# Recycling

## What Is Recycling?

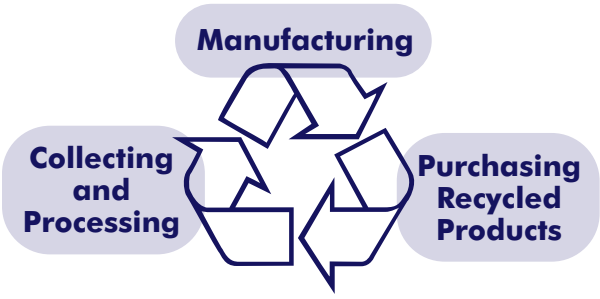
Recycling is a series of activities that includes the collection of used, reused, or unused items that would otherwise be considered waste, sorting and processing the recyclable products into raw materials, and remanufacturing the recycled raw materials into new products. Consumers provide the last link in recycling by purchasing products made from recycled content. Recycling also can include composting of food scraps, yard trimmings, and other organic materials. (See the Teacher Fact Sheet titled *Composting* on page 141 for more information.)

## How Does Recycling Work?

Many people already recycle items like paper, glass, and aluminum. While these efforts are a vital part of the process, the true recycling path continues long after recyclables are collected from household bins or community drop-off centers. Collecting, processing, manufacturing, and purchasing recycled products creates a closed circle or loop that ensures the overall success and value of recycling.

### Key Points

- The latest numbers show that the recycling rate in the United States has reached an all-time high—in 2001 the country recycled 29.7 percent of its municipal solid waste. (EPA, 2003)
- Recycling includes collecting materials and sorting and processing them into recycled raw materials to be remanufactured into new products.
- Recycling reduces the use of virgin materials, reduces the pollution and energy used in manufacturing and processing, saves landfill space, and creates jobs and revenue.
- New methods for the recycling and reuse of certain items, such as computer and electronic equipment, are being developed to prevent waste and save additional materials and energy.
- Recycling can only be effective if people buy recycled-content products.




## Collection

How and where recyclables can be collected vary from community to community. Some communities collect from residences, schools, and businesses through:

- Curbside collection programs, the most common method. Residents set recyclables, sometimes sorted by type, on their curbs to be picked up by municipal or commercial haulers.
- Drop-off centers, locations where residents can take their recyclables. These centers are often sponsored by community organizations.
- Buy-back centers, local facilities where recycled-content manufacturers buy their products back from consumers and remanufacture the used products into new products.

- **Deposit/refund programs,** which require consumers to pay a deposit on a purchased product in a container (e.g., bottle). The deposit can be redeemed when the consumer brings the container back to the business or company for recycling.

## Processing

After collection, some recyclables are "processed" and prepared for delivery to manufacturing facilities. Processing usually includes making sure the materials are sorted properly and that contaminants (i.e., nonrecyclables) are removed. Recyclables are then usually sent to a ***materials recovery facility*** (MRF, pronounced "murph") to be further sorted and then processed into marketable commodities for remanufacturing. Recyclables are bought and sold just like any other commodity, and prices for the materials change and fluctuate with the market. Each MRF has individual requirements about what materials it will accept, but most accept newspapers, aluminum cans, steel food cans, glass containers, and certain types of plastic bottles.

### Follow a Plastic Bottle Beyond the Bin...

After a plastic soda bottle is collected in a recycling bin, it is sorted and transported to a materials recovery facility. There it is cleaned and fed into a granulator that chops it into uniform-sized pieces, called "flakes." A manufacturer then purchases the flakes and melts them, squeezing the plastic into thin spaghetti-like strands and chopping those strands into small pieces called "pellets." These plastic pellets are further stretched and squeezed into thin fibers that can be remanufactured into items like clothing, bags, bins, carpet, plastic lumber, hospital supplies, housewares, packaging, shipping supplies, toys, and more. Consumers then complete the recycling loop by purchasing and using these new recycled-content products.

## Manufacturing

Once cleaned and sorted, the recyclables move to the next part of the recycling loop—manufacturing. More and more of today's products are being manufactured with recycled content.

