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Lessons and Activities for Grades 9 - 12.

**Don't Waste Away, page 1**
Language Arts, Art, Environmental Science
Solid waste communications
Students will:
- discuss solid waste issues
- discuss establishing sound environmental habits at an early age
- explore how messages are targeted to children
- create a book on environmental issues.

**The Environment On-Line, page 5**
Computer Science, Science, Social Studies
Using computers to access the latest information about the environment
Students will:
- explore the information about the environment available through on-line networks.

**My Bag, page 7**
Science, Math, Language Arts
Students will:
- see the volume of trash generated by each person in South Carolina
- identify trash as recyclable, reusable or repairable
- demonstrate the principle of reduction.

**Packaging Alternatives I, page 9**
Environmental Science, Home Economics, Basic Math
Creating an awareness of packaging alternatives
Students will:
- keep a record of the materials and packaging purchased in their households for one week
- classify the packaging purchased as recyclable, nonrecyclable and/or degradable
- calculate the percentage of recyclable, nonrecyclable and degradable packaging purchased by their households
- use calculations to estimate the percentage of recyclable, nonrecyclable and degradable packaging purchased by larger groups (e.g., whole class, school, county)
- identify alternatives to nonrecyclable packaging.
Packaging Alternatives II, page 15
Environmental Science, Home Economics, Art
Creating an awareness of packaging alternatives
Students will:
• discuss product packaging and advertising
• create a package design and advertising campaign
• look at environmental choices in packaging.

Enviro-Shopping I, page 19
Environmental Science, Social Studies, Home Economics
Understanding how our buying decisions affect the amount of waste we produce
Students will:
• see how their buying habits affect the amount of waste they produce
• discuss the merits and pitfalls of “green” labeling and labeling regulations
• investigate how environmental labeling works in other countries

Enviro-Shopping II, page 29
Environmental Science, Social Studies, Home Economics
Understanding how our buying decisions affect the amount of waste we produce
Students will:
• create samples of “green” product and package designs and create labeling standards that they think would be effective.

Read All About It, page 33
English, Journalism, Environmental Science
How the media reports on environmental issues
Students will:
• research how the media reports on various environmental issues
• conduct a search for various environmental topics in the news.

Drawing Opinions, page 35
English, Creative Writing, Art, Social Studies
Students will:
• discuss local solid waste issues
• explore how messages expressing an opinion can be communicated
• create editorial cartoon addressing environmental issues.

Buy Recycled?, page 39
Home Economics, Environmental Science, Social Studies
Students will:
• find the reasons people in a grocery store buy certain products
• determine the influence of packaging on consumer choices
• determine if consumers consider waste and recycling when making buying decisions.
Creative Conservation, page 45
English
Students will:
• define the term “waste” and describe four waste categories
• write poems to express their thoughts about the social issue of waste.

Lights, Camera, Action, page 47
English, Speech, Drama, Social Studies
Using television and promotional announcements to show that protecting the environment is desirable.
Students will:
• identify some of the influences, appeals and techniques advertisers use to promote products
• see how these techniques are also useful in educating and persuading the public on environmental issues.

Where Does the Good Stuff Go?, page 53
Environmental Science, Social Studies, Home Economics
Throwaway Society
Students will:
• understand that there are options to trashing used goods
• list reuse of goods as an option to landfill disposal and recycling
• list agencies that collect, refurbish and sell or distribute used items
• list benefits to individuals and society of reusing goods
• cite examples of how ancestors dealt with shortages of clothing, building materials and equipment.

Poetry for Solid Waste, page 57
English, Environmental Science
Students will:
• see how poetry can be used to communicate ideas and feelings about environmental issues
• write poetry related to recycling.

The End Of The Road, page 59
Drama, English, Art, Social Studies
Students will:
• write the script for a play, which they will also perform, to encourage consumers to recycle and to reuse.
The Business of Recycling, page 61
Social Studies, Economics, Environmental Science
Students will:
- research South Carolina’s recycling markets
- consider ways to encourage recycling markets
- examine the economics of recycling from a business point of view.

How Times Have Changed, page 65
Social Studies, Environmental Science, History
Population and waste management
Students will:
- interview parents, grandparents or other adults regarding their past lifestyles
- compare the waste management impacts of past and present lifestyles.

What It Really Costs, page 69
Environmental Science, Physical Science, Math
How the generation of waste materials may often be attributed to lack of insight of life cycle cost
Students will:
- determine the total cost of an item over its lifetime of expected use.

Thermodynamics, Litter and Resource Recovery, page 73
Math, Environmental Science
Students will:
- become familiar with the Second Law of Thermodynamics
- see a littered school ground and garbage that has been dumped together as disordered systems
- understand that some resource recovery processes are energy and time intensive methods of trying to bring order to the system.

Generating Methane from Waste, page 75
Environmental Science, Chemistry
Students will:
- understand the energy-producing potential of some solid wastes
- examine some systems of generating methane from waste
- construct a model methane generator.

Spreading the Word About Sludge, page 79
Social Studies, Science
How sewage sludge and manure can be applied to the land to reduce solid waste and return nutrients to the earth. Students will:
- determine the benefits and drawbacks of land application of sewage sludge
- gather information on quantities and methods of sludge disposal in their communities.
Microorganisms: Bacterial Recyclers, page 85
Biology, Environmental Science
How microorganisms recycle
Students will:
• relate the importance of healthy microorganisms to composting.

Classroom Compost, page 87
Biology, Ecology, Environmental Science, Earth Science
The benefits of composting
Students will:
• identify the components of an active compost pile
• explain the composting process
• identify current and potential markets and uses for finished compost products
• describe the benefits of composting as a waste management technique.

Household Hazards, page 93
Environmental Science, Home Economics
Household hazardous substances
Students will:
• distinguish between a hazardous substance and a hazardous waste
• inventory and classify potentially hazardous household products
• estimate the amounts of hazardous substances in households in their community.

Trading Wastes, page 103
Social Studies, Environmental Science, Health
Hazardous waste reduction and recycling, hazardous waste management, reusing
Students will:
• understand how reducing and recycling hazardous wastes can be both economically and environmentally sound
• know what a waste exchange is.

From Cradle to Grave, page 113
Biology, Environmental Science, Social Studies
Hazardous waste management, decision making
Students will:
• learn that the heart of our national and state hazardous waste management program is “cradle-to-grave” tracking of hazardous waste
• understand how Treatment, Storage and Disposal facilities (TSDs), help manage South Carolina’s hazardous waste.
A Little Can Mean A Lot, page 119
Science, Environmental Science
Hazardous waste generators, school hazardous wastes
Students will:
- distinguish between small quantity and large quantity hazardous waste generators
- list examples of small quantity hazardous waste generators
- categorize potentially hazardous wastes found at their school
- identify and explain three strategies small quantity generators can use to reduce the amount of hazardous waste they produce.

The Cost of Industrial Waste, page 127
Economics
Industrial waste and disposal
Students will:
- determine the costs and profits associated with different phases of the manufacturing process
- describe how industrial waste is created
- explain how industrial waste disposal costs can affect product costs.

What's In Those Barrels?, page 135
Government, Environmental Science, Speech/Debate
Regulating and monitoring hazardous wastes
Students will:
- describe the major functions of governmental agencies that regulate or monitor hazardous substances
- explain acts of Congress concerning hazardous waste
- discuss the role of a public hearing in a democracy.

How Very Little It Must Be, page 141
Chemistry, Math, Environmental Science, Communication
Drinking water and ground water
Students will:
- working from data, gain experience calculating ppm and ppb
- understand how proportionally small a ppm and a ppb are
- understand that very little of some contaminants goes a long way.

Making Acid Rain, page 145
Environmental Science, Chemistry, Biology
Understanding acid rain
Students will:
- learn that burning nonmetals produces oxides called acid anhydrides that, when combined with water, form acids. As gases, acid anhydrides may dissolve in rain to form acid rain
- understand the potential harm to the environment from acid rain
- see how scientific information is used in making decisions about waste management.
Making Landfill Models, page 151
Chemistry, Environmental Science, Math
Leachate and landfills
This lesson includes construction of a landfill model.
Students will:
• define waste and leachate
• describe a sanitary landfill in terms of its construction and function
• identify some common chemical and physical properties of leachate
• describe the effects of leachate on soil and groundwater.

Your Waste Is My Waste..., page 159
Music, Social Studies
Students will:
• create new words to old songs
• understand the folk music process
• hear how music can be used to promote environmentally sound actions by increasing public awareness of waste reduction and recycling issues.

Deciding What To Do, page 163
Social Studies, Government, Environmental Science, Drama
Examining the issues and the decision-making involved in siting waste disposal facilities
Students will:
• see the complexity of managing solid waste
• realize the wide range of perspectives and values involved in making decisions about solid waste
• understand that there is no one “right” or “correct” answer to most of the serious problems facing our society
• learn an interdisciplinary decision-making process through role playing.

The Road to Energy Recovery, page 177
Government, Environmental Science, Debate
Waste management, decision making
Students will:
• list some of the considerations needed to site a waste disposal facility
• explain the necessity for long-range waste management planning
• examine environmental and social problems associated with waste management.

Environmental Careers, page 189
Science
Students will:
• discover career opportunities in environmental management and protection
• identify trade magazines and professional publications as sources of career information
• develop skills in using libraries.
Plastics By the Number, page 193
Environmental Science
Students will:
- recognize the role of plastics in our society
- understand the plastics coding system
- understand why plastics must be separated for recycling.

Sea of Plastics, page 199
English, Environmental Science, Biology
Students will:
- identify pertinent information regarding the effects of plastic waste on wildlife
- determine individual actions which can help reduce the magnitude of the problem.

The Natural Resource Shuffle, page 211
Science, Language Arts, History, World Geography
Students will:
- identify natural resources in the materials we use every day
- see how natural resources are used by the things we buy and use
- see where the natural resources we use come from
- identify ways we can protect natural resources.

Running Out of Resources, page 219
Environmental Science, Geography, Math
Students will:
- review the raw materials used in the manufacture of products
- examine data regarding the geographic sources and life expectancies of nonrenewable resources
- describe how energy supplies can affect the manufacture of different products
- identify the United States as the prime consumer of nonrenewable resources
- describe the affects of increased consumption and population growth on depletion rates of nonrenewable resources.

Curbing Our Resource Appetite, page 227
Math
Students will:
- predict the different amounts of a natural resource that will be consumed if consumption increases at different rates
- graph predictions of natural resource consumption as a function of time
- describe the effects, benefits and costs of different resource consumption rates
- identify ways to reduce the consumption rates of natural resources.
Deinking Paper, page 235
Science
Students will:
• recycle paper to see the by-products of the process
• understand that by-products of all manufacturing processes pose potential environmental concerns
• see how technology is changing paper recycling.

Why Oil & Water Don’t Mix, page 243
Science (Biology), Chemistry, Auto Shop
Students will:
• learn why it is important to recycle used motor oil to prevent it from polluting.

Recycling Used Oil, page 247
Social Studies, Science, Math
Students will:
• examine used oil recycling
• define the benefits of used oil recycling to their community
• compute the potential energy savings from recycling used oil
• research the logistics of recycling used oil in their community.

Changing the Way You Change Your Oil, page 253
Driver’s Training, Auto Shop, Graphic Arts
Students will:
• learn how to change the oil in a car with used oil recycling as part of the procedure.

Getting the Word Out About Used Oil, page 259
Language Arts, Social Studies
Students will:
• survey their community to determine the level of awareness of used oil recycling, measure perceptions or misperceptions of the used oil problem, determine the willingness of the survey group to recycle used oil
• create a local public information campaign to educate students and/or adults to the benefits of used oil recycling.

Slippin’ Up On Used Oil, page 265
Social Studies, English, Drama
Students will:
• look at prevailing misconceptions about what to do with used oil
• examine options to trashing used oil.
What Is This Stuff?, page 269
Environmental Science, Biology
Students will:

- investigate six major pollutants
- list ways to reduce air pollution.

Who's In Charge Here, page 279
Science, Government, Social Studies
Students will:

- research the history of environmental regulations
- research environmental regulation agencies.

Chemicals In Ground Water, page 281
Science, Biology
Students will:

- see how nitrates move from land to water
- see how water/runoff and pollution can affect water quality.

Why Water Pollutes Easily, page 287
Science, Chemistry
Students will:

- examine the structure of water and causes of pollution
- review criteria for analyzing water
- see basics of how natural and manufactured filtering systems work.

Water Quality, page 291
Applied Biology
Students will:

- discuss water’s ability to dissolve substances
- discuss government regulation of drinking water quality
- test water samples.

Transpiration, page 295
Biology
Students will:

- observe various leaf adaptations to conserve water
- observe stoma in both monocot and dicot leaves.

Sun Bathing, page 301
Science, Environmental Science
Students will:

- create a model solar water heater.
Nuclear Power In Our State, page 307
History, Social Studies, Science
Students will:
- explore the history of nuclear power in SC
- see how much of our electricity comes from nuclear power
- examine why some people are concerned about nuclear power.

Energy Conservation By Design, page 313
Environmental Science
Students will:
- examine how controlling solar radiation can improve energy efficiency
- discuss home design for energy efficiency
- create their own home design for energy conservation.
**Don’t Waste Away**

**Preparation Time:** Easy-To-Do

**Materials:**
- Two books: *The Wartville Wizard* by Don Madden; *The Lorax* by Dr. Seuss; and the poem, *Sara Cynthia Sylvia Stout* by Shel Silverstein (in the Resource Section);
- *Solid Waste Fast Facts* handout and *Solid Waste Poetry* samples included with this lesson. Optional: DHEC “Trashumentary” video available, FREE from SC DHEC.

**Teaching Time:** One class period, outside projects that may take several days to complete

**Vocabulary:** Municipal solid waste

### Learning Objectives

Students will:
- discuss solid waste issues
- discuss establishing sound environmental habits at an early age
- explore how messages are targeted to children and young adults
- create a book on environmental issues.

### Background

See the general introductory information in the Resource Section for more information on solid waste in South Carolina. In the United States, our municipal solid waste, what we throw away, is:
- 39.2 percent paper
- 14.3 percent yard waste
- 6.7 percent food waste
- 6.2 percent glass
- 7.6 percent metals
- 9.1 percent plastic
- 16.9 percent other materials such as construction waste.

Industrial air emissions blowing in from China have caused severe acid rain throughout Japan. Scientists found acidity in snow almost equal to that in orange juice.

*Sourced from: 1993 Earth Journal*
materials such as yard wastes or it may be composted, as it is in the City of Columbia and many other communities.

The Act also required scales at landfills to weigh the garbage. Based on these new local numbers, each South Carolinian throws away an average of 4.8 pounds of municipal solid waste each day. Earlier numbers showed volumes of waste as high as 6.6 pounds per person per day and as low as 4.5 pounds per person per day.

Although these figures will probably keep changing, the fact remains that solid waste is a serious matter. People can make a tremendous difference in the amount of trash created. The earlier sound environmental habits are established, the greater the long-term impact. Habits should include recycling, reusing and source reduction. All children should be taught an appreciation for our environment.

**Learning Procedure**

1. Share the Background of this lesson and Resource Section materials with students.

2. Have students read *The Wartville Wizard*, *The Lorax* and *Sara Cynthia Sylvia Stout.* (A poem found in the solid waste portion of the Resource Section.) Also you may ask students to watch an environmentally targeted children's television program such as *Captain Planet* or video. The DHEC video “Trashumentary” targeted to middle and high school students also may be shown. (*You may contact DHEC’s Office of Solid Waste Reduction and Recycling at 1-800-SO-USE-IT to borrow books and videos from their library.*)

3. Discuss the messages presented and how they were crafted to suit the age of the audience.

4. Share the *Solid Waste Fast Facts* provided with this lesson.

5. Have students use these facts, background and Resource materials or similar information gathered independently, to create their own books for children on reducing solid waste. Make sure they target a specific age group. Projects may be a book of poems, modified nursery rhymes, a comic book, fairy tale, short story, picture book, coloring book, etc. (*See poem samples provided.*) It may be helpful to provide an assortment of children's books for students to look at to generate ideas. You may assign this as a group project with three to four students per group or as an individual project. Students will need several days to complete this.

**Solid Waste Poetry Samples**

_Mary Mary quite contrary_
_How does her garbage grow?_
_With convenience stuff and trash that's junked_ 
_and no recyclables in a row._

— B. Haggard

_Jack and Jill went up the hill_ 
_To reduce, reuse and recycle._
_They rinsed and smashed and recycled trash,_ 
_And bought recycled after._

— B. Haggard

**Extension Activity**

Have students research your local library for books on the environment suitable for their age group. Have students create an annotated bibliography and offer it to a nearby elementary school.
**SOLID WASTE FAST FACTS**

- The United States produces more garbage than any other country in the world.
- Each person in South Carolina is responsible for generating 4.8 pounds of trash each day.
- We produce enough trash to fill about 60,000 garbage trucks each day.
- South Carolina's goals are to reduce its trash by 30 percent and to recycle 25 percent of all solid waste. As of 1997, nine counties have reached that goal. They are: Charleston, Cherokee, Darlington, Lancaster, Laurens, Marlboro, Oconee, Pickens and Union counties.
- Each minute, about 10,000 food cans are recycled in the United States.
- Each person in the United States uses about 400 glass bottles and jars each year.
- More than 25 billion polystyrene cups are thrown away each year. If all of these cups were placed in a line, the line would be long enough to circle the Earth 436 times.
- For each ton of paper that is recycled, 24,000 gallons of water are saved.
- For each ton of paper that is recycled, 17 pulp-wood trees are saved from being cut down.
- South Carolina uses more than 34 million pounds of plastic packaging each year.
- Each year, Americans throw away:
  - enough office paper to build a 12-foot high wall of paper from New York to Los Angeles.
  - enough plastic soda bottles to circle the Earth four times.
- Recycling one six-pack of aluminum cans saves enough electricity to:
  - watch television for 28 hours.
  - light a 100 watt light bulb for 57 hours.
  - take three showers.
- Packaging accounts for a big portion of our garbage and up to 70 percent of packaging is suitable for recycling.

*Source: A variety of environmental publications, including The Recycler's Handbook, by the EarthWorks Group.*
For more information about South Carolina and the environment, call the South Carolina Department of Health and Environmental Control at 1-800-SO-USE-IT or visit our website at www.state.sc.us/dhec.
Learning Objective
Students will:
• explore the information about the environment available through on-line networks.

Background
For more information on this subject, please consult the Resource Section.

-excerpted from 1994 Environmental Almanac
“Every day, environmental business is conducted on-line. Students gain access to learning programs and databases, and can even have contact with experts on the environment.

“An example of how these databases can help students learn comes from a teacher who used a computer and modem to create a unique approach to teaching her fourth-grade students about earthquakes. Each day, the class dialed the U.S. Geological Survey for information on earthquakes that had happened in the last 24 hours. The students marked the locations on a map with pins. It did not take long for the children to map out the major fault lines along which most earthquakes occur.”

Most students today are computer literate and Internet savvy. There is a wealth of environmental information just waiting at the end of a mouse.

The U.S. Environmental Protection Agency’s web site is a treasure trove of on-line environmental information. Students can track solid waste, hazardous waste, air and water quality issues and regulations. It’s chock-full of information and tidbits. The address: www.epa.gov.

The British Petroleum Corporation’s web site, www.bpworldwide.com, is a source of worldwide energy consumption facts and figures.

The EnviroLink Network, available through America On-Line (AOL) is a solid starting place for data, discussions and research information on a wide variety of environmental topics, including information from the World Wildlife Fund. On AOL, hit keyword: envirolink.

EcoNet is the place where members share information and access directories of environmental information including the National Wildlife Federation’s Conservation Directory, (415) 442-0220. On the web it’s www.econet.org. (Please note the suffix is “.org,” not “.com.” If you confuse the two, you quickly discover the difference between the environment and economics.)

The Chicago Board of Trade (www.cbot.com) is the world’s largest futures and options exchange. In addition to oil, silver, soy bean, hog and pork belly futures, the CBOT features environmental trades.

E-Law, an international electronic network capable of moving legal public-interest information around the world quickly, links attorneys representing citizen groups in 25 countries including the former Soviet Union, Chile, and New Zealand.

Source: 1994 Environmental Almanac
including recyclables.

The CBOT Recyclables Exchange is dedicated to the trade of recyclable goods and is open to all Registered Users worldwide. The goal is to allow easy and immediate contact between buyers and sellers of recyclable commodities, active on the market at any given time.

The sellers are the businesses that have recyclables they want to offer for sale. They post Sell Listings on the Exchange by filling out a simple online form and then wait for a prospective buyer to contact them. For the sellers it works exactly like putting a classified ad in a newspaper.

The buyers are the businesses that are looking for recyclables they wish to purchase. They enter their Buy Parameters into the Exchange by filling out a simple online form. The Buy Parameters are nothing more than the description of what they are looking for. Then they wait for the Exchange to send them, by e-mail, a copy of any Sell Listing which carries what they are looking for as soon as it is posted on the Exchange by a Seller.

