. From what direction are the winds coming? (using the compass)
  - d. Would a wind turbine work well in your area? Why?
7. After the recollection of observations, promote a class discussion on whether a wind turbine would work in your area.

**Assessments:**

Do the students recall how wind is formed?

Can the students recognize wind as a source of energy?

Did the students understand the Beaufort Scale?

Were the students, as a class and individually, able to observe wind directions and speeds and match the speeds correctly with the Beaufort Scale?

Were the students able to conclude a proper location for a wind turbine?

**Reference:**

Renewable Energy: The Infinite Power of Texas. 'Looking at the advantages of Renewable Energy' [Online] Available <<http://www.infinitepower.org/lessonplans>> (December 20, 2004)



Name: \_\_\_\_\_  
Class: \_\_\_\_\_

Date: \_\_\_\_\_

## **BEAUFORT SCALE**

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Class: \_\_\_\_\_

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# Biodiesel

## Program Outline:

In-class discussion: *Biodiesel*: Students are further introduced to the concept of Biodiesel

## Classroom Curriculum:

- **Further introduction to biodiesel:** In a quick overview the students will be asked to lead a small class discussion about biodiesel as a renewable fuel. Restate that biodiesel works like gasoline: it is a fuel to run transportation methods. Explain that biodiesel is a fuel derived from vegetable oil, which comes from plants. Explain that the vegetable oil is mixed with methanol and lye to get biodiesel. Explain that the process involves:

1. Mixing methanol and lye
2. Heat vegetable oil
3. Mix vegetable oil and methanol-lye mixture
4. Shake the new mixture and allow it to settle for some time

State that the products are biodiesel and glycerin, which is the main ingredient in soap. Explain how there are no waste products in the reaction. Restate that vegetable oil for the production of biodiesel can be obtained from different sources: virgin vegetable oil, recycled vegetable oil and animal fat. Recycled vegetable oil comes from restaurants where it has initially been used for cooking and will later be disposed of. (See pages 9, 34 of Instructor's Handbook.)

- **Benefits of biodiesel:** Explain that it is a fuel, like gasoline, but biodiesel is very environmental friendly and less toxic than table salt. Also, there are no waste products in the production of biodiesel. Explain how it is easier to keep getting biodiesel from plants than it is to get gasoline out from the Earth; and how the overall production of biodiesel is very simple when compared to the refining of petroleum. (See page 41 of Instructor's Handbook.)
- **Biodiesel in the United States:** The biodiesel market has been growing for the past years, and there are numerous producers and distributors across the country. (See pages 43, 50 of Instructor's Handbook.)

## Recommended vocabulary terms:

Fuel, renewable resource, transportation, biodiesel, diesel, gasoline, vegetable oil, alcohol, lye, glycerin, fossil fuel, petroleum, nonrenewable resource. (See page 44 of Instructor's Handbook for definitions.)



## *Around the United States with Biodiesel*

*Students will become familiar with the biodiesel market in the United States.*

**Method:** Students will locate and label states that have biodiesel plants.

**Materials:** Print out of Biodiesel Chemistry handout, print out of biodiesel producers, US map printout, atlas

**Procedure:**

1. Hand out a copy of the Biodiesel Chemistry handout and review it with the students, allowing them to comprehend the process of making biodiesel.
2. Hand out a copy of the United States map to each student.
3. Ask the students to label each state.
4. Using the printout of Biodiesel producers, ask the students to label in the states that have Biodiesel production plants. Ask them to use a symbol (a red star, green circle, etc.) to label the following
  - a. Each active production plant
  - b. Each proposed production plant
5. The students don't have to be accurate on the location of each city with a plant. What is desired is for them to be accurate with the number of plants in each state, since there are states that have more than one; they should place a symbol for each one on each state.
6. Ask the students to list the states that don't have biodiesel production plants.
7. Allow each student to choose two states, one that has a production plant and one that doesn't.
8. Ask the students to address a letter to the governor of each state. In the letter, the student should state why biodiesel is a good option, and either share their thought on why it is good that the state has production plants, or why it is bad that they don't.
9. Invite the students to research other parts of the globe that use biodiesel using Internet sources.

**Assessments:**

Do the students understand the concept of biodiesel as a renewable fuel?

Can the students recall where biodiesel comes from?

Can the students state at least four benefits of biodiesel?

Have the students read and understood the Biodiesel Chemistry handout?

Have the students successfully labeled each state on the United States map?

Have the students successfully labeled the states that have Biodiesel production plants (proposed and active)? Did the students use appropriate symbols and an adequate legend in their map?

Have the students successfully determined the states that do and do not have biodiesel production plants? Have the students chosen two respective states?

Have the students written an adequate letter?

Name: \_\_\_\_\_  
Class: \_\_\_\_\_

Date: \_\_\_\_\_

# **BIODIESEL CHEMISTRY**

## **MAKING BIODIESEL**

The following is the ‘recipe’ for making Biodiesel from new vegetable oil.