- Recycled cardboard and newspaper are used to make new boxes, papers, and other products such as tissues, paper towels, toilet paper, diapers, egg cartons, and napkins.
- Recycled plastic called PET, found in soft drink, juice, and peanut butter containers, is used to make new products such as carpets, fiberfill (insulating material in jackets and sleeping bags), bottles and containers, auto parts, and paint brushes. Another kind of recycled plastic, HDPE, used in milk, water, detergent, and motor oil containers, can be remanufactured into trash cans, bathroom stalls, plastic lumber, toys, trash bags, and hair combs. Numbers imprinted on the plastic product indicate from which type of plastic the product has been manufactured and how it can be recycled. Not all communities recycle all types of plastic.
- Recycled glass is used again and again in new glass containers as well as in glasphalt (the roadway asphalt that shimmers in sunlight), road filler, and fiberglass.
- Recycled aluminum beverage cans, one of the most successful recyclables, are remade into new cans in as little as 90 days after they are collected. Recycled aluminum cans also can be used in aluminum building materials.
- All steel products manufactured in the United States contain 25 to 30 percent or 100 percent recycled steel, depending on the manufacturing process used.

## Recycling in the United States Throughout History

Although the United States has witnessed a major increase in public participation in recycling programs in recent years, industrial and commercial recycling has always made sense economically. The time line below presents a brief glimpse of recycling throughout U.S. history.

### Late 1800s to Early 1900s

- Before the days of mass production, the economic climate required people to routinely repair, reuse, and recycle their material possessions.
  - Scrap yards recycled old cars, car parts, and metal goods.
  - The paper industry used old rags as its main source of fiber until the late 19th century.
  - Retailers collected used cardboard boxes for recycling.

### 1914–1918 and 1939–1945 (WWI and WWII)

- Patriotism inspired nationwide scrap drives for paper, rubber, and other materials to help the war effort.
  - Many farms melted down and recycled iron or metal pieces of rusted machinery for warships, vehicles, and other military machines.
- People even saved grease from meat they cooked, which was used to make munitions.

### 1960s

- Interest in recycling waned as America's peacetime economy soared. Rising incomes and widespread, affordable, mass-produced goods created the "disposable" society.

### 1970s

- Environmental awareness rejuvenated the nation's interest in recycling.
- U.S. Environmental Protection Agency (EPA) was established December 2, 1970.
- The first Earth Day was held in 1970, significantly increasing recycling awareness. In the years following, 3,000 volunteer recycling centers opened and more than 100 curbside collection programs were established.
- EPA and some state agencies developed guidelines, technical assistance, and targets for local recycling efforts.

### 1980s

- The national spotlight fell on monitoring trash due to increased awareness of pollution resulting from poor waste management.
- Federal, state, and local governments became more and more involved in waste management.
- Waste management firms began to offer recycling programs in connection with proposals for new incinerators or landfills.

### 1990s

- Industry expanded the range of products made from recycled materials instead of virgin raw materials.
- National recycling rate reached double digits (28.2 percent in 1998).

### 2000s

- EPA sets national goals for reducing and recycling waste.

## Recycling Facts

- By recycling 1 ton of paper, we save: 17 trees, 7,000 gallons of water, 463 gallons of oil, 3 cubic yards of landfill space, and enough energy to heat an average home for 6 months.
- Manufacturers can make one extra-large T-shirt out of only five recycled plastic soda bottles.
- Americans throw away enough aluminum every 3 months to rebuild our entire commercial air fleet.
- When one ton of steel is recycled, 2,500 pounds of iron ore, 1,400 pounds of coal, and 120 pounds of limestone are conserved.
- Recycling aluminum cans saves 95 percent of the energy required to make aluminum cans from scratch.
- The amount of aluminum recycled in 1995 could have built 14 aircraft carriers.

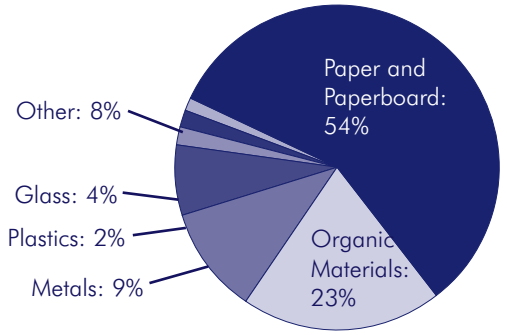
(Sources: Weyerhaeuser Company, 2001; Steel Recycling Institute, 2000; American Forest and Paper Association, 2000; R.W. Beck, 1997; The Can Manufacturers Institute, 1997; Anchorage Recycling Center, 2000; Recyclers' Handbook by Earthworks Group, 1997; EPA, 1997)

## Purchasing Recycled Products

The market for recycled materials is the final part of the recycling loop. Recycled products must be bought and used in order for the entire recycling process to succeed.