Buyers do not need to access the CBOT on a regular basis to scan the new Sell Listings in order to find what they are looking for: the system does it for them.

Learning Procedure
1. Review with the class basic information about on-line services and the information available.

2. Develop a project to access current information about the environment on-line. Remember the students who studied earthquake information cited in the Background Section. (Note: The fees for using these services vary. Your parent organization may be interested in funding your project. Many organizations, however, provide information free of charge.)

Extension Activity
Have students create their own environmental web site. Many commonly found programs allow people to design their own web pages without having to know the HTML programming language. Microsoft Office and Adobe's PageMill are just two. Students can map out their web site, select graphics, research the topics, write the articles and program the site. Call a local Internet provider (check your Yellow Pages) to see if they would donate space on their server to host your class' web site for a semester for free. They might even offer their expertise.

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Get Your Information First & Fast!
DHEC's Office of Solid Waste Reduction and Recycling has access to these on-line information sources. The Office is able to provide limited research of these environmental sources and can be reached at www.state.sc.us/dhec

SWICH: Solid Waste Information Clearinghouse
Contents: On-line library, updates of federal and state waste legislation, expert contacts, recycling markets, conference and meetings calendar.
http://www.swana.org/swich.htm

RecycleLine
Contents: recycled products guide, recycling markets, commodity prices, events calendar, equipment and services data bank.
http://www.prp.org/rpdirect.htm

PPIC: Pollution Prevention Information Clearinghouse
Sponsored by the U.S. Environmental Protection Agency
Contents: technical information related to pollution prevention, experts list, federal and state program summaries.
http://www.rtk.net/E213T32

South Carolina State Library System
Contents: able to search books, state publications and federal documents held at the State Library.
http://www.state.sc.us/scsl/

Journal Index
Contents: in-house index of solid waste and pollution prevention journals such as BioCycle, Resource Recycling, Waste Age and Municipal Solid Waste Management.
My Bag

**Preparation Time:** Easy-To-Do

**Moderate**

**Extensive**

**Grade:** 9 - 12

**Focus:** Recycling, Volume of waste

**Subjects:** Environmental Science

**Materials:** 4.8 lbs. of clean, selected trash (See note under Learning Procedure.), four or more clean plastic or paper bags, scale (kitchen or bath)

**Teaching Time:** 30 – 45 minutes

**Vocabulary:** Recycling, trash, reduce, reuse, estimate

**Learning Objective**

Students will:

- identify trash as recyclable, reusable or repairable
- demonstrate the principle of reduction
- visualize the volume of trash generated by each person in South Carolina each day.

**Background**

Each person in South Carolina (including students) generates about 4.8 pounds of household trash each day.

The Solid Waste Management Act of 1991 stated that South Carolina’s goal is to reduce solid waste going to our landfills and incinerators by 30 percent and to recycle 25 percent of our waste. As of 1997, nine counties have reached that goal. They are: Charleston, Cherokee, Darlington, Lancaster, Laurens, Marlboro, Oconee, Pickens and Union counties.

Through recycling or reusing, much of this 4.8 pounds of trash can be removed from the waste stream and not disposed in our landfills or incinerators. In this activity, students look into a typical bag of household trash and decide which items can be recycled, reused or repaired and which ones must be thrown away. For more information on the makeup of South Carolina’s waste stream, see the Resource Section.

**Learning Procedures**

**NOTE:** Before beginning this activity, it is important to know what is recyclable in your area. Check with your County Solid Waste Coordinator or call S.C. DHEC at 1-800-SO-USE-IT.

The trash in your bag should be representative of everyday household trash. Include items that can be recycled, reused and or/repair and some things that can only go to the landfill (shiny potato chip bags, disposable diapers, some packaging.) For sanitary reasons, do not include perishable kitchen

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**DOWN TO EARTH**

In 1991, more than 16,000 of the 31,000 grocery stores in the United States collected plastic bags for recycling.
waste (orange peels are ok.) Be careful to stick to the 4.8 pound weight limit. Try to fill your trash bag with items that your students would use such as fast food wrappers, CD packages, soda cans, snack food packages, old clothes, cosmetic bottles etc.

1. Show the students the bag of trash you have prepared and ask them to estimate its weight. Ask students to estimate from just looking at the bag and then from holding it. Weigh the bag. If using a bath scale, show students how to weigh the person with the trash bag, weigh the person without the trash bag and subtract to obtain the weight of the trash bag. Your answer should be very close to 4.8 pounds.

Tell students this is how much trash each one of us generates every day and South Carolina's population, 3.7 million in 1998. Remind them this figure includes trash from all of their meals, classroom waste, etc. However, it does not include any of the waste from business and industry. If included, each person's share of the total amount of waste generated in South Carolina each day would increase to around 8 pounds.

2. Make cards marked: recycle, reuse, repair, landfill/incinerator. Optional: add a bag for "reject" – this would be used for items that students decide they would not purchase. For example, some single serve or convenience items might be rejected. Tape these cards onto the bags. Discuss what these words mean. Discuss with the class what is recyclable in your community and how materials are prepared for recycling.

3. Dump the contents of the bag on the floor. Have the students point out several items and tell why they think they were purchased. Now that the items are trash, were they worth buying the product in the first place? Remind students that we can reduce the amount of trash we throw out by only buying what we really need and buying products that are designed to last. Also remind them that we ultimately pay for all the packaging we throw away.

4. Have students divide the contents of the trash bag into the proper categories — recycle, reuse, repair and landfill/incinerate. Optional reject. You may do this as a timed relay race. Have several students line up by the trash pile and give them two minutes to sort and categorize waste. This shows students how quickly these decisions are usually made.

5. After classifying, reweigh the items in the landfill category and discuss how much trash was saved from the landfill/incinerator. Ask: If everyone participated in recycling, how would this affect the amount of trash going to landfills and/or incinerators?

**Extension Activities**

1. Have each student (and teacher, too) tie a plastic bag to their waist. Each student is to place in the bag all class waste, clean and dry lunch waste and any other waste each individual is responsible for generating. Compare the amounts at the end of the day. You could try this both before and after this lesson to demonstrate how the students' habits may change.

2. As a math exercise, create a chart graphing the weight of the bags after the 4.8 pounds of trash has been sorted into recycle, repair, reuse, landfill/incinerate and reject.

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<table>
<thead>
<tr>
<th>lbs</th>
<th>Recycle</th>
<th>Repair</th>
<th>Landfill/Incinerate</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>6.5</td>
<td>6</td>
<td>5.5</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>5</td>
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<td>5</td>
<td>4.5</td>
<td>4</td>
<td>3.5</td>
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<td>4</td>
<td>4</td>
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<td>3</td>
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<td>2.5</td>
<td>2</td>
<td>1.5</td>
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<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1.5</td>
<td>1</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Note: Your results may vary depending on the type of trash you select and what is recyclable in your community. There are no right or wrong answers.
Packaging Alternatives I

**Grade:** 9 – 12

**Focus:** Creating an awareness of packaging alternatives

**Subjects:** Environmental Science, Home Economics, Basic Math (percentage calculations)

**Materials:** Samples of recyclable, nonrecyclable and degradable packaging; Our Waste Stream transparency, Weekly Household Purchase Record and About Solid Waste & Packaging (one per student) and a list of recyclable items in your community. Check with your county recycling coordinator or call S.C. DHEC at 1-800-SO-USE-IT

**Teaching Time:** Two class periods one week apart plus home assignment

**Vocabulary:** recyclable, nonrecyclable, degradable, compost pile, reuse

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**Learning Objective**

Students will:

- observe and keep a record of the materials and packaging purchased in their households for one week
- classify the packaging purchased as recyclable, nonrecyclable and/or degradable/compostable
- calculate the percentage of recyclable, nonrecyclable and degradable/compostable packaging purchased by their households
- use calculations to estimate the percentage recyclable, nonrecyclable and degradable/compostable packaging purchased by larger groups (e.g. whole class, school, county)
- identify alternatives to nonrecyclable packaging

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**Learning Procedure**

1. Project the Our Waste Stream transparency and review the relative amounts of each type of material in South Carolina’s waste stream. Discuss how packaging contributes to this waste. Define and discuss the terms “reusable,” “recyclable,” “nonrecyclable,” and “degradable/compostable.”

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Recycling has always been a part of glass making. America’s first manufacturing facility may have been a glass plant at Colonial Jamestown. Those glass makers reintroduced scrap glass into their furnaces to make new products. 

*Source: Glass Packaging Institute, 1998*
About Solid Waste & Packaging

Each person in the United States generates nearly 500 pounds of packaging per year through regular buying and using habits. In South Carolina, packaging waste accounts for a significant portion of the volume in our landfills. The South Carolina Solid Waste Policy and Management Act of 1991 set a goal to reduce the volume of solid waste by 30 percent. As of 1997, nine counties had reached this goal. They are: Charleston, Cherokee, Darlington, Lancaster, Laurens, Marlboro, Oconee, Pickens and Union counties. To achieve this, we should take a look at the products we buy and the packaging waste bought and thrown away.

To reduce the negative environmental impacts associated with the disposal of packaging waste, consumers need to be aware of their packaging choices. For example, many consumers are not aware that more than 70 percent of the packaging they discard is recyclable and could be used again to make new items.

Recycling packaging saves energy and resources.

Recyclable packaging materials include most forms of paper, wood, steel, aluminum and glass, and some forms of plastic like PET (polyethylene terephthalate) soft drink, ketchup and salad dressing bottles and HDPE (high-density polyethylene) milk, water, juice and detergent containers. Other forms of packaging, such as wax-coated paper containers are often nonrecyclable and, if possible, should be avoided.

The key to successful package recycling is knowing what is recyclable in your area.

In addition to purchasing recyclable packaging, consumers can also help to reduce the negative environmental impacts of packaging waste by purchasing degradable packaging. Degradable packaging materials can be decomposed by bacteria and fungi (biodegradable) or broken down by chemical reactions initiated by light (photodegradable). Degradable packaging materials include paper and wood. (NOTE: The issue of degradability is controversial. Consider making an assignment to review recent literature on the topic to share with the class.)

In looking at packaging that is degradable, it is important to remember that these items do not degrade in a landfill and would need to be handled in a system for this, such as a compost pile. In regarding a material as degradable, students must evaluate how and where this process will take place.

Buying items that can be degraded in a compost pile is only effective if there is a compost pile available and if the action is taken to get the item there. As it is with recycling, an item is only considered degradable if there is a system available to process it. A recyclable or degradable item that ends up in the trash and on to the landfill or incinerator has not achieved its purpose.

Perhaps the most effective method of reducing the quantity of waste entering the waste stream is reusing. Reuse means giving an item another life and not simply discarding it once its intended use is complete. For example, a plastic margarine tub can be cleaned and reused many times to store leftovers. Reuse means rethinking shopping habits.

The most basic functions of packaging are to contain, carry, protect and dispense materials. Containment is an essential element to packaging. Without the ability to contain products, especially...
liquids. distribution is difficult. Imagine how a grocery store would sell milk or juice without it.

Packaging can also serve useful secondary functions, preserving freshness and safeguarding against contamination, tampering and/or theft.

As competition for consumer attention in the retail market has grown, manufacturers have become increasingly dependent on packaging as a selling tool. The ability to display, motivate, promote and communicate has been explored to the point that they have become prime purposes of packaging. As a result, much of today's packaging is not essential.

Packaging waste is placing heavy burdens on our nation's waste disposal systems. A large portion of used packaging is also discarded as litter on roadsides and beaches and in cities and parks.

To minimize the environmental impacts associated with packaging, consumers need to make informed choices. For example, reducing the packaging used to "sell" products could greatly extend the capacity of our waste disposal systems and reduce the litter problem.

At the same time, a reduction in the amount of unnecessary packaging used would conserve energy and resources. By purchasing products with minimal packaging and products packaged in reusable, recyclable and/or degradable/compostable materials, we can all help to reduce the impacts of packaging waste.

Along with the strategy to recycle waste comes the responsibility to look for and buy products and packaging made from recycled materials.

Buying recycled products is important. This is called closing the loop of recycling. Today more and more products are available made from recycled content. Items such as recycled notebook and computer paper, recycled plastic office products and recycled paperboard cereal and food boxes are readily available.

Collect Recyclables

Buy Recycled Content Products

Process Materials

RECYCLE
2. Pass around samples of each type of packaging and discuss why it might have been chosen for the product. For example, some packaging is designed to help sell the product, to protect the product or to offer a specific amount of the product, etc. Ask students to estimate what percentage of packaging waste is recyclable, what percentage is degradable or compostable and what percentage is reusable. Note: these numbers may overlap. An item may be classified several ways. There is no single right or wrong answer for this.

3. Distribute copies of the Weekly Household Purchase Record (one per student) and instruct students to use this to keep a record of 20 household purchases during one week. For each item purchased, students will identify the type of packaging. For example, a 6-pack of soft drink cans would include aluminum (the cans) and plastic packaging (the ring holder for the cans) or the cardboard box. A box of cereal would include paper (the box) and plastic packaging (the box liner).

If students are not able to complete this assignment at home, ask them to list in class the last 20 products they recall using at home. Have students mentally walk through their day and list the packaged items they used. For example, their toothpaste may have involved packaging such as a box, the metal or plastic tube or pump, breakfast may have included cereal packaged in a paper box with a liner, milk may be in a waxed carton or plastic jug, etc.

Instruct students to classify each type of packaging on their lists as R (recyclable), NR (nonrecyclable), D/C (degradable/compostable) and/or RU (reusable). Also have students note if the packaging is made from recycled content (RC). Students should make these classifications based upon what is actually possible in your community. For example, if your area recycles only certain types of plastic, such as PET #1 and HDPE #2, then only these two types should be classified as recyclable. At the end of one week or after lists are complete, have students complete Part 2 of their sheets and calculate the percentages of packaging that are reusable, recyclable, nonrecyclable, degradable/compostable and contained recycled content.

4. List each student’s percentage results on the board and have students average results to estimate the overall percentage of reusable recyclable, nonrecyclable and degradable/compostable packaging and packaging made with recycled content purchased by the class. Instruct students to record these values on Part 3 of their sheets.

5. Ask students to review their lists and identify alternative products their households could purchase to reduce the percentage of nonrecyclable packaging used. For example, if your community has glass recycling, consider whether ketchup or barbecue sauce should be purchased in recyclable glass bottles rather than in plastic containers that may not currently be recycled in your area.

Extension Activities
1. Have students identify five common household items and describe reusable, recyclable, nonrecyclable, degradable/compostable and recycled content forms of packaging for each item. For example, margarine may be packaged in a reusable plastic tub, a recyclable plastic tub, a nonrecyclable plastic tub or squeeze bottle or a degradable or compostable cardboard container with a paper liner.

Note: Most foods are not available in recycled content plastic packaging due to a governmental requirement to protect public health. Presently plastics are not recycled at high enough temperatures to kill all food bacteria. Although the technology is available to make plastic containers with a recycled-content outer layer and a virgin-plastic inner layer, few companies are using this type of container.
Our Waste Stream

* Note: Yard wastes are banned from municipal solid waste landfills in South Carolina.

Source: US EPA
### WEEKLY HOUSEHOLD PURCHASE RECORD

**Part 1**
For each item listed, identify each different type of packaging used. For each type of packaging listed, use check marks to indicate whether it is recyclable (R), nonrecyclable (NR), degradable/compostable (D/C) and/or reusable (RU). Also identify if it is made from recycled content (RC).

<table>
<thead>
<tr>
<th>Item</th>
<th>Packaging</th>
<th>Type of Packaging</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>R</td>
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</table>

Total number of each type of packaging

**Part 2**
(Total # of each type of packaging ÷ Total # of all types of packaging) x 100 = % of each type of packaging

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<tbody>
<tr>
<td></td>
<td>recyclable packaging</td>
<td>nonrecyclable packaging</td>
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<td></td>
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<tr>
<td></td>
<td>degradable/compostable packaging</td>
<td>reusable packaging</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>made from recycled content</td>
<td></td>
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**Part 3**
Estimated % of each type of packaging used by households of the whole class

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<tbody>
<tr>
<td></td>
<td>recyclable packaging</td>
<td>nonrecyclable packaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>degradable/compostable packaging</td>
<td>reusable packaging</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>made from recycled content</td>
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</table>
Packaging Alternatives II

**Grade:** 9 - 12

**Focus:** Creating an awareness of packaging alternatives

**Subjects:** Environmental Science, Home Economics, Art

**Materials:** Picking Packages transparency, variety of art materials for students to use in creating packaging (see list below)

**Teaching Time:** One class period to introduce assignment, then time to complete project at home or school

**Vocabulary:** recyclable, nonrecyclable, reusable

**Prerequisite:** Packaging Alternatives I

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### Learning Objective

Students will:

1. discuss product packaging and advertising
2. create a package design and advertising campaign
3. look at environmental choices in packaging

### Background

Each person in the United States generates nearly 500 pounds of packaging waste per year just through regular buying and using habits.

In South Carolina, this packaging waste accounts for a significant portion of the volume of South Carolina's landfills and incinerators. The South Carolina Solid Waste Policy and Management Act of 1991 set a goal to reduce the volume of solid waste by 30 percent. As of 1997, nine counties had reached this goal. They are: Charleston, Cherokee, Darlington, Lancaster, Laurens, Marlboro, Oconee, Pickens and Union counties. To achieve this, we should take a look at the products we buy and the packaging waste bought and thrown away.

To reduce the negative environmental impacts associated with the disposal of packaging waste, consumers need to be aware of their packaging choices. For example, many consumers are not aware that, according to the US EPA, more than 70 percent of the packaging they discard is recyclable and could be used again to make new items. Recycling packaging saves energy and resources.

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**DOWN TO EARTH**

The U.S. EPA's newest initiative is called “Cleaner, Cheaper, Smarter.” Government teams will concentrate on regulations, pollution prevention, reporting, compliance, permitting and environmental technology.

Learning Procedure

In this activity, students will compete in teams to design a product package with the environment in mind and then sell the product.

1. Divide the class into groups. Select a product for students to use in designing and creating a package and sales campaign. The product should be the same for each team such as a baseball bat, personal care item, food product, toy, tennis ball or other common item. If the package and advertising campaign work is to be done in class, collect the suitable materials for each team to use. These items may include:
   - scissors
   - glue
   - tape
   - construction paper
   - markers
   - rulers
   - poster board
   - potential packaging materials (aluminum foil, paper bags, plastic wrap, cardboard, etc.)

If students are going to complete projects at home, you may suggest the types of materials to use.

2. In a whole class discussion, ask students to describe what advertisers do (create marketing plans and communications to help sell things) and ask them to identify the different means of communications advertisers use to sell products (television, radio, newspaper and magazine ads, billboards, contests, promotional flyers, packaging). Make sure students realize that an advertiser's main goal is to "sell" a product. Briefly discuss the different "pitches" advertisers use to sell a product (e.g. new and improved features, endorsements from famous people, status, convenience, keeping up with the Joneses, sex-appeal, better for the environment, cheaper). Are there any "environmentally friendly" methods of advertising? (internet, radio, television)

3. Set the stage for this activity by telling students to imagine they have just gotten a job as an advertising agent for a company that sells _____________ (the product you select.)

   Explain that each group's assignment is to develop an ad campaign and packaging design to sell their product. These campaigns should consider effective packaging to sell the product balanced by environmental concerns.

   Instruct students to keep a record of reasons why they choose particular package designs and sales pitches. Explain that the ad campaign can consist of skits, poems, jingles, posters or any other technique that could "sell" their product.

   Briefly review the primary and secondary functions of packaging and describe the negative environmental impacts associated with packaging waste. Discuss the potential conflicts associated with packaging designed to sell a product versus packaging designed to have a low environmental impact. Ask students to brainstorm ways to design a package that sells, but doesn't create a lot of waste.

   If this is an in-class assignment, distribute the product and other materials to each group. You may give students several class periods to complete their projects.

4. After groups have completed their projects, have each group present its ad campaign and package design to the rest of the class in a 10 minute presentation.

5. Assign each product package a number and display all package designs. Have students anonymously vote for the best package design and turn in their votes. Tally the scores and identify the first, second and third place packages. Conduct a whole class discussion addressing the following questions:
   - What made the winning package more appealing than the others?
   - How much packaging was involved in the package? Was the packaging necessary? Why or why not?
   - What influence does the packaging have on the quality of the product?
   - Why was the product packaged?
   - Who pays for the packaging?
• Who should pay for the disposal of packaging that isn’t recyclable or reusable?
• Should the manufacturer of the product be concerned about disposal of the packaging?
• What impacts will manufacturing and disposing of the packaging have on the environment?
• If the manufacturer is primarily interested in selling the product, is it more important to package the item to sell than to package it to have low environmental impact?

6. Ask students to identify packaging choices they can make to reduce environmental impacts. Show the Picking Packages transparency and rate the different types of packaging according to the disposal and recycling options in your area.

Extension Activity
Have students select several popular products and review the packaging. Can it be improved to create less waste? Do products contain any environmental claims that are not fully explained? Have students write letters to companies inquiring about packaging and requesting improvements.