### **REACTANTS:**

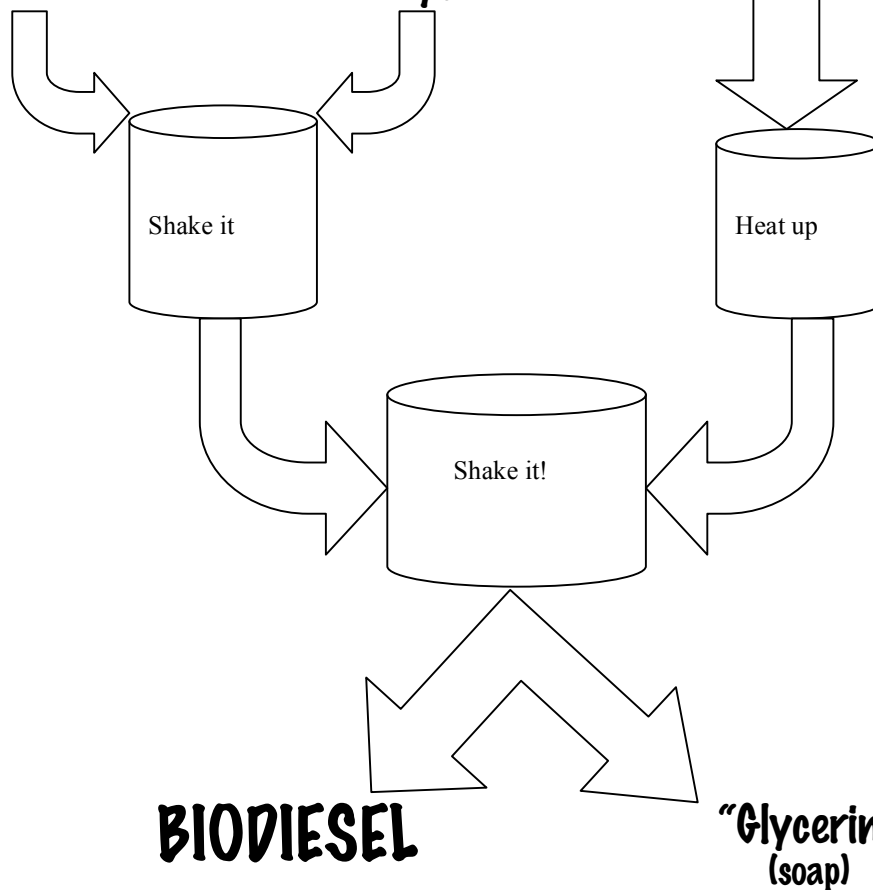
New vegetable oil, 1L  
Lye, 4 grams  
Methanol, 220 mL