Recycling and composting activities divert about 62 million tons of material from landfills and incinerators. (See the Teacher Fact Sheets titled *Landfills* on page 165 and *Combustion* on page 169 for more information.) In 2001, this country recycled 29.7 percent of its waste, a rate that has almost doubled over the past 15 years. That's 1.3 pounds per person per day. Of that 29.7 percent, here is the breakdown of what the United States recycled that year:

### Materials Recycled in the United States




Source: EPA, 2003

## What Are the Benefits of Recycling?

When each part of the recycling loop is completed, the process helps both the environment and the economy. Recycling prevents materials from being thrown away, reducing the need for landfilling and incineration. In addition, the use of recycled materials to manufacture new products prevents pollution caused by the manufacturing of produces from virgin materials. Also, using recycled materials for manufacturing decreases emissions of greenhouse gases that contribute to global climate change. Since the use of recycled materials reduces the need for raw material extraction and processing, energy is saved and the Earth's dwindling resources are conserved.

Recent studies indicate that recycling and remanufacturing account for about 1 million manufacturing jobs throughout the country and generate more than $100 billion in revenue. Many of the employment opportunities created by recycling are in areas of the country where jobs are most needed. Jobs include materials sorters, dispatchers, truck drivers, brokers, sales representatives, process engineers, and chemists.

## Recycling in Action

For recycling to work, everyone has to participate in each phase of the loop. From government and industry, to organizations, small businesses, and people at home, all Americans can easily make recycling a part of their daily routine. Below are some ways for individuals to get involved in recycling:

- Learn about and participate in a community recycling program. Know the collection schedule or drop-off location as well as which items are acceptable. Get involved by volunteering with a homeowner's association or community organization to educate neighbors about the recycling program.
- Empty all fluids and remove all lids from bottles and cans when recycling and do not contaminate recycling containers with trash.
- Participate and encourage colleagues to recycle in the containers provided in your school. Initiate a recycling program in your school if one does not exist.
- Make the effort to find recycling opportunities for items, such as plastic packaging, that are not included in your local recycling program.
- Use recyclable products and encourage others to do the same.

## What Are the Challenges of Recycling?

Despite its success, the potential of recycling in this country is not yet fully realized. Some plastics, for example, such as bottles and containers, are recyclable in almost any community, but others, such as plastic "peanuts" used in packaging, usually can not be included in curbside or drop-off recycling programs. These items still end up in the trash because it is not profitable to collect the tons needed for remanufacture into new products.

In addition, the costs of collecting, transporting, and processing recyclables can sometimes be

## Is Your School Waste Wise?

WasteWise is a voluntary EPA partnership program that helps businesses, governments, and institutions reduce waste and save money. Since the program began in 1994, WasteWise partners have reduced their municipal solid waste by more than 26 million tons! In 1998 alone, partners saved an estimated $264 million. Partners include many large corporations, small and medium-sized businesses, hospitals, tribes, and state, local, and federal governments, as well as 87 schools, school districts, colleges, and universities in more than 30 states.

The following are examples of the accomplishments of a few WasteWise partners in the education field. Alden Central School of New York, which educates children from K-12, implemented a comprehensive waste reduction program in all campus buildings. Students and staff eliminated 450 pounds of polystyrene cafeteria trays and dishes by switching to reusable products. They also composted 900 pounds of cafeteria food scraps and 150 pounds of yard trimmings for use as mulch on building grounds. Sligo Adventist School of Maryland also implemented several innovative waste prevention activities including the reduction of more than 1 ton of drink boxes by switching to bulk juice dispensers. Eastern Illinois University reduced the amount of computer paper used on campus by 10 percent and reused 13 tons of office supplies through an internal exchange among employees.

To find out how your school can join the WasteWise program, please call 800-EPA-WISE (372-9473), e-mail at ww@cais.net, or visit the Web site at <www.epa.gov/wastewise>.

higher than the cost of disposing of these materials as waste. The average cost to process a ton of recyclables is $50, while the average value of those recyclables on the market is only $30. Processors often compensate for this discrepancy by charging a set fee for each ton of material they receive or by establishing ongoing contracts with communities or haulers. Efforts to better manage waste and recycling programs are under development. Many communities across the country implement financial incentives to encourage people to recycle. Residents are charged a fee based on the amount of solid waste they throw away. The more a household recycles, the less garbage it throw outs, and the lower the collection fee it pays.