Just Do It

Have you ever been disappointed by a product that was more packaging than product? Next time, be sure to write the manufacturer and let them know.
When you go shopping, pick a product wrapped in the least amount of packaging as possible. Use this sheet as a guide when making your packaging decisions. A check (✓) in the ratings column means the packaging can be reused, recycled or composted; a zero (0) means the packaging is incinerated or landfilled; and a minus (-) means the packaging cannot be disposed of easily and should be avoided. **NOTE: You must research, know & understand what is and what is not recyclable in your area before you can accurately perform this exercise.**

<table>
<thead>
<tr>
<th>Kind of Package</th>
<th>Grocery Store Item</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>No packaging or natural package</td>
<td>Fruits, nuts, vegetables</td>
<td></td>
</tr>
<tr>
<td>Glass bottles</td>
<td>Beverages, oils, sauces</td>
<td></td>
</tr>
<tr>
<td>Reusable items</td>
<td>Cookie and cracker tins,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>heavy duty plastic plates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>from microwave dinners,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sturdy glass jars, plastic tubs</td>
<td></td>
</tr>
<tr>
<td>Uncoated paper</td>
<td>Bags of candy, cookies,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>chips and other snacks, sugar bags</td>
<td></td>
</tr>
<tr>
<td>Uncoated cardboard</td>
<td>Cereal boxes, detergent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>boxes, sauce and mix boxes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(without cellophane window)</td>
<td></td>
</tr>
<tr>
<td>All-steel cans</td>
<td>Canned fruits and vegetables</td>
<td></td>
</tr>
<tr>
<td>All-aluminum cans</td>
<td>Beverage containers</td>
<td></td>
</tr>
<tr>
<td>Steel cans with aluminum tops</td>
<td>Some pull-top cans</td>
<td></td>
</tr>
<tr>
<td>Waxed paper</td>
<td>Liners in cake boxes and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>other food boxes</td>
<td></td>
</tr>
<tr>
<td>Cellophane</td>
<td>Windows in paper boxes, pasta bags</td>
<td></td>
</tr>
<tr>
<td>Coated paper</td>
<td>Paper milk and juice cartons</td>
<td></td>
</tr>
<tr>
<td>PVC (polyvinylchloride)</td>
<td>Some plastic bottles</td>
<td></td>
</tr>
<tr>
<td>LDPE (low density polyethylene)</td>
<td>Plastic wraps</td>
<td></td>
</tr>
<tr>
<td>HDPE (high density polyethylene)</td>
<td>Plastic milk jugs, juice and</td>
<td></td>
</tr>
<tr>
<td>and PET(polyethylene terephthalate)</td>
<td>soda bottles, some shampoo bottles</td>
<td></td>
</tr>
<tr>
<td>Aluminum foil-based containers</td>
<td>Foil-lined boxes and bags</td>
<td></td>
</tr>
<tr>
<td>Collapsible metal/plastic tubes</td>
<td>Toothpaste, hand cream, cake icing</td>
<td></td>
</tr>
<tr>
<td>Metal and plastic pumps</td>
<td>Toothpaste pumps</td>
<td></td>
</tr>
<tr>
<td>Aerosol cans</td>
<td>Toiletries, deodorants,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>hairsprays, pesticides, oil sprays</td>
<td></td>
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</tbody>
</table>
Grade: 11 - 12
Focus: Understanding how our buying decisions affect the amount of waste we produce
Subjects: Environmental Science, Social Studies, Home Economics
Materials: Handouts included with this lesson, sample products
Teaching Time: Several class periods
Vocabulary: Federal Trade Commission (FTC), life cycle analysis, cradle to grave, cradle to cradle, Green Seal

Learning Objective
Students will:
• see how their buying habits affect the amount of waste they produce
• discuss the merits and pitfalls of "green" labeling and labeling regulations
• investigate how environmental labeling works in other countries.

Background

It's easy to be baffled by "earth-friendly" product claims. The truth is, for every product, no matter how valuable, we pay an environmental price.

Several organizations have gotten into the environmental labeling business and some companies are designing their own environmental logos for their products to support environmental claims.

Two organizations, Green Seal and Scientific Certification System (SCS) are attempting to offer an analysis of products based upon their environmental impact, but some of their methods and the results are considered controversial.

Green Seal, begun by Earth Day co-founder Denis Hayes, has begun its label program. The first seals were awarded in January of 1993. Green Seal uses a modified life cycle analysis method in evaluating products. It looks at a product from the raw materials, manufacturing, transportation and disposal cycles of its "life."

Green Seal’s life cycle analysis methods are considered modified because the company’s original full-blown research was scaled back due to costs. It can cost hundreds of thousands of dollars to research the environmental impacts of a product from cradle to grave or from raw materials extraction through production, use and disposal. The abbreviated analysis sets standards that a manufacturer must meet. To receive the Green Seal, bathroom tissues, for example, must be made from 100 percent recycled waste paper and at least 10 percent post-consumer paper (paper actually used and then recycled as opposed to recycled paper that may be floor scrap from the manufacturer); toxic
solvents can’t be used to de-ink the waste paper and there are limits on bleaching of the tissue; the final product can’t contain dyes, inks or perfumes and must be packaged either in bulk or in 100 percent waste materials.

Criticism of Green Seal is that it will appear to convey blanket approval in a world where environmental impact depends to some extent on where you’re sitting. “The diaper issue is a classic one,” says Bob Hunt, a vice president at Franklin Associates, a firm that has done nearly 200 life cycle studies. Cotton diapers use lots of water and disposables take up lots of landfill room. “In parts of California, they have 100 years left on the landfill, but they’re out of water. In New England, they have plenty of water, but they’re out of landfill space. How are you going to label that?”

Many environmentalists worry that consumers will stop thinking and just reach for a symbol, ignoring things like regional impact, source reduction and over-consumption. Furthermore, the cost of testing, research and, in the case of Green Seal, a licensing fee, may mean that some small manufacturers won’t be able to afford a seal, no matter how clean and green their products are. Many companies are staying out of the labeling controversy, waiting for the government to regulate labeling.

Scientific Certification Systems, founded in 1984 also has environmental claims certification, life-cycle assessment, a forest conservation program and food inspection and certification.

The President’s Council on Sustainable Development’s Eco-Efficiency Task Force has begun using the phrase cradle-to-cradle to describe eco-efficient manufacturing. Cradle-to-cradle suggests that manufacturing is not a linear process but a circular one. In other words, manufacturing waste from one process should be used to provide raw materials for the next production activity. The products of eco-efficient manufacturing, once used, should be able to be disassembled or reassembled to become useful again. Eco-efficient manufacturing is a closed loop, sustainable system … much like nature itself.

The Federal Trade Commission (FTC) has issued guidelines. Green labeling is sometimes seen as a marketing issue rather than an environmental one, partly because companies misuse environmental claims like “biodegradable” and “earth friendly” in their ads. With the EPA and the Office of Consumer Affairs, the FTC has formed a task force to deal with environmental claims.

The American Society for Testing and Materials also writes definitions that can become standards. They are working on definitions for degradability of plastics, among other issues.

Life Cycle Analysis: Science or Good PR?
With companies commissioning their own studies, the credibility of Life Cycle Analysis (LCA) is questionable. According to one scientist, Reid Lifset, an associate director of Yale University’s Project on Solid Waste and the Environment, “anyone can make a life cycle analysis produce results favorable to a sponsor through choice of modeling assumptions, data and especially through careful framing of the questions that the study is meant to answer.”

Standards are currently being developed to add some consistency to environmental claims such as life-cycle analysis (LCA). LCA is one part of the new ISO 14000 international standards that have been developed.

Another problem is that scientific conclusions are often interpreted by the company’s PR firm. Pages of charts and data may be boiled down to produce a single sentence. One example of this is the use in some studies of the term “environmental impact” to mean only the weight of pollutants and solid waste, not the affects of the toxicity of the pollutants.

The Society of Environmental Toxicology and Chemistry called upon scientists from several research firms and federal agencies to determine if a set of rules could be set for conducting a life cycle analysis and if a set of ethics could be decided upon for its use. They determined that it would take years to set these standards but agreed that three components should be standard in life cycle studies.
Inventory - The inventory determines how in-depth the study will be. For example: study boundaries may include the manufacture, distribution, use and disposal of a product and its packaging or it may consider the production of the raw materials. The inventory would also determine whether to consider such things as loss of habitat and biodiversity, groundwater contamination, generation of global warming gases among others that are difficult if not impossible to quantify. Once you've decided what goes into the inventory, you do a mass balance: measure what's going into the system - renewable and nonrenewable raw materials, energy, process water and so on. Then you measure the outputs - the product, the air, water and ground pollutants and solid waste at every stage from extraction of raw materials through transport, manufacturing and disposal.

Impact - Impact is difficult to determine. One estimation of the relative harm of certain substances comes from the Occupational Safety and Health Administration (OSHA) that has a rating system for toxic chemicals.

Improvement - This factor shows where and how pollutants could be reduced.

Is There Any Room For Common Sense?

According to Green Seal, common sense will give you an answer if you've got a little bit of the most important data. For example, we know that making virgin paper requires tree cutting, heavy pulping and chemical bleaching; and making recycled paper needs less pulping and bleaching, common sense says recycled paper is greener. And since paper and plastic bags pollute, a reusable shopping bag makes sense. But most products and claims are much more complex.

Seals To Watch

Germany's Blue Angel  
European Community Environmental Label  
Canada's Environmental Choice  
Germany's Green Dot  
Japan's EcoMark

Although the United States has had difficulty in coming up with a single mark to rate environmental quality of its products, other countries have been experimenting with many designs and programs.

Consumers in Germany call it the "Blue Eco Angel". What they are referring to is a special logo, which has for two decades now been a symbol for products with positive environmental features on the German market. Well over 4,000 products now bear the mark, proof of the success of increased environmental awareness.

A voluntary program, Germany's Green Dot allows private companies to buy into the program, allowing them to purchase placement of the Green Dot on their products. Fees are material-specific and based on weight. Consumers who buy Green Dot products pay a premium of roughly 1 cent per unit and then, when the product is used up, consumers dispose of the package in a separate recycling container. This waste is collected and managed separately from the public waste management system.

Since 1988, Canada has issued about 60 Environmental Choice seals in 18 product categories that emphasize recycling and reduced pollution. The standards, based on life cycle analysis, will be continually revised upward so that no more than 10 to 20 percent of the eligible products in a category qualify.

The Japanese look at energy efficiency and minimal environmental impact during manufacture and do not use life cycle analysis.

The European Community, with trade open, is developing a system that countries can live with while the Nordic Council (Finland, Iceland, Norway and Sweden) is also working on establishing a symbol.
<table>
<thead>
<tr>
<th>General Terms</th>
<th>Term: Recycled</th>
<th>Term: Recyclable</th>
<th>Term: Compostable</th>
<th>Term: Degradable</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTC Guidelines</td>
<td>Suggests that companies avoid. Specify whether claims relate to product or to packaging.</td>
<td>Percentage of content. Pre- &amp; post-consumer content. Show pre-consumer waste would go to landfill.</td>
<td>If only recycled in some states. must state few facilities.</td>
<td>Must state how product decomposes.</td>
</tr>
<tr>
<td>California</td>
<td>Can require scientific substantiation of claim.</td>
<td>10% by weight of post-consumer recycled content.</td>
<td>Conveniently recycled in Calif. cities of 300,000 or more.</td>
<td>Does not address.</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>Bans “environmentally friendly” and similar terms.</td>
<td>State pre- and post-consumer content percentages.</td>
<td>Materials on recyclable list or materials with 50% recycling rate.</td>
<td>Does not address.</td>
</tr>
<tr>
<td>New York</td>
<td>General terms not addressed.</td>
<td>Sets specific percentage minimums that must be met for materials.</td>
<td>Programs available to 75% of population or available in city where claim made.</td>
<td>Does not address.</td>
</tr>
<tr>
<td>Indiana</td>
<td>Scientific substantiation.</td>
<td>10% recycled content. pre- or post-consumer.</td>
<td>Any material returned to economic mainstream. Vary.</td>
<td>Must decompose into soil-like material in less than 1 year. Must break down in common disposal method in 1 year.</td>
</tr>
<tr>
<td>Other States</td>
<td>Other states do not address.</td>
<td></td>
<td>Florida requires address.</td>
<td>Does not address.</td>
</tr>
<tr>
<td>Outlook</td>
<td>States do not want vague terms used.</td>
<td>Only when using post-consumer or diverting from landfill.</td>
<td>Laws yet to be decided.</td>
<td>Avoid use of term, further regulation likely.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Use only on an item fully degradable within 120 days.</td>
<td></td>
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</tbody>
</table>
SCIENCE FOR SALE

Have you heard the following put forth as scientific truth in product promotional claims: "Disposable diapers are better for the environment than cotton ones." "Plastic grocery bags are as good as paper bags." "Disposable plastic cups are better for the environment than disposable paper cups." Well, then you have heard the results of a public relations firms' interpretation of life cycle analysis.

According to Environmental Defense Fund scientist Richard Denison, "It really is the case these days that when you look at who sponsored a study, you don't even have to open the study to find out what the conclusion was."

Studying Plastic
The Council for Solid Waste Solutions, funded by the plastics industry, hired Franklin Associates to do two studies of plastic.

Franklin, which does a lot of these studies, performed what they call a Resource and Environmental Profile Analysis on two different categories of products: polystyrene vs. bleached paperboard fast-food containers and polyethylene vs. brown-paper grocery bags.

Franklin reported that polystyrene containers use 30 percent less energy (including the nonrenewable energy inherent in the plastic itself), produce 46 percent less atmospheric wastes, 42 percent less water wastes and 29 percent more solid waste than paperboard containers.

Near the front of the report was the following disclaimer: "No attempt has been made to determine the relative environmental effects of the pollutants such as fish kills or groundwater contamination, as there are no accurate data available."

In other words, the "environmental impact that Franklin analyzed was the BTUs that went into each product and the weight of the pollutants that came out.

Nonetheless the Council on Solid Waste Solutions wrote letters to the media and politicians, boasting about plastic's performance. Some quotes said, "the Council ... has released two comprehensive reports analyzing the cradle-to-grave environmental impacts of popular plastic products and their paper-based counterparts."

The campaign worked. The Los Angeles Times and Forbes magazine were among the media that parroted the study as proof that McDonald's had done the wrong thing when it traded foam containers for plastic-paper wrappers.

It is this sort of situation that's motivating researchers to come to an agreement on how life cycle studies are conducted and how it can be used. Otherwise, this new science may become just the newest, most expensive Madison Avenue tool.

Excerpted from Garbage magazine, 1991, this information is presented to get students thinking about the product claims they read and hear. It is not intended to focus on any particular product, such as diapers, plastic or on any particular company such as McDonald's.

Certainly, industry has a position in using commissioned research to substantiate product claims. Until there are established and accepted standards, these studies are what's available to demonstrate product benefits.
Learning Procedure

1. **Ask:** Have you ever seen product packaging or advertising that includes references to that item’s impact on the environment? Encourage students to think of as many types of items as they can. (You may want to bring in examples of products or have students bring these to class. Many products—from shampoos to cosmetics to anything with a recycle “chasing arrows” symbol—allude to environmental benefits.)

   **Ask:** Why do companies use environmental claims on packaging? *(Because of environmental awareness, many people will make changes in the brands they buy if they think one is “better for the earth.” “Good for the environment” has become a major sales attribute that sells among many groups of people.)*

   **Ask:** What about claims that a product is earth-friendly? What does this mean? *(It means nothing. In fact, the state of Rhode Island bans the use of this term and similarly vague claims on packaging.)*

   **Ask:** Can a “biodegradable” plastic trash bag degrade if it is buried in a landfill? *(No, conditions in a landfill do not allow much of anything to biodegrade. There is not sufficient air and sunlight for this process. Even food items and newspapers have been dug up from landfills after years and found in nearly unaltered condition.)*

   **Ask:** When you see a “chasing arrows” recycle symbol what does it mean? *(The chasing arrows symbol does not have a standardized meaning. It may mean that the product or the package is all or partly recyclable or it may mean that some part of the contents were made from recycled materials. In any case, the term “recyclable” is meaningless unless the person buying the product actually can and does recycle the material in his or her particular area. The Federal Trade Commission is issuing definitions for the terms recycled and recyclable but has not addressed the chasing arrows symbol as of Fall 1994.)*

   **Ask:** Would you change what you buy if one product did have environmental benefits over another? Would you expect to pay more for the product? What kind of proof would you need that the claim was true?

   Explain to the class that these are the kinds of questions that are being asked as our country looks at the environmental claims being made by advertisers. On the positive side, many companies have changed the way they manufacture products to use less energy, to use fewer raw materials, to use more recycled materials, to create less waste and to produce less toxic waste. For example, many items made of plastic are now made of much thinner plastic but perform just as well. The plastic soft drink bottle and the aluminum
can have been reengineered to use much thinner materials in the middle of the bottle. Companies have also changed the way they package products to reduce waste, to use recycled materials and to be recyclable.

Changes in products and technology are happening very quickly and it seems that new products making environmental claims are on our store shelves every day. Products claim they are “safe for the ozone,” are “all natural,” made from “all natural ingredients,” made from recycled materials, are recyclable, are “environmentally safe,” “contain no CFC’s” and the list goes on.

2. Review with the class the Background material included with this lesson. For some classes you may want to summarize the materials and for others it may be suitable to copy the materials for home reading.

3. Ask: What role do you think the government of the United States should play in establishing standards for environmental product claims? What role do you think the South Carolina government should play in establishing standards for environmental product claims? How should these standards be enforced? Would you be willing to pay additional taxes to have the federal or state government involved in this? If not the government, then who should set standards?

Explain to the class that these are complex issues that are yet to unfold in our society. Some people believe that it is a responsibility of the government to set standards and enforce them while others feel that it would interfere with free enterprise and would end up slowing down the development and use of new technologies, similar to the criticism of the Federal Food and Drug Commission for holding up new medicines with too much red tape.

4. Bring in several products (of interest to students), such as two types of notebooks or backpacks, one plastic and one canvas, with the packaging intact. Have the class discuss the life cycle analysis process for these. For example, discuss the packaging waste and options to improve it, the materials and durability. How would students decide which one to buy? Which one is a better buy for the environment?

GREEN CONSUMERISM

Some companies go beyond making environmental claims about the products they make and sell. These companies incorporate their political positions into their marketing to reach a niche of people that they believe also hold their same beliefs. Companies are finding that their politics can be good for business. Companies like Ben & Jerry's Ice Cream and Benetton clothing chain are enjoying record sales as they link their political opinion to their marketing.

For example, for every cause the company supports, Ben & Jerry's has a product flavor. The company's Rainforest Crunch benefits rainforest preservation and Wild Maine Blueberry helps that state's blueberry-growing Passamaquoddy tribe.

Companies involved in this type of marketing make their opinions known in their advertising, on their packages, on aisle displays and on signs at cash registers and other points of purchase. In fact, this type of marketing has come to be known as "point-of-purchase politics."

Some marketing experts estimate that teenagers spend $79 billion every year. Most of this is spent on consumer goods. Topping the list of what teens buy with their own money are clothes and fast food. Alice Tepper Marlin, director of the Council on Economic Priorities and publisher of a pocket-sized paperback, Shopping for a Better World, that has sold 800,000 copies, says that you can "Turn your shopping cart into a vehicle for social change." The organization also launched a Corporate and Environmental Data Clearinghouse which has begun to issue reports on the environmental behavior of all 500 publicly held companies listed in Standard and Poor's.

The idea of providing consumers with information about corporations is catching on. Asahi News Journal in Japan recently ran a special report devoted to rating Japan's corporations.

source: 1993 Earth Journal
A WORD TO THE WISE:

BEWARE GREEN CLAIMS

excerpted from Home magazine June 1993

When Earth Day 1990 reintroduced environmentalism to the masses, something profound happened. People from all over the industrialized world discovered that they were always interested in helping the earth. But most didn't know how to make a personal commitment aside from picketing in front of belching smokestacks or sending a check to save the baby seals. What they wanted was a way to help on an everyday basis.

Companies, eager to cash in on this newfound concern, began labeling products "earth friendly," "environmentally sensitive," or "biodegradable." In fact, in 1991, approximately 13 percent of products introduced in the U.S. made some environmental claim, compared to 0.5 percent some six years earlier, according to a study by SCS, a not-for-profit environmental group.

But this phase was only to last a year or so. A major lawsuit against Mobil Chemical Corporation, maker of Hefty-brand garbage bags, brought to consumer consciousness a torrent of questionable green advertising. The company had introduced a new line of garbage bags and labeled the packages "degradable." This message implied that the bag would "naturally" disappear in a landfill.

However, research by Professor William Rathje of the University of Arizona, an archaeologist often referred to as "garbologist," found that almost nothing degrades in a landfill. Because no air, light or water penetrates these multistory behemoths, biodegradation here was chemically impossible. Indeed, Rathje found 30-year-old hot dogs and newspapers completely intact when he dug into dumps. After this revelation, a group of attorneys general from seven states sued Mobil to remove the claim. Mobil settled for $175,000 and agreed not to make any more misleading marketing statements on the bags.

