

# Strand I

## Solar Cooker

### Student Materials

Most people in the United States use an electric stove or a natural gas stove to cook their food. This is not the case in much of the world. Approximately 50% of the people on Earth cook using fire from burning wood. However, due to overuse, wood is becoming a scarce commodity in many countries. In addition, burning wood is a major source of air pollution.

One alternative to cooking with wood is using solar cookers. These devices use energy from the sun to cook food without producing any pollution. While there are many designs for solar cookers, a simple solar cooker can be made from everyday materials. There are many factors that can influence the effectiveness of a solar cooker including the size of the collector, the orientation of the panel and the color of the container.

### Your Task

You and your lab partner will design and conduct an experiment to investigate one factor that contributes to the effectiveness of a solar cooker in heating water. Factors you may want to investigate include: the shape of the collector, the shape of the water container, orientation of the collector, surface area or color of the container.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided.

#### Suggested materials:

heat lamps or sunlight	tape
cardboard	thermometer
aluminum foil	water
container for water	colored paper or paint
safety goggles	

# Energy Uses in Connecticut

## Student Materials

Energy is used everyday to heat and light our homes, schools and businesses. Have you ever thought about where the energy we use everyday comes from? How have these energy sources changed over the last several decades?

You have been provided with a spreadsheet containing some information about energy use and its sources in Connecticut from 1960 through 2001. Use this information and the Excel program to prepare a line graph showing the trends in the energy consumption from the following sources: coal; natural gas; nuclear; hydroelectric; and wood/waste over this time span.

**Your task is to choose one of the fuel sources (coal, natural gas, nuclear, hydroelectric or waste) and research the advantages and disadvantages of this particular energy trend as it is illustrated on the graph.** Does this trend support Connecticut's initiative to significantly decrease the use of non-renewable resources by the year 2010? Some support materials for the study of energy resources may be found at the websites listed below and many others.

### Nuclear Energy Resources

- **Energy Information Administration: Nuclear**  
<http://www.eia.doe.gov/fuelnuclear.html>
- **Office of Nuclear Energy, Science and Technology**  
<http://www.ne.doe.gov/>

### Hydroelectric Energy Resources

- **National Hydropower Association**  
<http://www.hydro.org/>
- **Power Matters: Hydroelectric Power**  
<http://www.tva.gov/power/hydro.htm>

### Biomass Energy Resources

- **Energy Efficiency and Renewable Energy**  
<http://www1.eere.energy.gov/biomass/>
- **Connecticut Clean Energy Fund (click on Biomass from the list)**  
<http://ctcleanenergy.com/BasicsofCleanEnergy/TypesofCleanEnergy/tabid/66/Default.aspx>

### Coal Energy Resources

- **Office of Fossil Energy-U.S. Department of Energy**  
<http://www.fe.doe.gov/programs/powersystems/cleancoal/index.html>
- **Coal Fired Power Generation**  
<http://www.rst2.edu/ties/acidrain/IEcoal/how.htm>

### Natural Gas Energy Resources

- **Adventures in Energy**  
<http://www.adventuresinenergy.org/main.swf>
- **Natural Gas Supply Organization**  
<http://www.naturalgas.org>
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## Strand II

### Synthetic Polymers

#### Student Materials

Polymers are large molecules consisting of chains of small molecules called monomers joined together in a repeating pattern. In the early 1900s, scientists began to understand the chemical makeup of natural polymers and how to make synthetic polymers with properties that complement those of natural materials. One simple synthetic polymer chemists developed is polyethylene. They developed it by repeating units of the monomer ethylene ( $\text{H}_2\text{C}=\text{CH}_2$ ). Polyethylene is a very large, zigzag-shaped molecule. One small part of a polyethylene chain is shown below.



Chemists and engineers have learned to process and modify molecules of polyethylene in different ways to manufacture common household products with a variety of characteristics. Polyethylene is used to make plastic trash bags, dry cleaning bags, milk jugs and soda bottles. In industry, materials made from polyethylene are tested for what are called “stress-strain behaviors.” Stress-strain behaviors include:

**tensile strength** - the amount of pulling force placed upon a material before it breaks

**abrasion resistance** - toughness of material against scraping, scuffing or scarring

**puncture resistance** - ability of a material to keep moving objects from perforating the surface

#### Your Task

You and your lab partner will design an experiment that investigates a stress-strain behavior among various plastic products made of the synthetic polymer polyethylene.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided.

#### Suggested materials:

plastic dry cleaning bag

plastic kitchen wrap

plastic sandwich bag

plastic grocery bag

ball bearings (different masses)

scissors

markers

sandpaper (coarse and fine)

coffee can

rubber bands

ring stands/ or clamps

ruler

safety goggles

### Synthetic Polymers

## Student Materials

One of the most important factors in researching an issue online is evaluating the credibility of the source of information. Anyone may publish their work online but not everyone who publishes information is interested in providing data-driven, unbiased and balanced information to the reader. Some sources online are interested in promoting a product or an industry. Other sources try to sway opinions without any credible facts to back up their views.