### **PROCESS:**

**Methanol**

**Lye**

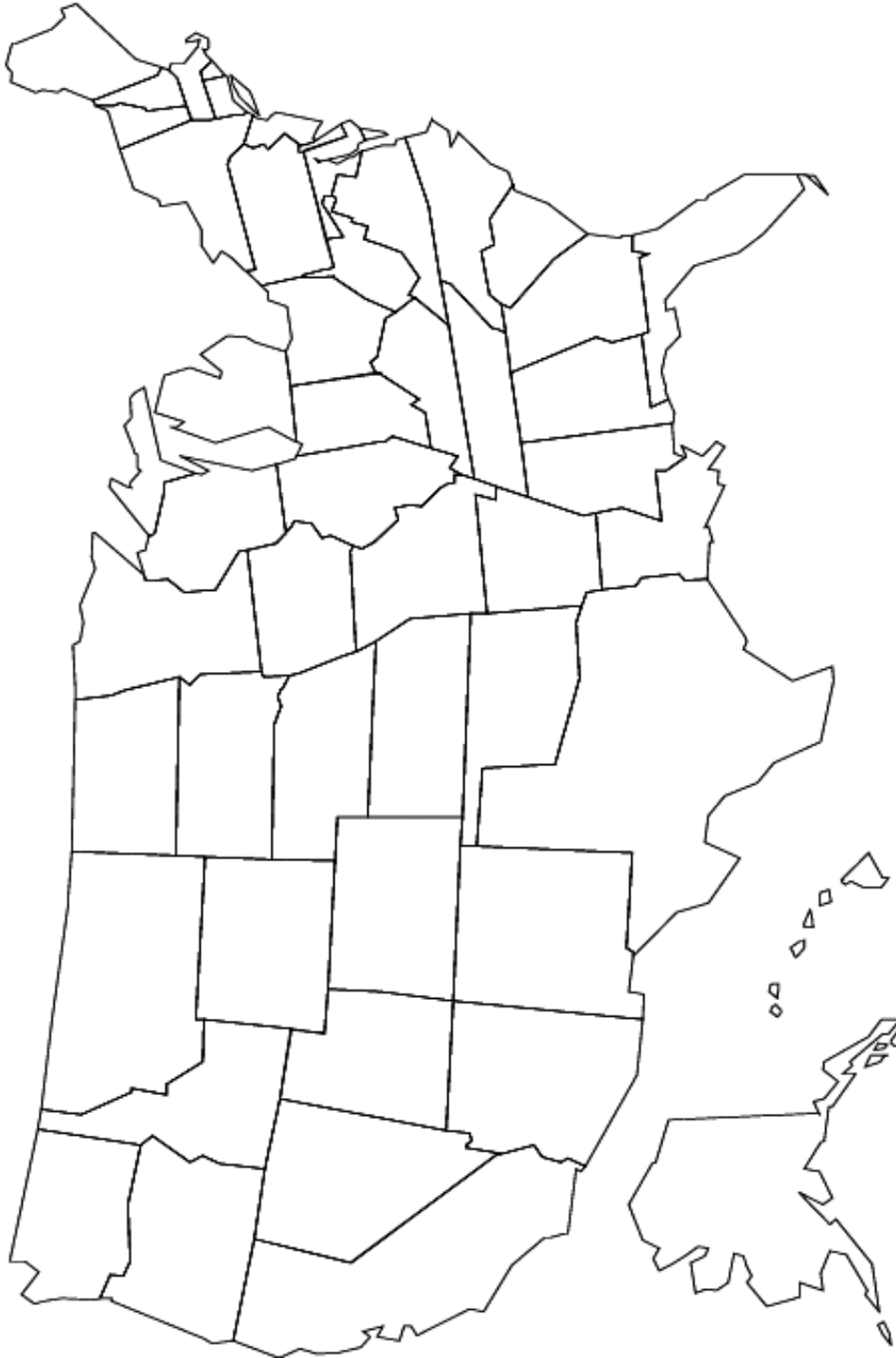
**Vegetable Oil**



Name: \_\_\_\_\_  
Class: \_\_\_\_\_

Date: \_\_\_\_\_

## **AROUND THE UNITED STATES WITH BIODIESEL**





# Renewable and Nonrenewable Energy

## Sources: Review

### Program Outline:

In-class discussion: *Renewable and non renewable energy source review.* Students are to review the concepts learned in the previous four weeks.

### Classroom Curriculum:

- **Renewable and nonrenewable energy sources:** Ask the students to review the flyers they created the first week. Review the main concepts: nonrenewable sources will some day cease to exist; renewable sources are always given to us by nature. Review the main vocabulary terms: solar energy, wind power, water power, biodiesel, fossil fuels. Ask the students to compare the uses of renewable and nonrenewable and ask them to state the ways in which they believed nonrenewable energy sources could be substituted by renewable. Analyze the pros and cons they wrote in their flyers. (See pages 11,12,14,15,19, 24-43 of Instructor's Handbook.)
- **Solar energy:** Ask the students questions about the solar oven activity. Is the sun an effective source of energy? Which household appliances could be replaced for those which employ energy from the sun? Why was the box covered in aluminum foil? (See page 31 of Instructor's Handbook.)
- **Wind:** Ask the students about the wind observation activity. Could they find any regions where wind speeds were adequate for placing wind farms? Why? What could this tell them about where wind farms are placed? (See page 25 of Instructor's Handbook.)
- **Biodiesel:** Review with the students that biodiesel is a renewable source of fuel. Invite the students to recall how each form of transportation is either renewable or not. Review the process of production of biodiesel. Ask them about conversion factors, and invite them to analyze the simplicity behind the production of biodiesel. (See page 34 of Instructor's Handbook.)

## Activity: Ideal Town

*Students will analyze how renewable energy sources can replace nonrenewable energy sources.*



**Method:** By inviting students to draw an ideal town where all forms of energy used come from renewable energy sources, they will analyze how these can realistically replace nonrenewable sources of energy.

**Materials:** 1 poster board per pair, colored pencils, markers, glue and other desired art supplies.

**Procedure:**

1. After reviewing the main topics discussed throughout the lesson plans, ask the students to form pairs. Together, the students should draw an ideal town where all forms of energy come ONLY from renewable energy sources. Allow them to choose different parts of a town such as: houses, a bank, a gas station, a bus station, schools and others. Promote that they include a combination of several different areas of a town.

**Assessments:**

Review the individual assessment questions from each of the specific lessons of this unit.

Can the students recall the information previously learned?

Are the students familiar with the key vocabulary terms from this unit?

Has the student been able to identify and classify nonrenewable and renewable energy sources?

Can the students recognize why renewable energy resources are important?

Was a successful class discussion held? Did the students actively participate?

Was the ideal town poster successfully created? Does it show critical and creative thinking on the part of the students?

Are the students able to recognize that using renewable energy resources is a feasible idea?