Fast on the heels of the Mobil suit, the attorneys general, led by Minnesota's Hubert Humphrey III, produced two reports that decried the use of a host of misleading green marketing terms. In the meantime, they sued and reached settlements with other companies that make products from disposable diapers to hair spray. Their targets weren't the products themselves, but claims like "ozone safe."

The "Hefty-bag" controversy had ushered in a new era of green marketing, one that called for more research, honesty and accountability. And although the Mobil suit put many a green marketing effort on hold, comprehensive Federal laws regulating green claims were not forth-coming. The two Federal agencies most likely to regulate green claims, the Federal Trade Commission (FTC) and the Environmental Protection Agency (EPA), held a few hearings which resulted in the usual cautious optimism, yet did nothing to actually rein in the fast and loose world of green marketing.

The FTC took a small step forward in late July, announcing that it would issue guidelines for the use of terms the attorneys general had brought into question. The FTC guidelines, however, are strictly voluntary and don't carry any specific penalties if violated.

The House and Senate and a host of state governments have weighed in with various proposals and modest laws to regulate green claims, but few of the proposals seem to have much merit or bite.

Other countries, however, are years ahead when it comes to regulating environmental marketing claims. Germany, Canada and Japan have initiated government-sponsored green seal programs that distinguish consumer products that are better for the environment.

Canada's closely watched "Environmental Choice" program is considering "life-cycle analysis" (LCA). LCA is a nascent science that attempts to discover how a product impacts the environment from the standpoints of raw materials, manufacturing, transportation and disposal. This "cradle-to-grave"
approach will become the gauge to show how one product is kinder to the earth than another.

Consider, for example, the ongoing "plastic versus paper" controversy. A major argument: whether plastic or paper will disappear faster in a landfill. LCA proponents suggest that disposability is but one of several considerations. Others include: How much pollution is created by each manufacturing process? And, which material requires the least amount of nonrenewable resources and energy? Paper, made from a "renewable" resource such as fast-growth pulp trees, is expensive to recycle and doesn't degrade in landfills any better than plastic. By volume, paper is one of the principal landfill components. Conversely, polystyrene plastic, used in fast-food "clamshell" boxes, is recyclable, but doesn't degrade much, either. And polystyrene plastic consumes petroleum and produces toxins during manufacturing. The material to choose? Scientists can't come up with a straightforward answer, because no organization has measured how much energy, raw materials, pollution and other waste are actual by-products of each process.

Although the U.S. government is studying the European, Japanese and Canadian programs, it's unlikely that similar programs will be in place here anytime soon, owing to Congressional politics, budget constraints and other priorities. For this reason, two private groups have emerged in the green labeling field. Green Seal, begun by Earth Day co-founder Denis Hayes (who has since left the program) and supported by major environmental groups, has just begun its labeling program. Like SCS, Green Seal also wants its symbol to become the de-facto standard for green labeling.

Norman Dean, president. Green Seal, says the group established its criteria after an exhaustive private and public comment period. Its first seals, after a delay of more than a year, were finally awarded in January of 1993. Tissue paper, refined engine oil, printing and writing paper are expected to be the first products Green Seal evaluates.

Skeptical of the life-cycle-analysis approach, Dean cautions that "experts have concluded that formal LCA hasn't developed to the point that you can use it to recommend one product over another." Consequently, Green Seal has asked Underwriters Laboratory, the giant industrial testing concern, to verify claims.

Green Seal thus far has received the blessing of the Washington green lobby because the organization is guided by members of the leading environmental groups. Although business representatives are allowed to sit on the Green Seal board of directors, those associated with consumer products companies are not. Green Seal will review its own criteria every three years. The public will be encouraged to comment on them. An advisory committee of scientists and other experts will work with the group's "Environmental Standards Council" to draft final recommendations and monitor the program.

SCS, the other would-be arbiter of all green claims, is taking a different tack. Rather than setting standards for manufacturers to meet, SCS has focused its efforts on claims certification by inspecting factories and other aspects of manufacturing. The group has certified more than 400 products. For example, the group has determined that certain garbage bags contain recycled plastic and that selected paper products are made from "post-consumer waste," stuff that's been thrown out. As the nonprofit branch of Scientific Certification Systems in Oakland, California, SCS has for years had a team of scientists checking for pesticide residue on produce.

SCS also is forming an alliance with industry groups, manufacturers, environmental engineers and private institutions like the Good Housekeeping Institute, to test and certify environmental claims. The group recently teamed up with the Home Center Institute and the National Retail Hardware Association to independently review green labeling on a wide variety of products sold in some 15,000 stores across the country. Participation is voluntary, but stresses partnership in verifying green claims at both the manufacturing and retail levels. SCS has collaborated in a similar way with West Coast supermarket chains.
Ellen Hackney, spokesperson for the Home Center Institute and the National Retail Hardware Association, says the SCS program will “first concentrate on those manufacturers that already have put environmental claims on packaging.” SCS, in cooperation with these same groups, will produce informational brochures that address health issues such as lead poisoning.

SCS also is working with the Home Depot and Fred Meyer retail chains to develop certification programs and environmental education information.

The SCS approach is similar to that employed by the Department of Agriculture. This agency provides research and information to farmers as well as inspecting and certifying meat and produce.

By working closely with retailers, SCS hopes ultimately to improve the environmental quality of merchandise and to provide standardized comparison shopping-guide labels for every certified product. Linda Brown, SCS spokesperson, says the company is developing an “Environmental Report Card” that will show the kind of toxins and environmentally unfriendly substances created in a product’s manufacture. A can of paint with such a report card would tell how much carbon dioxide and smog-producing volatile organic compounds (VOCs) are released into the air when the paint is used. Although not full-scale LCA, the report card is a step toward the “nutritional style” labeling that consumers find most helpful. By this year, Brown hopes that report cards will be “on dozens of products.”

“Consumers will have an opportunity to make decisions in a way they didn’t have before,” she says. “They won’t have to take the word of someone else [on environmental claims]. I think this will be a precedent.”

As for when the Federal government will regulate green claims, nobody is holding his or her breath. Julie Lynch, who monitors the green labeling arena for the EPA, says the agency is “in the process of finding out the utility of lifecycle analysis.” On the EPA’s view of the third-party certification programs: “It’s an experiment as far as we’re concerned,” she says.

Years will pass before any public or private program has enough research behind it to say conclusively whether one product is better than another in terms of total environmental impact. This will require years of study on subjects ranging from forest harvesting to recycling-process energy consumption.

by John K. Wasik
Learning Objective
Students will:
- create samples of “green” product and package designs and create labeling standards that they think would be effective.

Background
Please see Enviro-Shopping I for Background information for this lesson.

Learning Procedure
1. Tell the class that in this Enviro-Shopping activity, they are going to select a product and set the standards for environmental claims. They will also design a symbol that would let the public know that the product was indeed “better for the earth.”

2. Distribute the student product worksheets, Environmental Testing and Claims or use an overhead projector and have students produce their own worksheets. If an overhead projector is not available, you may want to copy the worksheet on the board. The worksheet serves as a guide to help students evaluate their product and its potential environmental claims.

You may wish to challenge the class to improve the worksheet by finding additional environmental elements to consider in evaluating their products.

Extension Activity
Have students complete the Consumer Survey included with this lesson.

Down To Earth
It wasn’t until shortly after 1800 that the world’s population reached the 1 billion mark and not until 1930 that it reached 2 billion. Now the world’s population grows by a billion about every 12 years and is projected by the United Nations to be greater than 9 billion by the year 2050.
STUDENT WORKSHEET

Environmental Testing and Claims

Name and Type of Product______________________________

Does the product or product packaging make or imply any environmental claims? What are they?

________________________________________________________

Are these claims in any way qualified or substantiated? Are there references to any scientific studies or standards used?

________________________________________________________

Does the product or package have any environmental type symbols? If so, what do they represent?

________________________________________________________

If you were going to evaluate the product and give it an environmental seal of merit, consider the study framework suggested by the Society of Environmental Toxicology and Chemistry and outline the study for your product.

1. Inventory - How in-depth would the study need to be? Will you include manufacture, distribution, use and disposal of the product and packaging, the renewable and nonrenewable raw materials used? If so what elements would be important? Would you need to consider byproducts of production, pollution, energy use? If so, what are they?

________________________________________________________

________________________________________________________

________________________________________________________

2. Impact - Does this product cause harm to the environment? In general, what is this harm and how would you rate it?

________________________________________________________

________________________________________________________

3. Improvement - Could pollutants be reduced? Could the resulting solid waste be reduced?

________________________________________________________

________________________________________________________

________________________________________________________
Do you think that your product currently merits any environmental seal or has any special environmental qualities that make it a superior product?

Do you think the product could be changed to merit a seal? How?

Do you think that these changes would cause an increase in the sales price for the product? If so, do you think the company that makes the product would be wise to change the product? Why?

Design your Environmental Seal of Merit and describe its standards.
A Consumer Survey

Do You ...

<table>
<thead>
<tr>
<th>Question</th>
<th>Never</th>
<th>Sometimes</th>
<th>Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Consider whether you really need something before you purchase it?</td>
<td>3</td>
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<td>2. Think about what will happen to a product or package after you no longer need it?</td>
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<td>3. Try to reuse things you already have instead of disposing of them and buying new things?</td>
<td>3</td>
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<td>4. Consider what pollution and wastes were created in the manufacture of the things you buy?</td>
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<td>5. Take advantage of the opportunities to recycle in your area or advocate establishing recycling?</td>
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<tr>
<td>6. Purchase items with recycled content?</td>
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<td>7. Shop at second-hand stores or garage sales?</td>
<td>3</td>
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<td>8. Do you see ‘bargain’ as a factor of quality and durability as well as price?</td>
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<td>2</td>
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<td>9. Donate old clothes and other items for further use?</td>
<td>3</td>
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<td>10. Use reusable items instead of disposable products?</td>
<td>3</td>
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<td>11. Refuse to buy products that contain too much waste packaging?</td>
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<td>12. Use mugs or cups at work/school/parties rather than disposables?</td>
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<td>1</td>
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<td>13. Buy in bulk or buy concentrates that use smaller packages?</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>14. Use less toxic substitutes for cleaning and household maintenance?</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>15. Write to companies or governmental officials about your concern about the environment and wasteful products?</td>
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<td>1</td>
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<tr>
<td>16. Read consumer articles to find out about the quality and durability of products you buy?</td>
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<td>2</td>
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Total

Grand Total
Read All About It

Preparation Time: Easy-To-Do

Grade: 9 - 12
Focus: How the media reports on environmental issues
Subjects: English, Journalism, Environmental Science
Materials: Several current news stories or articles about the environment, Searching the News handout included with this lesson (optional)
Teaching Time: Partial class period to introduce then ongoing, plus student research assignment

Learning Objective
Students will:
• research how the media reports on various environmental issues
• conduct a search for environmental topics in the news.

Background
Read any daily newspaper or watch any of the major network and cable evening news programs and you’re likely to see at least one feature on the environment. Many environmental news stories involve several issues including state and federal governmental regulations, technology and business. What’s going on in our environment is big news.

Learning Procedure
1. Ask: What was the last news story you heard or read about concerning the environment? (List these on the board and have students recall as much information as they can about these stories.) Share with the class the environmental news or articles that you found.

2. Assign students to keep a class bulletin board of environmental news they find in local newspapers and magazines and that they see on television news or find over the Internet. News clips and articles may be original or copies. Written material should be properly documented with the name of the publication, title of article or story, the date and page number. To document television news reports, have students write down the feature lead idea and a few details. They should also document the day, program and network or cable channel. Print Internet items and/or record the web address.

Assign students to bring in several items for the bulletin board over a specified length of time. Every week, have students discuss what they think the top environmental news stories for the week were nationally and locally.

Extension Activities
1. As an ongoing project for the year, have the class summarize the important environmental news stories from their bulletin board into a regular column for the school newspaper.

2. Have the class complete the Searching the News handout assignment. You may group students in teams and use the squares similar to a bingo board challenging teams to complete all squares or any line.

3. Invite a representative from your local newspaper who covers environmental news to speak to the class on sources of information and issues.

4. Have students review their clips for a specific length of time and evaluate the content. How does the media report environmental news? What weight is given to scientists, activists, the government?

In the mid-1990s South Carolina made national environmental news when three companies in the state were fined a combined $1.05 million for alleged hazardous waste violations.
Student handout

Searching The News

The media plays a tremendous role in keeping environmental issues in the forefront of our society. You can find articles that relate to the environment in nearly every special interest publication and in nearly every issue of the newspaper.

Over the next two weeks, search through newspapers, magazines and the Internet to find each of the environmental news clips listed here.

1. A HEADLINE ABOUT GOOD ENVIRONMENTAL NEWS
2. THE PHRASE "ACCORDING TO THE EPA"
3. AN ENVIRONMENTAL COMIC STRIP
4. A NEWS WIRE STORY ABOUT THE ENVIRONMENT
5. A STORY ON SCIENCE OR TECHNOLOGY RELATING TO THE ENVIRONMENT
6. A STORY ON HEALTH EFFECTS OF POLLUTION
7. A NEWS ITEM ON RECYCLING
8. ENVIRONMENTAL HINTS IN AN ADVICE COLUMN
9. ARTICLE THAT INCLUDES REFERENCE TO SC’S DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
10. AN ADVERTISEMENT THAT REFERS TO THE ENVIRONMENT
11. A PHOTO THAT REFERENCES THE ENVIRONMENT
12. A STORY ABOUT ENVIRONMENTAL LEGISLATION
13. A LETTER TO THE EDITOR THAT REFERENCES AN ENVIRONMENTAL ISSUE
14. AN EDITORIAL ABOUT AN ENVIRONMENTAL ISSUE
15. A HEADLINE THAT REFERENCES AIR OR WATER POLLUTION
16. AN ENVIRONMENTAL WEB SITE ADDRESS

Save your clips or copies of clips, in a notebook. Number each one according to the corresponding number on the item below. Add the name of the publication, the date and the page number.
Drawing Opinions

Grade: 9 - 12
Focus: Communications
Subjects: English, Creative Writing, Art, Social Studies
Materials: A week's worth of editorial pages from your local newspaper, Anail's Environmental Comments (handout)
Teaching Time: One class period, outside projects
Vocabulary: Political cartoon, lampoon, editorial, broadsheet

Learning Objective
Students will:
• discuss solid waste issues
• explore how messages expressing an opinion can be communicated via the political cartoon
• create editorial cartoons addressing environmental issues.

Background
See the Resource Section for more information on solid waste in South Carolina.

The editorial pages of newspapers across the country employ the quick wit of artists to state opinions on issues of the day. Satirical commentary is the stock in trade of the editorial cartoonist.

Editorial commentary through political cartoons has a rich and lengthy history. Advancements in printing technology in the 18th century made the woodcut illustration possible in newspapers called broadsheets that were plastered on walls for all to read. Illustrations and woodcuts made information and commentary available for those many people who did not read.

The art of the political cartoon, however, didn’t hit full stride until the late 19th century in America. It was political corruption and scandals such as Tammany Hall in New York that fueled the editorial cartoonists such as Thomas Nast’s lampooning of fires. Nast’s work was so influential and widespread that convicted New York mayor, “Boss” Tweed escaped from prison and was arrested in Spain after he was identified from a Nast political cartoon.

Editorial cartooning today remains a significant tool for expressing opinions on issues of the day. The successful editorial cartoonist will use facts, foibles and exaggeration combined with an individual artistic style to communicate an opinion.

Learning Procedure
1. Share the Background Section of this lesson and Resource Section introduction on solid waste issues with the students.
2. Collect a week’s worth of editorial pages from your local newspaper. Have students analyze your local editorial pages to determine:
   • the issue being discussed
   • the editorial writer’s position on the issue
   • the editorial cartoonist’s position on the issue
   • which tool, the editorial or the cartoon, communicates its message more directly (be sure to consider not just the graphic presentation but also the depth of the information presented)
   • which tool tries to employ humor and which tries to present a well-reasoned argument.

3. Share the handout Ariail’s Environmental Comments with the students. From the cartoons, have the students’ reconstruct the issues that might have prompted these cartoons. (NOTE: Some of these issues may be dated. See the brief descriptions or have the students research when these cartoon appeared in The State newspaper.)

4. Have students choose an environmental issue, research the facts, write a description of the issue, form an opinion on the issue and create their own editorial cartoon that expresses this opinion.

5. Have students present their cartoons to the class and defend their opinions.

Extension Activity
Have students research and write a report on early editorial cartoonists.

Ariail’s Environmental Comments
(A Teacher’s Guide)

A. Local governments in Columbia were considering legislation to reduce the number of billboards in and around the city. This issue caused some members of the advertising community to argue that this was a matter of restricting trade.

B. The Greenville News had uncovered files buried in the Richland County Landfill alleging unethical behavior by members of the University of South Carolina’s administration. This cartoon appeared after that administration was dismissed and a new USC president had been hired. (This entire issue also points to an interesting environmental fact: nothing degrades in a landfill. Although the files had been buried in the landfill for a number of years, they were still legible.)

C. Commenting on voter backlash against incumbent politicians during the 1992 elections.

D. Appeared in the waning days of the Bush Administration that was accused of dragging its feet on taking actions to reduce greenhouse effect gasses that lead to Global Warming.
Ariail's Environmental Comments

These editorial cartoons are by The State newspaper's award-winning cartoonist Robert Ariail. They appeared in The State in 1991 and 1992 and have been reprinted in the book Ariail Attack. They are used here by permission of the author.

[Cartoon image with text]

A]

B]

AND THESE, DR. PALMS, ARE OUR ARCHIVES...

[Sign: RICHLAND CO. LANDFILL]
IN HONOR OF EARTH DAY, I'VE STARTED SEPARATING GARBAGE INTO CONTAINERS FOR THINGS THAT SHOULD BE RECYCLED...

AND THINGS THAT SHOULD BE THROWN OUT.

WHAT DO YOU CALL THE PHENOMENON THAT INCREASES THE LIKELIHOOD OF GLOBAL WARMING?

The White House Effect
Buy Recycled?

Learning Objective
Students will:
• find out the reasons people in a grocery store buy certain food products
• determine the influence of packaging on consumer choices
• determine if consumers consider waste disposal and recycling when making buying decisions.

Background
Product packaging makes up a significant portion of our solid waste stream, what we throw away. In South Carolina, nearly 50 percent of all solid waste is glass, plastic and paper.

According to the U.S. Environmental Protection Agency’s 1996 figures, paper comprises 39.2 percent of the solid waste stream, plastic, 9.1 percent; and glass, 6.2 percent. Careful buying is the first step in solving the problem of too much solid waste. Consumers should consider waste disposal and recycling when deciding what to buy.

But there is a more important, less obvious force behind the “Buy Recycled” movement and that is simple economics. The economic principle of “supply and demand” is a major factor in bringing products with recycled content to the marketplace. The more consumers demand recycled products, the more the availability of these products will increase.

And manufacturers recognize their role in Buying Recycled. The Buy Recycled Business Alliance is a “national group of companies committed to increasing their purchases of recycled content products,” according to their membership literature.

“Manufacturing and buying recycled products are no longer just ‘environmentally friendly’ things to do. Since today’s consumers are expressing a clear preference for recycled content products, buying recycled makes good business sense for any company — whether it’s a multinational corporation or a local business.

“The Buy Recycled Business Alliance is a national effort by U.S. companies to promote market development and procurement of recycled content products. The Alliance is based on a spirit of partnership and

In 1991, Mexico’s President Carlos Salinas de Gortari was awarded the Earth Prize, also called the “Green Nobel,” for his environmental statesmanship. President Salinas was also presented the World Conservation Leadership Award in 1992.
cooperation and on the shared belief that market expansion is the most crucial factor to ensure the continued growth and economic development of recycled content products.

"Founded by the National Recycling Coalition, a non-profit organization representing diverse recycling interests, the Alliance has launched the Buy Recycled Campaign: a nationwide effort to encourage businesses of all sizes to increase the use of recycled content products in their day-to-day operations." In South Carolina, the Buy Recycled Business Alliance can be contacted through DHEC's Office of Solid Waste Reduction and Recycling at 1-800-SO USE IT.

In one very clear example of the type of recycled content efforts made by one corporation, consider a hamburger chain’s story: McDonald’s. The McDonald’s Corp. made a corporate commitment to purchase products with recycled materials wherever practical... and practicality is a major factor. McDonald’s was buying paper napkins made from virgin materials. To purchase the same napkins made from recycled paper would add $1 million to their napkin costs... not a practical option.

However, if each napkin’s overall size were just 10 percent smaller, the cost of using recycled material to manufacture the napkins would remain the same. Today McDonald’s recycled-material napkins, when unfolded all the way, are 10 percent smaller than they used to be, hardly a significant difference when used by their customers. The napkins are still folded to the same size so they will fit the millions of napkin dispensers across America. And they cost the same as the virgin material napkins.

The more people "Buy Recycled," the more recycled products there will be to buy. And this will help recycling collection programs find new markets for the items that they collect. "Buying Recycled" will also fuel developments in new technologies for recycling products.