You are trying to evaluate the risks versus benefits of using plastic products. During your research you find the sites and articles listed below. **Your task is to evaluate the credibility of the sources of information by filling out the template on the following page.** Use the background information and skills provided to you by your teacher to evaluate the sources. Remember to document your evidence as to the kind of site, authority of the author, the point of view of the author/site, date of publication, and any other information that is important in the evaluation of the reliability of the site. You may use the ICONN Database (<http://www.iconn.org>) to locate four articles. Use the federated search option, advanced search by the terms plastics (subject) and recycling (all headings). If you need additional information search by Bottle Bill and Connecticut in *The Hartford Courant*.

### Assessing the Credibility of Information

Name of website	Kind of site (.edu, .org, .com)	Author/Source	Date of publication	Point of view of the author/site	Reliability of the information provided

**Write a brief assessment about the credibility of the sources you investigated:**

# Acid Rain

## Student Materials

Acid rain is a major environmental issue throughout Connecticut and much of the United States. Acid rain occurs when pollutants, such as sulfur dioxide from coal burning power plants and nitrogen oxides from car exhaust, combine with the moisture in the atmosphere to create sulfuric and nitric acids. Precipitation with a pH of 5.5 or lower is considered acid rain.

Acid rain not only affects wildlife in rivers and lakes but also does tremendous damage to buildings and monuments made of stone. Millions of dollars are spent annually on cleaning and renovating these structures because of acid rain.

### Your Task

Your town council is commissioning a new statue to be displayed downtown. You and your lab partner will conduct an experiment to investigate the effect of acid rain on various building materials in order to make a recommendation to the town council as to the best material to use for the statue. In your experiment, vinegar will simulate acid rain.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided.

#### **Suggested materials:**

containers with lids  
graduated cylinder  
vinegar (simulates acid rain)  
pH paper/meter  
safety goggles

#### Proposed building materials:

limestone chips  
marble chips  
red sandstone chips  
pea stone  
access to a balance

## Connecticut Brownfield Sites

### Student Materials

More than 290 sites in Connecticut have been identified as “Brownfield Sites.” These are parcels of property once used for industrial, commercial or manufacturing and are now typically abandoned due to **suspected** contamination. Often these unused parcels adversely affect the quality of living in the area and may pose potential health risks to local citizens. Financial assistance is available from the state and federal governments to assess and remediate these sites.

Find a Connecticut Brownfield site near your hometown by clicking on the Brownfield Inventory link found at the Connecticut Department of Environmental Protection’s website:

<http://dep.state.ct.us/wst/remediation/brownfields/brownfields.htm>. What has the property been used for that led it to being identified as a Brownfield site? Use a search engine such as Google or the ICONN Database to research one of the potential contaminants at the site. If you have trouble identifying a specific contaminant from the nearby Brownfield site, ask your teacher for clarification from the master list he or she has been given.

**Your task is to formulate a question about the site that may be answered through scientific investigation and to design the investigation.** Do not worry about the specific steps needed to isolate the contaminant or specific techniques used to measure the contaminant’s effect on the environment. Focus on writing a general plan for your investigation including the independent and dependent variables to be studied, general procedures you will follow and the data you will collect. Include a control group if appropriate.

## **Strands I, II, III Laboratory Investigations**

## Designing and Conducting Your Experiment

**1. In your words, state the problem you are going to investigate. Write a hypothesis using an “If ... then ... because ...” statement that describes what you expect to find and why. Include a clear identification of the independent and dependent variables that will be studied.**

**2. Design an experiment to solve the problem.** Your experimental design should match the statement of the problem and should be clearly described so that someone else could easily replicate your experiment. Include a control if appropriate and state which variables need to be held constant.

**3. Review your design with your teacher before you begin your experiment.**

**4. Conduct your experiment.** While conducting your experiment, take notes and organize your data into tables.

**Safety note: Students must wear approved safety goggles and follow all safety instructions. When you have finished, your teacher will give you instructions for cleanup procedures, including proper disposal of all materials.**

## Communicating Your Findings

Working on your own, summarize your investigation in a laboratory report that includes the following:

- **A statement of the problem you investigated. A hypothesis (“If ... then ... because ...” statement) that described what you expected to find and why.** Include a clear identification of the independent and dependent variables.
- **A description of the experiment you carried out.** Your description should be clear and complete enough so that someone could easily replicate your experiment.
- **Data from your experiment.** Your data should be organized into tables, charts and/or graphs as appropriate.
- **Your conclusions from the experiment.** Your conclusions should be fully supported by your data and address your hypothesis.
- **Discuss the reliability of your data and any factors that contribute to a lack of validity of your conclusions.** Also, include ways that your experiment could be improved if you were to do it again.