The consumer plays a significant role in the Buy Recycled circle. However, the consumer must be an informed buyer. Many products carry meaningless environmental claims. For example: "Earth-Friendly" is a term that has no legal or environmental meaning.

**SCIENTIFIC CERTIFICATION SYSTEMS**

Organizations such as Scientific Certification Systems (SCS) are working to establish environmental standards to certify manufacturers environmental claims. Their Green Cross and Globe emblem on certified products is accompanied by "precise information about the environmental achievements which have been verified." SCS has published some general guidelines to help consumers "decipher fact from fiction." These guidelines, reprinted from SCS's Consumer Guide to Environmental Claims are:

"1. All Products Have An Impact on the Environment

Every product involves the use of resources and energy at some point in its production, use or disposal. Solid and hazardous wastes may also be generated. Even products which perform a valuable environmental function (for example, water-saving shower heads) are not without some environmental impact. Watch out for vague claims like 'environmentally friendly' and 'safe for the environment' which may promise more than they deliver. Also be on the lookout for environmentally suggestive packaging or symbols which may leave a strong impression but don't add up to much.

"2. Specific Claims are Best

The more specific the claim, the better. Specific claims are easier to understand, easier to verify and less likely to be misleading. For example, many people are confused by the three-arrow recycling symbol. Sometimes, the symbol is used to indicate that a product is recyclable. Other times, it indicates that a product is made, at least in part, from recycled materials. Look for this..."
distinction. Recycled content claims should always indicate an actual percentage (from 1-100 percent).

“3. Significant Achievements Deserve Recognition
Not every environmental claim represents a significant achievement or improvement. In fact, in their rush to jump on the environmental bandwagon, some companies have resorted to making trivial or irrelevant claims. For example, what makes one paper napkin more “landfill safe” than another? Not much, since the landfill, not the product, is the primary determining factor. And what about a product that suddenly advertises ‘no CFCs’ when in fact, no chlorofluorocarbons (CFCs) have been allowed for 15 years? By being selective, you can give the right kind of encouragement to manufacturers.

“4. Claims Should Be Verified
Every company should be able to provide detailed documentation to support the claims they make. Don’t be shy about asking. Some companies are having their claims independently verified for added assurance by organizations like Scientific Certification Systems. Find out about the group doing the certification to make sure there are no conflicts of interest. If your store is making the claim, ask what steps have been taken to verify the accuracy of the claim.”

Learning Procedure
Part One
1. Share the Background information included in this lesson with the class. As a group, have the class develop a questionnaire to use to interview people or a family member in a grocery store about the reasons they buy the items in their grocery carts. (A sample is included with this lesson.)
   Ask: Which of the following factors influenced your decision to buy this product?
   - The cost
   - The convenience in preparation
   - I saw it advertised
   - High nutritional value
   - Lack of artificial coloring, flavoring or preservatives
   - The packaging is reusable/recyclable
   - I am having company; it is a special purchase
   - I am trying something new
   - It has catchy packaging - visually attractive
   - A friend recommended it
   - It was on sale/I had a coupon
   - Buying it for the kids
   - Uses less packaging than other brands
   - I’ve used this product before.

2. Assign students to conduct the survey with family members or with the cooperation of a local grocery store. This can be done individually or in teams. Be sure to ask about six or seven items in the interview subject’s shopping cart.

3. As a class, discuss the results of different team’s survey. Analyze and chart the results of your class findings.
   - Which were the most common reasons for buying a food product?
   - How often was recyclability taken into account?
   - Were people concerned about waste disposal when deciding what to buy?
   - Were people even aware of solid waste disposal issues?

Part Two
(Note: This will require the cooperation of the manager of the School Store. If your school does not have a store, you might consider setting up a temporary store for this portion of the lesson.)

1. Ask the students if they would be willing to choose a product if it was made from recycled materials. Ask if they would be willing to pay more for a recycled product if the quality was comparable to a similar, nonrecycled product.
2. In the school store, offer products such as pencils, paper and notebooks made from virgin, nonrecycled materials and recycled materials. Offer them side-by-side with signs clearly advertising the recycled content of one set of products. Make sure the products have the same price. Be sure to note each product’s profit margin, that is, what the store “makes” on each product sold. Calculate this by subtracting the original cost of the product (the store’s cost) from what you sell it for. Track the sales of each product for a week and graph your progress.

3. Using the same set up, raise the price of the recycled products by 10 percent. Be sure to note the new profit margin on each product. Track the sales of nonrecycled and recycled products for a week and graph your progress.

4. The third week, raise the price of the recycled products another 10 percent. Be sure to note the new profit margin on each product. Track the sales of nonrecycled and recycled products for a week and graph your progress.

5. At the end of three weeks take inventory and compare the sales figures. How did sales of the nonrecycled products compare with the recycled products over three weeks? When the prices were the same, did buyers choose one product over another? Did a higher price influence buyers to choose one product over another? How did changing the price affect overall weekly profits for the store? What role did advertising (the in-store signage) play in influencing buying decisions?

Questions for the Class
1. How frequently do purchasers consider how packaging contributes to waste when shopping?
2. Does a “Recycled,” recycle symbol or some other type of environmental benefit statement on packaging boost product sales?
3. Does an environmental statement on packaging boost sales even if the price is higher?
4. Is there a price-tolerance level?
5. Do people believe environmental benefit statements on product packages?

Extension Activities
1. Repeat the survey from Part One with students in the School Store. How did their answers compare to the “real world” answers obtained originally?
2. Many countries, states and cities have regulations that require recycling and waste reduction. In South Carolina, each county or region is required by law to have a waste management plan in place. Have the class find out the regulations and waste disposal and recycling options in your area. To get started, call the S.C. DHEC, 1-800-SO-USE-IT for information or call your county government.
3. With improvements in recycling technology, products with recycled content are priced competitively with products made from virgin materials. Have students survey the prices of several recycled products with those of products made from virgin content. Items to survey may include paper or plastic products.

Just Do It
Buy recycled whenever it’s practical.
**SHOPPING SURVEY ... WHY WE BUY IT.**

When shopping, do you think about the product and its packaging and the waste?

- [ ] Yes  
- [x] No  
- [ ] Sometimes

Factors that influence people's buying decisions *(check those that apply, write answer for other)*

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<th>Nutrition</th>
<th>Reusable or recyclable</th>
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9 - 12

PAGE 45
For more information about South Carolina and the environment, call the South Carolina Department of Health and Environmental Control at 1-800-SO-USE-IT or visit our web site at www.state.sc.us/dhec.
Creative Conservation

Grade: 11 - 12
Focus: Examining our "throwaway" lifestyle through creative writing and poetry
Subject: English
Materials: References on poetry forms; bulletin board space or poster board; examples of haiku, couplet, limerick, free verse and cinquain poetry, The Lorax by Dr. Seuss, A Description of a City Shower by Jonathan Swift. For Extension Activities: The Wasteland by T.S. Eliot.
Teaching Time: Two class periods, plus homework assignment
Vocabulary: Waste, hazardous, nonhazardous, biodegradable, nonbiodegradable, planned obsolescence, throwaway lifestyle

Learning Objective
Students will:
* define the term “waste” and describe four waste categories
* write poems to express their thoughts about the social issue of waste.

Background
One traditional use of poetry has been to express views on social issues or conditions and examples of such poetry provide a valuable record of the development of human societies.

One of the most important issues today is that of waste and our management of waste to protect our environment. Waste is defined as any material that is discarded, useless or unwanted. Some waste is not hazardous to us or our environment (nonhazardous); however, some is extremely hazardous or dangerous to plants and animals.

Wastes from natural materials can be broken down into simpler compounds by microorganisms and are referred to as being biodegradable; wastes from human-made products, such as plastics, glass and aluminum, cannot be broken down by microorganisms (nonbiodegradable).

Even waste that can be broken down must be handled to allow that process to take place. For example, grass clippings put in the trash and taken to the landfill will not break down; they are preserved in the landfill. Materials that can be broken down must be processed in waste management systems designed to allow decomposition, such as compost piles.

Many of our products are designed to be used only once and then thrown away; these items contribute to ours being called a throwaway lifestyle. Other products are designed to become obsolete or useless in a short period of time (planned obsolescence).

In the United States, Turner Broadcasting created and produces a children’s environmental cartoon called Captain Planet.
We seldom stop to think about where the materials for these products come from or that the natural resources for these materials are limited. Likewise, we seldom think about where discarded items are taken or that land available for their disposal is limited.

Learning Procedure
1. The purpose of this activity is to evaluate the issue of waste and respond through the art of creative writing or poetry.

Share with the class, *The Lorax* by Dr. Seuss and discuss:
   a. how the story uses humor and rhyme to make a point about waste and wasteful habits
   b. how the story has appeal for all ages.

For more advanced classes, share with the class "A Description of a City Shower," by Jonathan Swift and discuss:
   a. the poetry form used and what that says about the poet
   b. the language used to evoke sensory images
   c. the main purpose of the poem
   d. Swift's attitude toward change as it might relate to the social issue of waste today.

2. Explain to the students that they will be writing poems in the forms of their choice (couplet, haiku, limerick, cinquain or free verse) about the social issue of waste.

3. Review with the students what they have learned about metaphors, similes, rhyme, alliteration and onomatopoeia.

4. Review the Background material for this lesson and the Solid Waste introduction in the Resource Section. Discuss with students the concepts of "planned obsolescence" and "throwaway" lifestyles as they relate to the students’ lives.

5. Assign each student to find a picture that illustrates an aspect of waste in terms of the class discussion. Have them find pictures that show their personal response to the issue, using newspapers, magazines or photocopies from library journals. For example, if students believe that waste is encouraged through convenience items, they might create a collage of convenience-product advertising.

6. As a homework assignment, have each student write a poem in the form of his/her choice and use the picture as an illustration for the poem.

7. In class, ask the students to share their pictures and poems. Open the classroom for discussion as each poem is read. Identify the form of the poem, the language used to evoke images and the message the poem imparts.

Extension Activities

2. Have the class organize a poll of other students in the school concerning the issue of waste. Publish the results of the survey and the poems your class wrote in the school newspaper.

Questions for the Class
1. Define the term "waste." Identify four categories of waste and give an example of each.

2. What does poetry have to do with the social issue of waste?
Lights, Camera, Action

Grade: 9 – 12
Focus: Using television and promotional announcements to show that protecting the environment is desirable
Subjects: English, Speech, Drama, Social Studies
Materials: See list of materials itemized below
Teaching Time: Several class periods (not including actual production time for commercials)
Vocabulary: Public service announcement

Learning Objective
Students will:
- identify some of the influences, appeals and techniques advertisers use to promote products
- see how these techniques are also useful in educating and persuading the public on environmental issues.

In this activity, students will take a look at how commercials are designed to sell products and how commercials or public service announcements (messages that are printed or broadcast for no charge) can be used to "sell" products or ideas that protect the environment.

Students will design and produce their own environmental public service announcements or advertisements for environmentally sound products.

This activity is a cooperative learning activity with students working in groups of four or five.

Materials
For television production: video camera, blank video tape, VCR, tape recorder, pencils, paper, tape, markers, resource books, pre-taped commercials. Handout for students: Writing and Producing Your Own TV Commercial.
(Note: You may want to contact your local television station for help with this project.)

For print projects: art paper and drawing supplies such as markers. For classes with photography capabilities, encourage students to use original photographs in their print advertisements where appropriate.

Of the 88 advertising claims investigated by the National Advertising Division of the Council of Better Business Bureaus, 16 were about environmental claims. In two-thirds of the cases the offending companies changed or dropped their claims.

Source: The Green Consumer
Learning Procedure

Day One
1. Discuss the important elements of effective advertising such as: targeting a specific audience, presenting a unique product advantage, style, visuals, delivery, eye appeal and other considerations. Also, discuss the difference between public service announcements, PSAs, (non-paid messages that are broadcast as a service to the public, examples include messages from the Heart Association or other organizations that service the public) and paid advertising (commercials that the advertiser pays to have broadcast).

The student handouts may be copied and distributed to students to provide technical background information for developing commercials.

Day Two
2. Have students view and discuss various TV commercials (you will need to pre-tape before session) and various print ads for products and services. These should include a mix of products and messages that promote protecting the environment and ads for products that can cause environmental problems if not handled properly.

Discuss how the commercials make their points. Could the commercials be changed to reduce the environmental consequences of the product or to promote better environmental habits? (For example, could commercials for canned soft drinks promote recycling the cans or could commercials for paper products remind people not to litter but to recycle?)

Day Three
3. After students have a feel for the commercials, divide the class into groups. Have each group select a specific topic. (A product, service or position to promote. Students should identify a product such as a cleaner, hair care product or agricultural product; or a service such as lawn care or automotive repairs; or a position such as recycling is good for the community.) Allow them time to discuss and begin to brainstorm ideas for their own commercials. Bring the whole group together to share ideas and generate new ones.

Day Four
4. As a group, students should be allowed to choose the media for their commercial.
   - print: newspaper, magazine, direct mail;
   - broadcast: 30- or 60-second TV commercial or public service announcement or radio spot
   - outdoor: billboard, bus board or other.

Encourage the use of props, cue cards, role playing, costumes, photography or illustration or whatever tools are available to produce finished-quality communications.

Give students about a week to complete the production of their ads. Schedule a presentation of the finished ads to the class.

Day Five
5. Present the commercials to the class and/or ideally, to another group (younger children, adults, community leaders, etc.).

Extension Activities
1. Contact a local advertising company and invite a speaker in to talk about advertising the environmental positives of a product and the trend toward “Green Products” and “Green Advertising.”

2. Have students write the National Advertising Division, Council of Better Business Bureaus, 845 Third Avenue, New York, NY 10022, for more information about how environmental claims are investigated.

Just Do It

Pay attention to the environmental claims made on the products you buy. How are they backed up? If a product you buy has a vague environmental claim, write the manufacturer and ask for more information.
It starts with an idea.

The first thing you'll need to write and produce your own TV spot is an idea. Ask yourself these questions:

- What message do I want to convey?
- Who am I trying to reach with this message? (Who is the audience? How old are they? Are they men and women, are they teenagers, are they kids? What do I know about the audience, their economic position, their likes and dislikes?)
- How can I present this message in a way that is clear and will attract the attention of the target audience?
- What action do I want the target audience to take after seeing the commercial?
- Can I make my commercial an interesting 30 second story?

Turn your idea into words.

Once you have your idea, turn it into words. Let's say your idea is to show what happens to a soft drink container after the contents have been consumed. Will you use actors or an off-camera announcer? Write down one or more possible scripts - figuring about two words per second. If you intend to have all of your 30 second spot filled with talking, that means you should write 55 to 65 words. If only part of your spot has dialogue or speaking, you'll want to use fewer words. After writing your script, read it out loud. Does it sound realistic... does it sound natural? How will this message appeal to your target audience? Keep writing and re-writing your script until it sounds believable and makes a statement that people will listen to and understand. Make sure your beginning words draw people into the spot... and that your ending is either powerful, humorous or memorable.

Turn your idea and words into pictures.

TV communicates with images. Take advantage of that by thinking of the strongest, most vivid, most imaginative pictures that you can. Again, going back to our example of a soft drink container - what could you do to make that image as dramatic as possible? Put it in a spotlight? Show it through a dense fog of smoke? Photograph it from up close? Have a pile of smashed and unsmashed cans instead of just one? Show a container being cast off into a ditch or being added to the pile? These are all visual possibilities. Your own mind is the only limit to what you can show. Think graphically... and let your pictures carry the emotion and impact of your commercial.

Putting the words and pictures together.

Take a blank sheet of paper and draw a line from top to bottom down the middle. On the left-hand side you will write all your visuals. Describe each visual action in detail. For example, camera moves in right to a container in the hand. The hand moves outward to toss the container toward the pile. The pile is scattered and broken with additional debris. On the right hand side of the paper, write down your words or copy so that your dialogue or off-camera announcer’s words are written down next to the visual action that takes place at the same time. In other words, if your announcer says “here, you can be a part of the problem or the solution.” Write those words next to the picture of the action that takes place at that time. By writing down the visual action and words next to each other on the paper, you can tell at a glance, exactly what is going to be happening - words and pictures together - in your spot.

The Storyboard tells the story.

What follows is a storyboard. In each frame, sketch a rough picture of what you’ll show on the screen. Under each frame, describe what is happening and write the dialogue that goes with that picture.

Rehearsing and planning are important.

Several days before your scheduled shooting date, take your storyboard and talk to the director of the commercial about it. Together you can plan how you will shoot the spot. Also, you’ll want to decide what props you need. You must have all your props together before you shoot the commercial.
In addition, if you are using actors, have them fully rehearsed so you don’t waste time in the studio. If you are using any other elements, such as a piece of music or an off-camera announcer, it would be wise to have these audio elements already recorded before you go into a video studio.

Your judgement makes the difference.

This is the time when your concept comes to fruition. In the capable hands of the director, cameraman, acting and voice talent and video technicians, your idea should come off without a hitch, provided you have preplanned everything with care. So, your job during the actual production of the spot is to offer opinions and feelings about what is going on. The director’s job is to instruct the crew and talent.

Putting it all together.

Sometimes, your commercial cannot be shot in a single, 30-second “take.” In such a case, your spot will be filmed in short sequences and edited together. This takes place after the spot has been shot. Editing the spot or putting it all together, can take a few minutes or several hours depending on how many scenes have to be edited together. If your spot takes place in a single setting, with little action, editing time will be short. On the other hand, if you are cutting back and forth from scene-to-scene or if you are changing your pictures to coincide with a piece of music, the editing process can be time consuming.

Your message is ready!

It is finished... and it represents a lot of hard work – and plenty of fun – by everyone who contributed. The important thing is that you created something that reflects your views on an important subject... and you learned a lot about writing and producing television along the way!

Adapted from:
Writin and Producing Your Own TV Commercial You Can Do It
Kari V. Peters, KTIV Channel 4

STORYBOARD GUIDELINES:

On the radio, only words are used to get a message across. In video, the message has to be conveyed with the help of pictures. You need to show your audience, don’t just tell them.

A storyboard is similar to a comic strip. The action unfolds in a series of still pictures.

Narration, dialogue, music, sound effects and camera movements are written under or next to each frame.

Steps in Storyboard Production

1. Get a picture in your mind of what you would like to show your audience. The visual aspect of your message should go along with the words you’ve written, but should add interest or excitement to that message.

A good thing to do is think of what on TV appeals to you. What messages do you remember and how were they conveyed?

2. Start drawing pictures of your message. Draw a picture of each separate part of the message.

2. Start drawing pictures of your message. Draw a picture of each separate part of the message.

3. Look over the pictures you’ve drawn. Now think about how you’ll present those pictures in front of a camera, not a video camera, just your parents’ 35mm camera, for example.

4. Work your pictures into individual frames for the camera. Each frame should be related, together they should show some continuity of action.

You can add interest to the pictures if you imagine yourself to be a professional photographer, taking pictures from all different angles, all different zooms.

Decide which angles and which zooms look best. Once you’ve drawn each camera frame of your message, you’ve got a storyboard.
5. Now consider how the action in your pictures would look in video. Think of the pictures you’ve drawn as one continuous action story. How would you bring those pictures to life? How would you act them out?

Rehearse before you get in front of the camera. But once you are in front of it, try to forget it’s there. By pretending you’re still just rehearsing, you’ll be less nervous and more natural. That’s one of the keys to an effective message.

**Camera Guidelines**

If you shoot your commercial in a studio, you may be able to use two cameras; keep this in mind as you draw your storyboard and write your script instructions.

Let’s say Camera 1 is set up directly in front of the scene to take a wide shot of all the action. Perhaps camera 2 can be set at a 45-degree angle to the scene, zoomed in to a close-up shot of whatever action is taking place.

Your script will have to designate which camera is in use for each shot. Your storyboard will need to show the type of shot you have planned.

**Low angle shot**—The camera is close to the ground looking up at the subject. This makes the subject bigger, more dominant in the viewer’s mind. The viewer may feel less in control or less superior.

**Focal point**—Close-up shot of a still item.

**Wide shot**—Takes in the whole scene or entire person.

**High angle shot**—The camera is higher than the action looking down on it. This tends to make the action or speaker smaller or less important in the eye of the viewer. Viewers may feel a sense of superiority when viewing this angle.

**Close-up**—Tight on the head or on the action.

**Extreme close up**—One element of the action or of the person’s face.

**Medium shot**—Usually head and shoulders from the waist up.
For more information about South Carolina and the environment, call the South Carolina Department of Health and Environmental Control at 1-800-SO-USE-IT or visit our web site at www.state.sc.us/dhec.
Where Does the Good Stuff Go?

**Grade:** 10 - 12  
**Focus:** Throwaway society, responsible consumerism  
**Subjects:** Environmental Science, Social Studies, Home Economics  
**Materials:** Items that are suitable for reuse, map of your community  
**Teaching Time:** Several class periods. Note that students need time to work on refurbishing items and to complete home assignments, so the other class periods should not be planned as immediately consecutive.  
**Vocabulary:** Refurbish, reuse, recycle  
**Prerequisite:** My Bag lesson

### Learning Objective
Students will:
- understand that there are options to trashing used goods
- list reuse of goods as an option to landfill disposal and recycling
- list agencies that collect, refurbish and sell or distribute used items
- list benefits to individuals and society reusing goods
- cite examples of how ancestors dealt with shortages of clothing, building materials and equipment.

### Background
The United States has a reputation as a throwaway society. Yet, if students study their heritage, follow a Goodwill Industries collection truck, price a vintage car or browse an antique shop; they will discover all the good stuff doesn’t get thrown into the trash and doesn’t go to the landfill. It is important that students realize there are responsible options to trashing goods they no longer want or need.

### Learning Procedure
This lesson studies the many options to throwing away items and how many items can be **refurbished** (repaired and made useful again) and reused.

1. As a class, make a list of items that are often thrown away but could be reused. *(NOTE: Reused means that the item essentially is unchanged from its original purpose or form. Recycled means the item is significantly changed before being made into a new product.)* Reuse items may include: jewelry, appliances, toys, cars, antiques, clothing, military surplus and furniture.

   Show students items you’ve collected that can be reused. These items may include clothing, used household items, repairable small appliances.

2. As a class, make a list of agencies that collect, refurbish and sell or distribute usable merchandise. This list will grow as the lesson continues. These places include: second hand stores, Goodwill Industries, antique stores, near new shops and army...
surplus. Items can be given away or resold at reduced prices.

Have students locate these places on a map of your town or community.

**Ask students:** Why do you think America is referred to as a throwaway society? (our preference for new things, designed obsolescence, advertising, poor quality of some non-durable goods, convenience, the fact that it is less costly to buy new than to repair)

3. Invite a speaker or discuss with the class how our grandparents reused goods during the Great Depression or during World War II. Have them discuss the practice of turning collars and cuffs on shirts, furniture passed from generation to generation. How everything – string, feed sacks, wax paper, paper sacks, grease - was reused.

4. Discuss and assign the students projects. (See handout.)

**Alternative**
Take a class field trip to one of the collecting agencies. Have each student bring the item they refurbished to the collection center and follow the sorting/distribution path for their item. (Several agencies welcome tours.)

**Questions for the Class**
1. List your reasons for reusing goods. (cost is less, more ecological, only way to find some goods, quality of items, style of items is unique)

2. Suggest reasons why many people shop at reuse centers. (money savings i.e. bargains, just like the challenge, fun)

**Extension Activities**
1. Predict possible effects of an economic recession on reuse agencies and on the people using reuse centers. (fewer items donated, fewer items available, the lower income people using the agencies could experience greater economic hardship)

2. Suggest reasons for and against using tax dollars (municipal funding) to supplement reuse agencies financially.  
   (For: reduced landfill cost – pass savings onto agencies.  
   Against: greater burden on taxpayers.)

Reuse agencies receive most of their donations from middle income people. Suggest ways to include other income levels in the reuse programs. 
(Enlist community groups i.e. churches, special targeted mailings, advertising campaigns)

3. List ecological and economic impacts on a municipality if reuse agencies were not available.
   (Landfills have limited space, therefore:  
   1. greater distances to haul  
   2. higher cost as landfills fill  
   3. loss of valuable resources, land, usable items  
   4. economic hardship)

4. Could a reuse agency contribute to the effects of an economic recession?
   (Possibly: not buying new items could drive down cost and demand, could contribute to unemployment and recession.)

5. Why are some used items very valuable, i.e. antiques?
   (Supply and demand – people want them!  
   Trends – antique furniture and cars)

**Just Do It**
Consider using a thrift store as a fund raiser for one of your school clubs. Explore sources of donations that can be fixed up and repaired for resale. Remember to plan for advertising to target needy families in your area and price items fairly.

\[9-12\]
Refurbishing Assignment

Date Due:

You may choose one of two options for this assignment.

Option 1: Find an item in your home that is unwanted and is going to be thrown away (be sure you have permission to use the item). The item may be a personal item, something from your family, something from a neighbor. Your assignment is to refurbish or find a way to reuse the item. Be prepared to bring in the "new" refurbished item and give a short oral presentation describing the following:

a) the object before you rescued it from being trashed.
b) what you did to the object to refurbish it for reuse.
c) what you are going to do with the item now.

You will need to turn in the item along with a one page report covering the three points above.

Option 2: Interview a representative from an agency that processes usable, discarded goods. Consider and plan your questions in advance. Suggested questions are offered below. You will turn in a written report on your interview and make a brief oral presentation on your findings. Your written report should include your interview questions and answers and your impressions of the facility you visited and the work done.

Sample questions:
- What is the goal or mission of the reuse agency?
- Where do the donations come from? Who donates the items?
- Who benefits most from the agency?
- What are the most commonly donated items?
- Which donated items are not valuable for resale?
- What happens to unusable or unsold items?
- How are the profits from resale of items used?
- Does your agency receive financial assistance from any outside source, i.e. church, government, service organization?

For this interview, please remember to call in advance, politely explain your assignment, ask for an appointment, be on time and thank the person for their time. If you would like to use a tape recorder to capture what is said in the actual interview, please ask for permission in advance.
For more information about South Carolina and the environment, call the South Carolina Department of Health and Environmental Control at 1-800-SC-USE-IT or visit our web site at www.state.sc.us/dhec.
Poetry for Solid Waste

Grade: 9 - 12
Focus: Using poetry to communicate the benefits of recycling.
Subjects: English, Environmental Science
Materials: Writing materials, student copies of poem types (optional)
Teaching Time: Two class periods
Vocabulary: Cinquain, haiku, diamante

Learning Objective
Students will:

- see how poetry can be used to communicate ideas and feelings about environmental issues
- write poetry related to recycling.

Everyone can be a poet, at least to some extent — and yet lots of people think any kind of poet’s expression is beyond their capacities. This activity is designed for every student — or group of students — to create a poem.

Learning Procedure
1. Discuss with students the use of poetry to express thoughts and feelings about environmental issues. Share with students the poems included with this lesson and others that you may enjoy. Tell students for this poetry writing activity, poems can be free verse or rhyming. Cinquain and haiku are interesting forms that students may want to try.

For group poetry writing, every person thinks of a thing about waste or recycling. Each person contributes one word. One or more students or the teacher can put all the words together to form the poem while others discuss their experiences in being concerned about recycling.

Here are a few examples of poetic forms that can be used. These have been excerpted and adopted from Project Wild, Secondary, 1983, 1985, Western Regional Environmental Education Council and previously from Project Learning Tree (Washington, D.C. American Forest Institute, 1977).

Haiku – Haiku, originated by the Japanese, consists of three lines of five, seven and five syllables each. The emphasis is syllabic not rhyming. For example:

aluminum can
made into a useful tool
guide to harmony

Cinquain – Cinquain is derived from the French and Spanish words for five. This form of poetry is also based on syllables — or may be based on number of words — but there are five lines.

Oil pools from dead remains
Diamonds from the same place, too
Both precious, highly valued
A simple matter of pressure.

“Understanding that the world does not belong to any one nation or generation, and sharing a spirit of utmost urgency, we dedicate ourselves to undertake bold action to cherish and protect the environment of our planetary home.”

Vice President Al Gore, Earth in the Balance
Each line has a mandatory purpose and number of syllables or words. These are: 1) the title in two syllables (or two words); 2) a description of the title in four syllables (or words); 3) a description of the action in six syllables (or words); 4) a description of a feeling in eight syllables (or words); and 5) another word for the title in two syllables (or words). Here are two examples, the first using syllables and the second using words:

**paper**
- vital, useful
- remade to serve again
- too often wasted by us all
- unfair

**cardboard box**
- containers of our things
- holds, protects, surrounds, stores, carries, covers
- convenient, useful, inexpensive, adaptable
- strong for its weight
- unlimited uses

**Diamante** - Diamante is a poem shaped in the form of a diamond. It can be used to show the words are related through shades of meaning from one extreme to the opposite extreme, and beginning and ending nouns could be natural resources. A pattern of parts of speech are as follows:

- **noun**
- **adjective adjective**
- participle participle participle
- **noun noun noun noun**
- participle participle participle
- **adjective adjective**
- **noun**

Example:

- sapling
- taller, thicker
- living, growing, maturing
- wood, paper, printed, read
- bundled, reformed, fiber-board
- wall, construction
- house

The completed poems can be typed or printed neatly and then displayed with a photograph or black and white pen and ink drawing of the product. Here is an example of free verse with a drawing:

**Seed**
- **sun**
- **soil**
- rain
- roots, stem, branches, leaves
- longer, stronger, wider, taller
- grows into wood, cut for timber, used to build to construct, used for script, for packaging first one use, then another, another never discarded, nor lost many many uses none wasted precious

**Extension Activity**

1. Send your recycling poetry to the school or local newspaper to be published and read by others.

2. Poems can be laminated and used for placemats in the school cafeteria as part of your school’s Earth Day celebrations.

3. Compile your students’ work into a book of poetry. Printed on recycled paper, this may be sold as a fund raiser.

**Just Do It**

Read more about the environment. Visit your local library or bookstore and check out all the new books!
Learning Objective
Students will:
• write the script for a play, which they will also perform, to encourage consumers to recycle and to reuse.

Materials
Materials for producing play (with this lesson) can be assigned to students. Encourage students to reuse waste materials where possible to produce a “green production.” Materials include:
• Backdrop of a typical kitchen
• Scene 1 Props: papers, cans, bottles and large plastic bags
• Scene 2 Props: box, cans, bottles, paper and plastic milk jugs
• Scene 3 Props: a recycle bin with four compartments marked paper, plastic, glass and cans
• Costumes: Will & Mae, Al-Can, Jill Jar, Patty Paper and Peter Plastic.

Background
It is estimated that more than half of American waste is recyclable. On a national level, experts project that 25 to 30 percent could be composted (a form of natural recycling) and 40 to 50 percent of the waste stream could be recycled.

Along with the amount of waste that could be reduced through other methods, the amount of waste going to our incinerators and landfills could be reduced by as much as 70 percent.

For more information about solid waste and recycling, see the Resource Section.

Learning Procedure
1. Review with the class basic information about solid waste and reusing, reducing and recycling methods. Also review with the class the methods that are currently available in your area to reduce the total amount of waste going to the local landfill and/or incinerator. If your area does not currently have any structured recycling program, this play can be used as a tool to educate students and the community about taking action now.

2. Use the information provided in the following skit (or a skit and characters created by students) and have the class write a script and perform the play for elementary students, the local parent/teacher association or a community meeting on local issues.

In January 1996 the University of North Carolina-Charlotte Recycling Office began recycling hard and softbound books, magazines, course catalogs and campus directories in cooperation with Carolina Recycling Inc. In two years they recycled 27,910 pounds (14 tons) of these materials.

Source: UNC-C
Outline for the Play:  

**END OF THE ROAD**

Scene I  
Mae and Will Waste's kitchen on Evermore Drive.  
Mae and Will are overstuffing big plastic garbage bags with papers, cans and bottles.  

Mae laments the TV commercials that say the garbage bags will not break. She feels they never hold enough. Will reminds her that trash is piled four feet deep in plastic bags all through their backyard and that no more waste will fit out there.  

Mae longs for the good old days when the landfill was open and the big truck came and picked their garbage up every week and took it "away." Will says the landfill had to fill up eventually and that there is no "away." and that there really never was.  

While Will leaves to take the trash out, Mae is greeted by a strange looking creature named Al-Can. Al-Can is sad because he is in his prime, feeling strong and vigorous, but instead of putting him to work, they are throwing him away. Al-Can claims to have part of the solution to their trash problem. He says all those aluminum cans they have been throwing away are very valuable. If they collected their aluminum cans, they would not only make a little money, but would also cut down on trash. Al-Can goes outside to look at all the trash.  

Mae is delighted and calls Will. Will laughs at her, telling her he never heard of a talking can. After Mae leaves, Will is confronted by a glass jar named Jill Jar. The jar tells him that glass is valuable and that if he would collect all his glass jars and bottles and take them to the recycling center, he would be saving valuable resources and energy. She asks him to think about the heat and energy that it took to make her lovely shaped clear exterior and that it would be a shame to waste all of that by throwing her away.  

When Mae returns, they are both confronted by Patty Paper who wants to be used again. She states she's tired of lying around, she still feels young and there's a lot of life in her yet. She doesn't want to go "up in smoke." Mae and Will decide to collect their cans, glass bottles and papers and take them to the local recycling center.  

Scene II  
Later, Will and Mae are excitedly discussing what they will do now that they have a clean yard and some extra money. Will wants to grow a garden so they don't have to buy so much food. Mae is thinking of setting up a recycling center in the kitchen. She recycles cans, bottles and paper but doesn't know what to do with her plastic milk jugs. She thinks and thinks.  

Will and Mae hear a knock at their door. They are greeted by Peter Plastic. He tells Will and Mae that he wants to be recycled. It took thousands and thousands of years to form the petroleum (oil) that plastics are made from, so why not recycle plastic milk jugs? Peter reminds Will and Mae that plastic milk jugs can be remolded into a variety of products like carpet and rope fibers, plastic lumber and shingles and highway markers.  

Scene III  
Will and Mae are happy at last. They no longer have piles of trash. Once the trash was cleaned up, they began to see lots of ways to reduce the amount of trash they make. Mae decides to start buying in bulk and looking for items with less packaging and recyclable packaging.  

They are joined on stage by Patty, Jill, Peter and Al. They are now all happy that Patty, Jill, Peter and Al are useful and valuable, and no longer just trash. They have made their world and ours a better place.  

Mae and Will tell the kids about the local recycling options (or the need to take action to start recycling locally) and ask them to get their parents involved for the sake of Patty, Jill, Peter and Al. Will and Mae remind everyone that we can all start reducing trash today!  

(After the play, have the players discuss with the audience the concepts of waste reduction and recycling presented in the play. You may also want to open the floor for questions when presenting the play to younger audiences.)
The Economics of Recycling

**Grade:** 9 – 12  
**Focus:** Recycling markets  
**Subjects:** Social Studies, Economics, Environmental Science  
**Materials:** Copy of the South Carolina Recycling Markets Guide, call 1-800-SO USE IT to obtain a free copy  
**Teaching Time:** One class period, plus research  
**Vocabulary:** Recycled materials, the Center for Waste Minimization, Office of Solid Waste Reduction and Recycling, Recycling Market Development Advisory Council, cradle-to-cradle

Learning Objective  
Students will:  
- research South Carolina’s recycling markets  
- consider ways to encourage recycling markets  
- examine the economics of recycling from a business point of view.

Background  
It’s easy to say that everyone should be recycling. After all, recycling saves valuable resources and energy.  

Beyond educating the public to the advantages of recycling at home, a critical component of recycling is finding markets for the collected materials. These markets are companies that are willing to buy the materials and reprocess them into new products.  

Some people think that the government should encourage recycling through policies that offer incentives such as tax advantages to companies that use recycled materials, materials collected to be reprocessed and used again to make new products, instead of virgin materials in their manufacturing processes. Others think the government should leave finding markets for recycled goods to the normal business channels of supply and demand. The following quotes demonstrate different view points when it comes to recycling policies.

"An inventory of the world’s discards would reveal metals more valuable than the richest ores, paper representing millions of hectares of forests and plastics incorporating highly refined petrochemicals. That these products rich in raw materials and concentrated energy are frequently considered worthless is indicative of a distorted economic system. We are literally throwing away our future.”  
- These words, written in 1987 by Cynthia Pollock-Shea, reflect many people’s views on the importance of recycling.

"We do not buy scrap out of altruism or patriotism. Neither do we buy it just because it saves energy or is good for the environment. It’s nice if those benefits follow along but we don’t have much patience with those who not only advocate, but would legislate, putting the cart before the horse.”  
- A steel company executive made these comments in 1981 reflecting the bottom-line economics of recycling at the time.

The Japanese recycle about 45 percent of their used paper.  
*Source: EarthCare Paper Company*  

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**The Economics of Recycling**

**Preparation Time:** Easy-To-Do  
**Moderate**  
**Extensive**
According to *State Recycling Laws Update* newsletter (Feb. 1993), 39 states now have some sort of comprehensive recycling law that requires local governments to plan and reduce what's going into landfills and incinerators. Now the issue turns to "where are we going to sell all these segregated materials?" States have done a good job of mandating collection, but the markets have not magically appeared. Government and environmentalists claim the problem is that manufacturers have not moved to use recycled materials in their packaging and products. California, Oregon and Wisconsin have mandates that require recycled content in packaging in rigid plastic containers although enforcement is nearly impossible.

Curbside recycling is popular — there are now more than 6,500 programs in the United States. Unfortunately, communities are not businesses and may not select the materials designated for pick-up and recycling based on local or regional markets. Materials are often selected based on a list mandated by the state or are those that local politicians think are most problematic or those that seem to have a high "weight" in landfills. In this country, business or commercial recyclers have few mandates, even though the economics are better.

While more and more businesses are looking at their waste streams and examining what they throw away, economics spurred by consumers dictate what they end up diverting from landfills.

The President’s Council on Sustainable Development’s Eco-Efficiency Task Force has begun using the phrase cradle-to-cradle to describe eco-efficient manufacturing. Cradle-to-cradle suggests that manufacturing is not a linear process but a circular one. In other words, manufacturing waste from one process should be used to provide raw materials for the next production activity. The products of eco-efficient manufacturing, once used, should be able to be disassembled or reassembled to become useful again. Eco-efficient manufacturing is a closed-loop, sustainable system ... much like nature itself.


The South Carolina Solid Waste Policy and Management Act of 1991 encourages recycling and buying recycled products. It states that South Carolina's goal is to reduce solid waste going to our landfills and incinerators by 30 percent and to recycle 25 percent of our waste. As of 1997, nine counties have reached that goal. They are: Charleston, Cherokee, Darlington, Lancaster, Laurens, Marlboro, Oconee, Pickens and Union counties.

The South Carolina Department of Health and Environmental Control (DHEC) works to help communities find markets for recycled materials and helps companies connect with local supplies of recycled materials through the Center of Waste Minimization. The Recycling Market Development Advisory Council, housed at the South Carolina Department of Commerce, is a clearing house for matching industries with waste that can be recycled to industries looking for sources of materials to be recycled. DHEC also provides information on markets for recyclable materials through its Office of Solid Waste Reduction and Recycling. To receive more information, you can contact DHEC’s Office of Solid Waste Reduction and Recycling at 1-800-SO-USE-IT. (NOTE: *Action for a cleaner tomorrow: A South Carolina Environmental Curriculum* is printed on a recycled stock. DHEC has a variety of items made from recycled materials, such as pencils and rulers, available for teachers.)

An annual guide to recycling markets and waste exchanges, *South Carolina Recycles Market Directory*, is printed and distributed statewide. The document lists markets for tires, lead-acid batteries, white goods (appliances), plastics, scrap metals, glass, paper, laser toner cartridges, textiles, pallets, drums, construction waste, photographic recovery, cooking oil, oil filters, oil absorbents, used oil and many others. For a copy, call DHEC at 1-800-SO-USE-IT.
The Chicago Board of Trade (www.cbot.com) is the world's largest futures and options exchange. In addition to oil, silver, soy bean, hog and pork belly futures, the CBOT also features environmental trades, including recyclables.

The CBOT Recyclables Exchange is dedicated to the trade of recyclable goods and is open to all Registered Users worldwide. Its goal is to allow easy and immediate contact between buyers and sellers of recyclable commodities, active on the market at any given time.

The sellers are the businesses that have recyclables they want to offer for sale. They post Sell Listings on the Exchange by filling out a simple online form and then wait for a perspective buyer to contact them. For the sellers it works exactly like putting a classified ad in a newspaper.

The buyers are the businesses that are looking for recyclables they want to purchase. They enter their Buy Parameters into the Exchange by filling out a simple online form. The Buy Parameters are nothing more than the description of what they are looking for. Then they wait for the Exchange to send them, by e-mail, a copy of any Sell Listing which carries what they are looking for as soon as it is posted on the Exchange by a Seller.

Buyers do not need to access the CBOT on a regular basis to scan the new Sell Listings in order to find what they are looking for: the system does it for them.

Just like any commodity, recyclable market pressures ... supply and demand ... drive the prices of these products up or down; and for the most part, these products are items no longer needed, wanted or useable by their owners.

Market prices for these commodities ... newspaper, Number 1 PET plastic, glass, corrugated paper, Number 2 HDPE plastic, aluminum, steel, items commonly found in home recycling bins all across South Carolina and the country ... fluctuate by manufacturing needs, legislative changes and the amount of material that is being fed into the systems by county and state recycling programs. In other words, if you recycle at home, you increase the supply of recyclable material in the market. If the supply is high and demand is low, prices will drop. If demand is high and supply is low, prices will climb. Sometimes there is even a steady state where supply equals demand and prices stabilize.

In 1997, according to a report in the March 1998 edition of Waste Age magazine, prices were, as you might predict, all over the place. For example:
- Prices for most paper grades started low (in 1997) but edged higher, with old newspaper getting $26 per ton by November
- Prices for corrugated (cardboard) grew strong in the summer, but slipped to $6.70 by December
- Prices for PET plastic rebounded in the latter half of the year, with prices for PET bales of bottles (primarily soda bottles) reaching 14 cents per pound, according to one end user
- HDPE (primarily milk jugs) continued its downward slide into the new year
- Aluminum and steel can end-user prices climbed steadily
- Glass prices continued their steady downward slide.

Learning Procedure
1. Ask: Why isn't everyone recycling? Discuss the merits of recycling (saves energy, saves resources, saves landfill space, reduces pollution, etc.).

Ask: What is the difference between industrial recycling and household recycling? (Industrial recycling takes place at the manufacturing site, recycling scrap materials and waste and using recycled materials in the manufacturing process instead of virgin materials. Household recycling is the pick-up or drop-off of household materials for recycling.)
Ask: if recycling offers all these benefits, why is it sometimes said that recycling is not economically feasible? (Some companies are not set up to use recycled materials and to do so would require expensive changes in manufacturing processes. In some cases, costs associated with handling and transporting recycled materials are cost prohibitive, raw materials are readily available for very low costs, some companies do not think that consumers are willing to accept higher prices for products that have recycled content, etc.)

2. Divide students into small groups and assign each group a recyclable material to research. Have students report on the South Carolina markets for the recyclables.

For a more lengthy research project, have students investigate prices for the recyclables, where the materials are taken for reprocessing and what the materials become. Students may want to write to several of the companies that use recycled materials instead of virgin materials to find out their reasons for doing so. This activity will take some time. Have students plan their research and schedule phone calls and letters to companies well in advance.

3. Tell the class that some people believe that the government should be involved in recycling and should make a National Recycling Policy that helps recycled materials compete. Ask: What do you think the government should do to help recycling? How should these projects be handled and funded?

Questions for the Class
1. Why is it important to know the markets available for a recyclable before you begin collection?

2. What is the difference between industrial recycling and household recycling?

Extension Activities
1. Have the class contact the National Recycling Coalition, (202) 625-6406, for their brochure promoting a national recycling policy. Conduct a poll of your class/school to determine if students favor governmental regulation of recycling. Let your representative know the results.

2. Have the class review South Carolina’s Solid Waste Management Plan and report on the state’s strategies for recycling. Invite a speaker from the Office of Solid Waste Reduction and Recycling or the Recycling Market Development Council to discuss the plan with the class and to answer questions. For a copy of the plan, write to: Department of Health and Environmental Control, Office of Solid Waste Reduction and Recycling, 2600 Bull Street, Columbia, South Carolina 29201.

3. Have students investigate other states’ recycling and environmental legislation and compare it to what’s being done in South Carolina.

4. If any of the companies listed in the South Carolina Recycles Market Directory are in your area, invite a speaker to visit your class to discuss operations or, if possible, schedule a field trip.

Just Do It

When you shop, look for products made with recycled content. Recycling doesn’t work unless we remember to "buy recycled" and close the loop.
Learning Objective
Students will:
  • interview parents, grandparents or other adults regarding their past lifestyles
  • compare the waste management impacts of past and present lifestyles.

Background
In the past 30 years, South Carolina’s population has grown from about 2.4 million (1960) to about 3.7 million in 1998. By the year 2010, South Carolina’s population is projected to be about 4.5 million.

While South Carolina is still considered a rural state, population growth is an important factor in the state’s solid waste management planning.

While the number of people living in this state is increasing, so is the amount of household or municipal solid waste that each person creates. In 1960, each person’s share of South Carolina’s municipal solid waste was 2.66 pounds per person per day. By 1990, this had grown to about 4.5 pounds per person per day, according to figures from the United States Environmental Protection Agency. National numbers from the U.S. EPA were all that were available since, prior to the state’s Solid Waste Policy and Management Act of 1991, there were no requirements to measure the amount of trash going to our municipal solid waste landfills. In 1997, South Carolina quantified its waste and figures and showed that, as an average, each person is responsible for generating 4.8 pounds of household garbage per day.

In addition to changes in the amount of solid waste generated in South Carolina and in the United States during the past 30 years, changes in technology, lifestyles and the economy have resulted in changes in the composition of the nation’s solid waste.

Today, we are accustomed to consuming or buying and using, as much as we want and can afford as well as disposing of old items whenever we want new ones without considering the consequences of our actions. This “throwaway lifestyle” coupled with our growing population potentially threatens our environmental quality.

The average American uses nearly 12 pounds of HDPE (#2 plastic) bottles and containers in one year. This type of plastic makes up about 21 percent of the plastic in the municipal solid waste stream, although HDPE plastic is recyclable in many communities.

Source: Waste Age magazine

DOWN TO EARTH

The average American uses nearly 12 pounds of HDPE (#2 plastic) bottles and containers in one year. This type of plastic makes up about 21 percent of the plastic in the municipal solid waste stream, although HDPE plastic is recyclable in many communities.

Source: Waste Age magazine
Learning Procedure
1. Ask students to imagine themselves as reporters investigating how times have changed since their parents or grandparents were children. Read the following paragraphs to students:

"Toys have changed through the years. At one time, most toys were made of natural materials like wood. Then they were made of papier-mache or were handmade country toys like whirligigs, bean shooters, yo-yos, jacks and tops. Over time, commercially manufactured toys became available, like wooden Lincoln Logs and Tinker Toys and metal Erector Sets. Then plastic toys came on the market with Frisbees, Hula-Hoops and plastic models. Now, battery-operated and electronic toys, pinball games, video games and computers are popular."

2. Ask students to respond to the following questions and encourage them to think of how their parents or grandparents might respond to the same questions.

• What were your favorite toys when you were a child? How many toys did you have?
• Of what were your toys made? Who made them?
• How long did your toys last? Could they be fixed if they broke?
• Would it have been cheaper to fix the toy or get a new one? Why? Could you fix a broken toy at home or did you take it somewhere else to be fixed?
• If broken toys could not be repaired, what did you do with them?
• How are toys sold today different from those you had when you were little?

3. Distribute copies of the Sayings and Slogans interview sheet. Review and discuss the sayings and what they mean. What other sayings come to mind?

4. As a homework assignment, instruct students to interview a parent, grandparent or other adult following the questions outlined on the sheet. (Students may use a tape recorder to record interviews. Remind students that they must ask and have the permission of the person being interviewed before a tape recorder can be used.)

5. After interviews have been completed, have students share their results with the class. Discuss the terms "throwaway lifestyle" and "environmental quality" and conduct a classroom discussion addressing the following questions:

• How have lifestyles changed in the past 30 - 50 years?
• How have these lifestyle changes affected environmental quality?
• How can we change our present lifestyle to improve environmental quality?

Extension Activity
Have students research the term "planned obsolescence." What does it mean? (Planned obsolescence is when a product is intended to last a certain period of time and then be discarded. For example, many small household appliances have short product life expectancies.)

Just Do It
Sure, our lifestyles and buying habits have changed, but you can continue to change! Talk to your family about what you buy and teach everyone in your family to buy with the environment in mind.
Part One
Sayings and slogans tell us a lot about the time in which we live. In the past, sayings like these mirrored the buying habits of the times:

“A stitch in time saves nine.”
“Waste not, want not.”
“An ounce of prevention is worth a pound of cure.”
“Built to last a lifetime.”

Today, we are more likely to hear:
“Quick and easy to use.”
“No mess, no bother.”
“Disposable.”
“Individually wrapped for your convenience.”
“They sure don’t make ‘em like they used to.”

Part Two
Interview Questions:

1. What other old sayings can you think of besides the ones here? What do the sayings mean?

2. What qualities in products did people appreciate when you were growing up? Has that changed over time? How?

3. Did people take better care of their belongings when you were growing up than they do now? Why?

4. How many pants, dresses or pairs of shoes did you have?

5. When clothes wore thin or tore, were they repaired or were new ones purchased?

6. What did you do with old clothes? What did you do with old toys?

7. Can you show or describe a family heirloom and tell me the qualities that make it so special?

8. Do you think we are more wasteful today? In what ways? Why?

9. What types of things did you throw out in the trash when you were growing up? Were they similar to what we throw out today?

10. What containers did you use for trash? What did you do with the trash?

11. Did you have as much trash to throw away then as you do now? Why?
For more information about South Carolina and the environment, call the South Carolina Department of Health and Environmental Control at 1-800-SO-USE-IT or visit our web site at www.state.sc.us/dhec.
What It Really Costs

Preparation Time: Easy-To-Do
Moderate

Focus: How the generation of waste materials may often be attributed to lack of insight of life cycle cost

Subjects: Environmental Science, Physical Science, Math (basic)

Materials: Life Cycle Cost handout, Energy Rating Sheets from various appliances

Teaching Time: One class period

Vocabulary: Life cycle cost, kilowatt-hour

Learning Objective

Students will:
• determine the total cost of an item over its lifetime of expected use.

In this activity, students will calculate the comparative costs of size AA batteries that are commonly used in items in the household. Students will then compare the actual lifetime costs versus the initial costs to compare the “best” buy. Students will relate this result to the savings in materials, energy and landfill space.

Background

The idea behind life cycle cost is to calculate the entire cost of an item by using the initial cost, expected lifetime and cost of energy used during the item’s life-span. This is a concept not often understood by the public and not used in determining the overall cost of an item. For example, what is the “best buy”? Just the item that costs less to buy at the cash register or the item that costs less in the long run? All these factors, including costs of production, natural resources and disposal costs are important when also looking at the impact upon the environment.

Learning Procedures

1. To help students understand the concept of “life cycle cost” have them complete the handout included with this lesson. The worksheet leads students through the process of calculating this value.

Costs for the items would include: cost of energy used, length of service life, initial cost of item to the consumer (the student).

Students may discover that the “best buy” is usually the best buy over time and that a product that is inexpensive to purchase often becomes the most expensive in the long term.

Also students will find that, though life cycle cost analysis, they can have an impact on the amount of rataerials used and discarded. An item that lasts longer may be more expensive initially, but is less expensive over the lifetime of the item. Buying less items means fewer materials in the waste stream. In many cases, such as batteries, there are also fewer items in the toxic waste stream.

DOWN TO EARTH

A new robotic, solar-powered mower may be the answer to the U.S. EPA's announcement that all new, small, gas-powered engines will have to meet emission regulations after 1996. The initial cost, $1,995, of a solar-powered mower may send people looking for old-fashioned push mowers instead.

Source: Environment Magazine

PAGE 69
2. Use the appliance efficiency sheets (or permit students to visit an appliance store) and compare the energy efficiency labels on "white goods" appliances to discover the lifetime costs of: stoves, refrigerators, freezers, dryers, etc.

3. Have students consider their criteria for purchasing a car. How about a car’s costs over time. Have students select a car they’d like to have and find out the initial cost of the car, fuel efficiency or miles per gallon and anticipated cost of gasoline required to drive the vehicle during its life expectancy. (You may set these for the class. The average car is driven about 10,000 miles per year. Most cars will last at least 10 years.) Have students share their results with the class.

$ \text{price of car initially} \\
\text{average miles per gallon} \\
x 10,000 \text{ miles per year} \times \text{life expectancy or 10 years} \\
\text{Remind students that this does not take into account the costs of repairs or how proper maintenance can extend the life of a car. It does give an idea of how energy consumption can effect the overall cost of an item.}

Questions for the Class
1. What factors must be considered when calculating life cycle costs?

2. You are comparing two electric ranges to purchase. Range A costs $624 and uses 40 kilowatthours (KWH) per month. Range B costs $407 and uses 69 KWH per month. Calculate the life cycle costs for each and determine the best buy. You can consult your electric bill or contact your local power company to learn the cost per KWH in your area. (Or use the national average electric rate of $0.0825 per kilowatthour.)

3. Refrigerator A costs $919 and uses 587 KWH per month. Refrigerator B costs $1,700 and uses 152 KWH per month. Calculate lifetime costs for both appliances and determine the best buy.

4. Electric water heater A costs $198 and uses 3,240 KWH per month to operate. It has a service life of 15 years. Electric water heater B costs $577 and uses 1,200 KWH per month. It has a service life of 15 years. Calculate lifetime costs and determine the best buy.

Just Do It

Next time you are making a purchase, consider life cycle costs. Be sure you are getting the best value for your money.
### Life Cycle Cost

**Example**

**Disposable versus Rechargeable Batteries**

Service Life for the following:

- **AA Alkaline**
- **Rechargeable**
- **Disposables**

<table>
<thead>
<tr>
<th>Battery Type</th>
<th>Service Life</th>
<th>Original Cost</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rechargeable</td>
<td>4 hrs. per charge - service life worth up to 1,000 charges = 4,000 hrs.</td>
<td>$5.95</td>
<td>$13.95 divided by 4,000 hrs. = $0.005/hr (Plus nominal electric power)</td>
</tr>
<tr>
<td>Disposables</td>
<td>9 hrs. service life</td>
<td>$1.40</td>
<td>$1.40 divided by 9 = $0.16/hr</td>
</tr>
</tbody>
</table>

**Type:**

- **A**
- **B**

### Energy Technology Life Cycle Costing

Service life for the following appliances:

- **Freezer** 20 year service life
- **Refrigerator** 15 year service life
- **Gas Range** 13 year service life
- **Electric Range** 12 year service life
- **Dishwasher** 11 year service life
- **Clothes Washer** 11 year service life
- **Electric Dryer** 14 year service life
- **Gas Dryer** 13 year service life

**Use the EnergyGuide for the dishwasher to answer the following questions:**

1. Why is there one estimate for yearly energy costs for $58 and another one for $35?

2. What was the cost per kilowatthour and about how many loads of dishes per week was used to obtain the estimate of $58?

Do you think the estimate for $58 is too low or too high? Explain your answer.

3. Using the chart at the bottom of the EnergyGuide, determine how much the yearly energy cost would be if you washed 6 loads of dishes per week and used an electric water heater. (Use approximate cost/kilowatthour for our area.)

**Use the EnergyGuide for the clothes washer to answer the following:**

4. What is the difference in the average estimated yearly costs of using electricity vs. gas?

5. What is the estimated yearly cost of the electric washer with the lowest energy cost?

What is the estimated yearly cost of the electric washer with the highest energy cost?

6. Using the chart at the bottom of the EnergyGuide, about how much would an electric washer cost per year if you wash 4 loads of clothes each week?
### Sample Energy Rating Sheet

**Clothes Washer**

<table>
<thead>
<tr>
<th>Capacity: Standard</th>
<th>Whirlpool Corporation</th>
<th>Models: 4484/40/38</th>
</tr>
</thead>
</table>

**Estimates on the scale are based on a national average electric rate of 8.3¢ per kilowatt hour and a natural gas rate of 6.05¢ per therm.**

**Energy Guide**

#### Electric Water Heater

- **Model with lowest energy cost**: $72
- **Model with highest energy cost**: $150

**Gas Water Heater**

- **Model with lowest energy cost**: $21
- **Model with highest energy cost**: $55

#### Estimated yearly energy cost

Your cost will vary depending on your local energy rate and how you use the product.

**How much will this model cost you to run yearly?**

<table>
<thead>
<tr>
<th>Loads of clothes</th>
<th>Electric water heater Cost per year</th>
<th>Gas water heater Cost per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>$22</td>
<td>$21</td>
</tr>
<tr>
<td>4</td>
<td>$44</td>
<td>$42</td>
</tr>
<tr>
<td>6</td>
<td>$66</td>
<td>$64</td>
</tr>
<tr>
<td>8</td>
<td>$88</td>
<td>$87</td>
</tr>
</tbody>
</table>

**Whirlpool Corporation**

**Models**

**ONLY STANDARD SIZI WASHERS ARE USED**

**Dishwasher**

|--------------------|-----------------------|----------------|

**Estimates on the scale are based on a national average electric rate of 8.3¢ per kilowatt hour and a natural gas rate of 6.05¢ per therm.**

**Energy Guide**

#### Electric Water Heater

- **Model with lowest energy cost**: $58
- **Model with highest energy cost**: $89

**Gas Water Heater**

- **Model with lowest energy cost**: $35
- **Model with highest energy cost**: $47

#### Estimated yearly energy cost

Your cost will vary depending on your local energy rate and how you use the product.

**How much will this model cost you to run yearly?**

<table>
<thead>
<tr>
<th>Loads of dishes per week</th>
<th>Electric water heater Cost per year</th>
<th>Gas water heater Cost per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>$39</td>
<td>$21</td>
</tr>
<tr>
<td>4</td>
<td>$78</td>
<td>$42</td>
</tr>
<tr>
<td>6</td>
<td>$117</td>
<td>$64</td>
</tr>
<tr>
<td>8</td>
<td>$156</td>
<td>$87</td>
</tr>
</tbody>
</table>

**Whirlpool Corporation**

**Models**

**ONLY STANDARD SIZE DISHWASHERS ARE USED**
Thermodynamics, Litter & Resource Recovery

**Preparation Time:** Easy-To-Do
**Moderate**
**Extensive**

<table>
<thead>
<tr>
<th>Grade: 10 – 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus: Resource recovery, litter, source separation</td>
</tr>
<tr>
<td>Subjects: Physical Science, Physics, Math</td>
</tr>
<tr>
<td>Materials: Deck of cards, food coloring and bowl of water, golf or ping pong balls, sheets of paper cut into pieces with plastic coding symbols drawn on them, colored beads</td>
</tr>
<tr>
<td>Teaching Time: Two class periods</td>
</tr>
<tr>
<td>Vocabulary: Thermodynamics, entropy</td>
</tr>
</tbody>
</table>

**Learning Objective**
Students will:
- become familiar with the Second Law of Thermodynamics, which states that any system and its surroundings tend spontaneously toward a state of increasing disorder; in other words, entropy.
- see a littered school ground and garbage that has been dumped together as disordered systems.
- understand that some resource recovery processes are energy and time-intensive methods of trying to bring order to this system.

**Background**
As much as 49 percent of litter materials are made from recyclable items and it costs about one dollar per pound to pick up litter.

The Second Law of Thermodynamics states: Without a constant input of energy, all systems and their surroundings tend toward disorder. A discussion of littering, landfills and resource recovery can graphically illustrate this law.

**Learning Procedure**
Ask if anyone in the class knows the definition of the term thermodynamics. Explain that thermodynamics is the physics of the relationships (dynamics) between heat (thermo) and other forms of energy. Demonstrate for the class or have students participate in teams in demonstrating these exercises.

1. Starting with a deck of cards ordered by suit, shuffle the cards. Observe. Then shuffle again. How long will you have to shuffle until the cards are in order again?

2. Drop some food coloring into a bowl of water. Describe what happens to the food coloring and discuss what would be necessary to reconcentrate the food coloring.

3. Scatter golf or ping pong balls from an ordered position. How much energy does it take to reorder the system?

4. (Before class begins, take about 20 pieces of paper [or index cards] and on each piece draw one of the plastic coding symbols, number one through seven. These pieces of paper represent the various types of plastic we use and then recycle, reuse or throw away.) Stack these pieces by code on your desk. There should be several of each type. Push the pieces of paper off your desk. Using time as a measurement, compare the amount of energy it takes to reorder the system so that the number one and number two plastics can be recycled without contamination from the other types.

**Down To Earth**
The United States – and South Carolina – have a recycling goal of 25 percent. California and some other states are creating special enterprise zones that provide tax breaks and other incentives to new firms handling a recycled material.

Source: 1994 Environmental Almanac
5. Use beads of various colors to represent natural resources – aluminum, tin, petroleum (plastics), wood – that commonly end up as solid waste. Put each color group in a different cup. Dump beads from separate cups together to represent mixed garbage; then, using time as a measure, compare the amount of energy needed to separate the beads and reorder the system. Have students make a chart to compare how long it takes to mix up the items versus how long it takes to reorder them.

6. Go outside and observe areas of your school that are badly littered. Discuss:

- Whether it takes more energy to dispose of litter properly in the first place or to reorder the system, (i.e., have custodians pick it up). The people who have to spend their time picking up the litter could be using their time and energy more constructively.

- Whether the amount of litter is acceptable or not and why it is there. Ask: What are some of the possible solutions to help with the problems of school litter?

7. When it comes to solid waste, discuss why a landfill is a good example of a disordered system. Ask: Before the garbage ends up in the landfill, how could this “system” be reordered? (limit consumption, source separate and recycle) Ask: Why are attempts to reorder the system after the garbage is mixed together (i.e., some resource recovery processes attempt to sort the garbage after it has been collected, this is called commingled recycling) much more energy-intensive and expensive than source separation? Can you think of situations where commingled recycling might be effective? (Where there is a source of very inexpensive labor to do the sorting, such as prison labor)

8. Create a step-by-step system for solid waste disposal from generation to final disposal that is more efficient than the current system. Outline the energy-saving components of your system.

Extension Activity
Research and discuss the net energy inputs and outputs of various energy sources: natural gas, gasoline, ethanol, methanol, electric batteries, hydroelectricity, solar power and wind power.

For example, how much energy does it take to harvest the raw material and refine it into a useful energy source versus how much of this energy could be converted into other energy sources? What are the net energy inputs into collecting raw crude oil and refining it into gasoline versus the net energy output of gasoline in terms of converting the stored energy of gasoline into the mechanical energy of making a car move?

Just Do It
Find out how recycling works in your area. Are materials separated or commingled?
If materials are separated, what can you do to help educate people about the importance of careful source separation?
Generating Methane from Waste

Grade: 11 – 12
Focus: Recovering energy from waste
Subjects: Environmental Science, Chemistry
Materials: See list of materials itemized below
Teaching Time: One class to set up the experiment, time for generating gas will depend upon procedure used
Vocabulary: organic waste, methane, slurry, anaerobic, pyrolysis, methane digester

Note: This experiment may be used as a demonstration during the study of decomposition and composting. Generating gas may take several days.

Learning Objective
Students will:
• understand the energy-producing potential of some solid wastes
• examine some systems of generating methane from waste
• construct a model methane generator.

Background
Methane gas is created naturally as a waste product of anaerobic bacteria living in water-logged soils and wetlands and also in human-produced environments such as rice paddies and landfills. The digestive system of animals such as cattle and sheep contain these bacteria and produce methane gas. A single cow belches out 100 cubic feet of methane each day. The microbes in the guts of termites, which digest wood, also produce methane. Methane is produced for fuel in some parts of the world and burned in methane digesters. Methane gas is a greenhouse gas and contributes to global warming. About 12 percent of global warming is attributed to increases in methane in the environment.

The top ten sources of methane in our atmosphere:
1. wetlands 20.2%
2. rice fields 19.4%
3. cud-chewing animals 14.0%
4. biomass fires such as burning forests 9.7%
5. oil & natural gas pipeline leaks 7.9%
6. termites 7.0%
7. coal mining 6.2%
8. landfills 6.2%
9. animal wastes 5.0%
10. sewage 4.4%
(Source: Environmental Literacy, the A to Z Guide)

In China and India, there are millions of mini-power plants that use methane gas.
Source: Environmental Literacy, the A to Z Guide
Once buried, organic wastes decompose anaerobically, which means that they decompose without oxygen. Pyrolysis is the chemical change as a result of an increase in temperature that produces heat. Carbon dioxide, methane, ammonia and hydrogen sulfide gases are all produced as microorganisms break down waste. Note this distinction. This lesson deals with organic wastes. Inorganic wastes may decompose eventually, if given enough oxygen, light and time. However, they do not decompose in a landfill where they are sealed off from oxygen and light.

Trapped beneath the landfill surface, the gas byproducts of organic waste decomposition become potential health and safety threats if not properly vented. To avoid explosions or lateral migration of methane beneath the surface of the landfill, vents are installed to reduce pressure build-up of the gases.

Methane is the largest component of natural gas. If the landfill volume is great enough (at least one million tons), the methane produced can be captured, purified by removing carbon dioxide and water and sold to gas utility suppliers. Capturing methane from landfills may not turn a profit, but it can help to defray the landfill’s operating costs. There are many methane recovery systems operating or under construction in the United States and a great many more landfills large enough to handle a methane recovery system.

According to an article in Waste Age magazine, “The Clean Air Act,” November 1993, the United States EPA has proposed new performance standards for new municipal solid waste landfills and emission guidelines for existing facilities under Section 111(b) of the Clean Air Act. This was in response to EPA’s findings that municipal solid waste landfills can be a major source of air pollution that contribute to ozone problems, air toxics concerns, global warming and potential explosion hazards.

The EPA conducted a study of landfills to determine the methane generation rate constant and the potential methane generation capacity of the refuse. Based on this data and other assumptions, EPA estimated that the baseline (1987) emissions from the 7,124 existing landfills in the U.S. was 15 million mg/yr of methane and 300,000 mg/yr of other non-organic compounds that occur in landfill gas including trichlorofluoromethane, trichloroethylene, benzene, vinyl chloride, toluene and perchloroethylene. These predictions do not include emissions from the some 32,000 landfills closed prior to 1987.

Because of emissions concerns, EPA is considering the regulation of “municipal landfill gas emissions” in total.

Materials
- safety glasses
- fume hood (if using heat source)
- three Erlenmeyer flasks (one 500 ml, two 125 ml)
- a lubricant such as petroleum jelly
- organic slurry of manure or ground grass clippings, etc. (from a compost pile)
- balloon (blow it up several times to stretch it out, this makes it easier to inflate)
- three rubber stoppers (these may be pre-drilled)
- one foot of glass tubing
- 3 feet of surgical tubing (or any flexible, large diameter tubing that can be attached to glass tubing)
- the nozzle from a medicine dropper
- one pinch clamp
- a drill to bore a hole in rubber stopper (you may have pre-drilled stoppers)

Learning Procedure
1. Review with the class the background material included with this lesson. Explain to students that they are going to create a methane generator.

2. Refer to the illustration to help with setting up the methane generation/collection apparatus. Wear safety goggles. This experiment must be properly constructed. Your system must be well-sealed. Any leaks will result in a lack of gas pressure. (You will
want to practice this experiment and have students assist you in demonstrating the experiment for the class, if enough equipment is available, you may have students set up several stations.)

3. Wear safety goggles while setting up and conducting this experiment. Bore two holes in each rubber stopper or use a stopper with two holes already in place.

4. Run a tube from the flask representing the landfill to a gas storage container. (NOTE: Make sure all connections are tight. Use petroleum jelly or Amogel on stopper holes. Keep tubing to a minimum. Use large diameter tubing.) The storage container's stopper should have two holes, one for the tube coming from the landfill flask (the large flask) and one for a nozzle and clamp — this is your flare.

5. Run a tube from the large flask representing the landfill flask to the third flask. This is the pressure relief system. Attach a second tube to the third flask and connect a balloon that's been blown up several times. Make sure the tube from the landfill flask extends down into water (see illustration, fill your gas collecting flask to near capacity with water). This arrangement will prevent an excess of gas from feeding back into the landfill flask.

6. Fill the large flask about three-fourths full with an organic slurry (i.e. manure and ground grass clippings, etc. mixed with water until a thick, but pourable, consistency is reached). This flask will represent the landfill. Keep it warm. In the classroom, keep it away from any air conditioning. Warmth from a sunny window will help. You may keep this set up under a fume hood.

7. It will take days, maybe even weeks before gas is produced. Keeping the slurry warm speeds production. As gas is produced, the balloon is inflated.

Optional Procedure to Speed Up Gas Production
1. Set up as before only without the second flask, which involved the flare.

2. Let the slurry (compost and manure) set overnight and then apply continuous heat and stirring. (Use a hot plate set on about 3 or 4.) This should produce gas in about 20 minutes. You should see the balloon inflate.

Questions for the Class
1. What is methane?
2. How is it produced?
3. List materials that can be used to generate methane.
4. Describe another means of using solid waste to produce fuel.

Extension Activities
1. Have students research the historical uses of methane gas digesters. For example, in Holland a tarp was placed over a portion of a swamp with a hose running from under the tarp to the house for light and heat.

2. Have students work in teams to build four or five of these three-flask methane generation/capture apparatuses. Have students test different organic wastes. Which produces the most gas the fastest? Which waste produces the best fuel?

3. Research modern methane technology.

4. Study resource recovery technology to learn how industrial fuel is created from solid waste by pyrolysis.
Methane Digester Model
Spreading the Word About Sludge

Learning Objective
Students will:

- determine the benefits and drawbacks of land application of sewage sludge
- gather information on quantities and methods of sludge disposal in their communities.

Background
- excerpted from an article entitled “Sludge,” by David Tenebaum in the Oct./Nov. ’92 issue of Garbage magazine.

One large component of the waste we produce daily is our bodily waste. Because of modern plumbing and septic systems, we are able to flush away and forget this waste. However, each time we flush a toilet, we typically send about five gallons of clean water, as well as matter full of minerals and nutrients, down the drain. Both water and rich organic matter are wasted.

Of the 25 billion gallons of sewage sludge produced daily in the U.S., 15 percent goes into the ocean, 35 percent is burned, 25 percent is buried and the remaining 25 percent is composted. Many South Carolina residences use household septic tanks – leach field systems, to treat their septic wastes. Other on-site treatment includes dry wells, outhouses and composting toilets.

The remaining households in South Carolina make use of one of the 262 municipal and 1,056 non-municipal sewage treatment plants and 67 drinking water treatment plants. Various industrial activities such as papermaking also generate sludge requiring treatment and disposal.

Sewage can be processed and used as soil conditioner, an option more communities are investigating in order to save disposal costs.

Sewage sludge is dewatered and composted to produce soil conditioner or fill. Once sterilized, the material can be used as fill in landfills or spread on fields. Treated sludge is mainly used as a food for feed crops and ornamentals, not for feeding the crops that feed people.

Spreading sludge on land maximizes its soil-enriching value.

Septic sludge is an entirely different issue from sewage sludge. Septic sludge, that is sludge from septic tanks, contains pathogenic (disease-causing) bacteria, viruses and other microorganisms from human wastes. Soil conditioners made from septic wastes fed with commercial industrial waste are often contaminated with heavy metals such as cadmium, mercury, as well as pesticides. There is differing opinion as to whether sludge and/or compost from this kind of sludge poses a health threat.
[NOTE: According to South Carolina's Department of Health and Environmental Control, waste water-treated sludge should not contain pathogens. For the purposes of this lesson, this article discusses the benefits of sewage sludge.]

Treated or composted sludge can be packaged and sold as organic fertilizer. Products made in this way include Nu-Earth from Chicago, Milorganite from Milwaukee, ORGRO from Schenectady and Metroloam from Boston.

[In South Carolina, the Department of Health and Environmental Control regulates which plants can receive sludge.]

According to Garbage magazine, "Sludge," October/November 1992, treated sludge is benign smelling, and is quietly becoming a big recycling success story.

By putting sewage sludge on farm fields, we're closing a major resource loop – from farm crop to food to sewage to sludge to fertilizer back to farm crops.

As recently as 1982, 75 percent of this waste was buried in landfills, abandoned in giant lagoons, dumped in the ocean or incinerated.

Recycling has been pushed by the need to do something with the 6.1 million dry tons of sewage sludge produced by the United States each year.

Today, most of our recycled sludge – 42 percent of total production – is applied to farms. forests and degraded land. Another 5.8 percent is bagged and sold or given to landscapers, highway departments and consumers.

When you compare sludge's 48 percent recycling rate to the 13.3 percent of household solid waste that's recycled, and when you consider that some solid waste "recycling" is just junk material awaiting a market, you can see why some consider sludge one of this country's premier recycling successes.

But, half of the nation's sludge still gets dumped. With the right processing, this waste can be diverted from landfills and recycled into farm fields.

Slogging into Sludge

Sludge, a residue of the solid portion of municipal wastewater, is produced at a sewage-treatment plant. Like most such plants, the one in Madison, Wisconsin, is adjacent to a wetland. (Sewage plants are located as low as possible so gravity helps wastewater flow toward them.) At the plant, a series of fetid "swimming pools" and white domes – both housing various treatment processes – announce the presence of "Microbes at Work." Underground is a web of gargantuan pipes and pumps.

Wastewater arrives via an intake pipe that spews forth a gray soup of ingredients like water, urine, feces, intestinal bacteria, toothpaste, shampoo, paint, cleaners and whatever else we pour down the drain. A good treatment plant separates this slurry into fairly clear water and clean sludge. Briefly, here's how:

When the "soup" arrives, gravel and sand settle out and scum is skimmed from the surface. Then water and the "heavy materials" start going their separate ways. The primary sludge enters huge, bubbly tanks, where oxygen-loving (aerobic) bacteria feast on organic matter.

Next it's piped to oxygenless "digesters" where anaerobic bugs devour stinky, ammonia-rich organic matter. (The methane that's released is burned for electricity to power Madison's plant.)

After about 20 days in the anaerobic digesters, the sludge is stabilized, the odor is gone and the nitrogen has been transformed into nitrates (NO₃), a plant fertilizer. Although heat and chemicals inside the digesters kill most of the nasty bacteria.

"In all the years that sludge has been put on agricultural land, there's not been a [single] documented case where someone has developed an infection due to land application," says Art Peterson, a veteran sludge scientist.
After the winter's freeze out, when the soil is thawed, tankers truck liquid sludge over the short haul to nearby farmland. (To cut transportation costs, some plants dry their sludge.) In the fields, specialized tanker-tractors weighing 50,000 pounds (fully loaded) gulp down 3,500 gallons at a serving and inject the liquid about eight inches into the soil. The applicator injects roughly 12,000 gallons to each of the eight to 10 acres it covers each day.

If you were to drive past a field that's freshly treated with sludge, you wouldn't notice much more than dark, moist soil. Take a whiff and you'd get an earthy aroma, similar to compost. Because of the sewage district's attention to detail, you wouldn't notice any of the black slurry.

Growing plants, however, get a good dollop of what Art Peterson calls "black gold." Experiments show that sludge can entirely replace commercial fertilizer on field corn (corn grown for cattle and hog feed). Unlike chemical fertilizers, humus-heavy sludge improves soil structure, thereby increasing water infiltration and decreasing runoff.

Publicity is critical to sludge-recycling programs. When the Madison district began spreading sludge in 1974, "recycling" was just entering common parlance, and nobody was sure how local farmers would react to a black slurry from a sewage plant.

A new name was key to Madison's PR program. "Sewage sludge evokes very negative images," understates recycling program director David Taylor. So the district held a contest for a euphemism and applied the winner, "Metrogro," to Madison's processed sludge. The district emblazoned the flashy name on its stainless-steel tankers, which are considerably cleaner than the semis now unloading at your supermarket.

The name game is catching on nationally. In December 1990, a professional group called the Water Environment Federation sponsored a national competition for a moniker less fearsome than "sewage sludge." Are you ready for "biosolids?" Researchers for Webster's have opened a file on "biosolids" for possible incorporation in a future edition.

In Madison, at least, the PR campaign worked. The district hauls about 10,000 tons of dry solids per year, enough to cover about 4,000 acres. Farmers want more. Taken together, they've put up about 30,000 acres for treatment. Those who are lucky enough to do a deal for Metrogro aren't altruistic recyclers: Farmers get all the nitrogen and phosphorus they need for field corn at just $7.50 an acre. If purchased in chemical fertilizer, these elements would cost roughly $40 per acre per year. (A sludge farmer might need about $10 for additional potassium.)

The big picture: According to soil scientist Art Peterson, one to two percent of the nation's cropland — much of which has been depleted by erosion or chemical-intensive agriculture — could absorb the entire national output of sludge. And a minor irony: If sludge recycling catches on, it will transform the kitchen garbage disposal from its perch on the acme of superfluous gadgetry to a recycling highway. Instead of schlepping orange rinds and coffee grounds to the compost heap, we would sluice them down the drain and hit the disposal switch. The sewage-treatment plant will do the rest. (Of course, by circumventing the compost pile, you'll raise out on a valuable soil amendment for your backyard.) [In South Carolina, neighbors are notified of sludge usage at neighboring farms and can request a public hearing.]

Dealing with Pollutants
What about all the household and industrial toxics that are flushed down drains, to join the 40 million gallons of wastewater that flows daily into Madison's treatment plant? What about pathogens and parasites?

With sewage treatment, much of the incoming slop decomposes into benign substances. Take glucose from food, which if left untreated would travel with wastewater into lakes and rivers, depleting oxygen. At the sewage plant, incoming glucose is broken down by microbes into carbon dioxide and water. But some components, like heavy metals and PCBs, do remain intact.

To appreciate the hazards of accepting polluted wastewater, the Madison district need look no further...
than the lagoons where it still stores sludge that accumulated for three decades before recycling began in 1974. Those lagoons are so polluted with cancer-causing PCBs that Madison became the nation's first sewage district to be placed on the federal Superfund list for cleaning up hazardous waste sites. The district may be compelled to burn millions of gallons of contaminated sludge at a cost of $50 million to $100 million. "Whether your standards are financial or environmental, it's a hideous prospect," says chief engineer James Nemke.

The lesson is simple: Once heavy metals, chemical pesticides or other nasties flow into the waste stream, it's very tough to get them out. That's why the district requires industries to pretreat their sewage. Some manufacturers in the Madison district have substituted less-toxic materials, thereby cutting toxic effluent. Others use precipitation to remove heavy metals from effluent. (Precipitation converts a toxic material from a soluble to an insoluble form, which settles out of wastewater.)

Nationwide, metal concentrations in sludge are also falling, a reflection of the recycling imperative. In the mid-1970s, battery, plastics and electroplating industries upped the cadmium level in Chicago's sludge to 280 to 300 parts per million (ppm). By 1992, those numbers fell to 40 ppm—much of it from background sources such as tire particles flushed down street sewers.

Quality control in Madison and elsewhere is ensured by a network of tests and government regulations. Each day, newly processed sludge is analyzed for total solids and nitrogen content. Each month, the district checks for phosphorous, potassium, cadmium and other metals. Every other month, it looks for 39 more metals, pesticides, herbicides, PCBs and bacteria.

Madison tests the surface layer of sludge-treated soil at least once every three years. (Because heavy metals are much more mobile in acidic soil, sludge-treated fields must be maintained at a pH of 6.5 or higher.) Deeper soil samples and plant tissues are analyzed for cadmium, copper, lead, nickel and zinc. Before and after each application, the district tests more than 750 private wells for their pH, as well as zinc and nitrate. One significant change has been detected: an increase in nitrate levels. Credit wider use of nitrogen-heavy commercial fertilizers.

PCBs? These cancer-causing compounds bind tightly to sludge and degrade extremely slowly. The federal maximum of PCBs in sludge intended for land application is 50 ppm. In 1991, Madison's sludge averaged 5.5 ppm.

Despite the concern about heavy metals in sludge, they too tend to stay where they are, as long as the soil isn't too acidic (above pH 6.5). In 1986, Art Peterson tested heavy-metal levels in sludge for the Milwaukee sewer district. He concludes, "Movement of these metals into groundwater seems practically impossible." As for crops grown from sludge-treated soil, when Mr. Peterson tested corn he found lead levels were below the detection limit of 1 ppm.

Pathogens? Most are killed by chemicals and heat in a treatment plant's anaerobic digester. To prevent the survivors from being eaten by those on top of the food chain (you and me), sludge is kept out of the vegetable patch. Feed crops that receive sludge are dried, ground and eaten by animals, significantly cutting a disease-causing organism's chances of finding its way to us.

Healing the Land

In Central Illinois, where farms are measured in thousands of acres, human waste is repairing a human wasteland. Following World War II, in this farmscape: 200 miles southwest of Chicago, strip miners cast aside dozens of feet of "overburden" from entire square miles—all in pursuit of a four-foot thick seam of coal. After the mining companies ripped out the coal, they left behind a scarred landscape with inexplicable hills and odd-shaped lakes covering nearly 16 square miles. Nobody seemed to care that the "overburden" comprised some of the world's most productive farmland.

On 345 acres of tailings piles, nothing grows: no trees, no grasses, no shrubs. These enormous mounds of subsoil, rock and low-grade coal were left by miners.
when they departed more than 30 years ago. With a pH less than 3, not even soil bacteria tolerate the highly acidic piles. Attempts to reclaim tailings piles with chemical fertilizer have failed, partly because there's no organic matter to support essential soil microorganisms.

But Chicago's Water Reclamation District is working a miracle. The refuse piles are springing back to life. And they are being served generous dollops of sludge.

It's not a pretty process: scalping the bizarre hills left by strip miners into an erosion-resistant landscape, then covering them with thousands of tons of black sludge. But it works. Each acre of the district's largest pile, which covers 110 acres to about 50 feet deep, was covered this past summer with 1,000 dry tons of sludge and 70 tons of agricultural lime. Test plots, begun in 1987 on similar tailings piles, have shown that plants flourish once sludge restores organic matter and neutralizes the acid. The reclaimed refuse piles are now capped with a crop of grasses and legumes — feeding grounds for songbirds and small mammals.

An imperfect miracle, but a miracle nonetheless. To my eye, this piece of planet Earth is far more healthy than it's been for decades. All thanks to sludge.

Learning Procedure

1. Ask: We tend to focus our attention on the waste from manufacturers and households, but what do you think happens to the human waste we flush away every day? (List student responses on the board.)

Explain to students that human wastes often end up in incinerators, in the ocean or in landfills and that proper management of these wastes is important to our environment.

2. Review with the class the Background information. Tell students that they are going to be conducting research about their community to find out what is happening to wastes.

3. As a class or in project teams, contact sewage treatment plant operators and sanitary engineers in your community and find out what is happening to sludge. Is it being recycled? Taken to local landfills? Burned? If sludge is recycled, is it made available to farmers, landscapers or the public? How is the recycled sludge being used?

4. Interview farmers or gardeners who use sludge and ask about the use of sludge as a soil enhancer.

5. Have students prepare a booklet for your school library on your community and its sewage waste.

Extension Activities

1. Invite a waste management engineer to the class to explain site selection for sludge spreading or write to an area waste management company and ask about sludge treatment and spreading.

2. Have students research different composting toilets and design a composting toilet system for a home or camp. What are the benefits and drawbacks?

3. Investigate alternative wastewater treatment technologies.