Finally, recycling facilities are not always a welcome addition to a community. As with other waste management operations, recycling facilities are often accompanied by increased traffic, noise, and even pollution. Community leaders proposing the location for a recycling facility can encourage the NIMBY (Not in My Backyard) sentiment.

## Additional Information Resources:

Visit the following Web sites for more information on recycling and solid waste:

- U.S. Environmental Protection Agency (EPA): <www.epa.gov>
- U.S. EPA, Office of Solid Waste site on recycling: <www.epa.gov/epaoswer/non hw/muncpl/reduce.htm>
- Plug in To e Cycling: <www.epa.gov/epaoswer/osw/conserve/plugin>
- U.S. EPA, Office of Solid Waste WasteWise Program site: <www.epa.gov/wastewise>
- U.S. EPA, Office of Solid Waste site on global climate change and recycling: <http://yosemite.epa.gov/oar/globalwarming.nsf/content/actionswaste.html>
- U.S. EPA, Office of Solid Waste, Kid's Page: <www.epa.gov/epaoswer/education/kids.htm>
- U.S. EPA, Region 9 Office's Recycling Site for Kids: <www.epa.gov/recyclecity>
- National Recycling Coalition: <www.nrc recycle.org>
- Institute for Scrap Recycling Industries: <www.isri.org>
- American Plastics Council: <www.plastics.org>
- Steel Recycling Institute: <www.recycle steel.org/>
- Aluminum Association: <www.aluminum.org>
- Glass Packaging Institute: <www.gpi.org>
- American Forest and Paper Association: <www.afandpa.org>
- Institute for Local Self Reliance: <www.ilsr.org>
- Rechargeable Battery Recycling: <www.rbrc.org>
- Polystyrene Packaging Council: <www.polystyrene.org>
- Electronic Industries Alliance: <www.eiae.org>

To order the following additional documents on municipal solid waste and recycling, call EPA toll free at (800) 490 9198 or look on the EPA Web site <www.epa.gov/epaoswer/osw/publicat.htm>.

- *Characterization of Municipal Solid Waste in the United States*
- *Planet Protectors Club Kit* (EPA530 E 98 002)
- *A Collection of Solid Waste Resources* CD ROM

# Buying Recycled

## What Is "Buying Recycled?"

"Buying recycled" means purchasing items that are made from postconsumer recycled content—in other words, materials that were used once and then recycled into something else. This process is also known as "closing the loop."

Consumers "close the loop" when they purchase products made from recycled materials. After an item has been collected for recycling, sorted and processed, and remanufactured into a new product, it still has one more critical step to undergo: purchase and reuse. If no one buys recycled-content products, the entire recycling process is ineffective.

### Key Points

- Buying recycled-content products encourages manufacturers to purchase and use recycled materials.
- Buying products with "postconsumer" content closes the recycling loop.
- Not all recyclable products can be recycled in every community.
- Buying recycled products saves energy, conserves natural resources, creates jobs, and reduces the amount of waste sent to landfills and incinerators.
- Today's recycled-content products perform just as well, cost the same or less, and are just as available as their nonrecycled counterparts.
- New products containing recycled materials, from construction materials to playground equipment to computers, are constantly being developed.

## How Can People "Close the Loop?"

Consumers hold the key to making recycling work. Many manufacturers are already making the use of recycled materials a part of their official company policy. Through buying recycled-content products, consumers can encourage this trend, making each purchase count toward "closing the loop." Purchasing recycled-content goods ensures continued availability of our natural resources for the future.

The first step in buying recycled-content products is to correctly identify them. As consumers demand more environmentally sound products, manufacturers are encouraged to highlight these aspects of their merchandise. While this trend is good, shoppers should be aware of the various uses of "recycled" terminology. To help consumers understand product claims about recycled content, the

## A Recycled Product Shopping List

More than 4,500 recycled-content products are already available in stores, and their numbers are rapidly growing. Some of the everyday products people regularly purchase contain recycled-content. Here are some items that are typically made with recycled materials:

- Aluminum cans
- Cereal boxes
- Egg cartons
- Motor oil
- Nails
- Trash bags
- Comic books
- Newspapers
- Paper towels
- Carpeting
- Car bumpers
- Anything made from steel
- Glass containers
- Laundry detergent bottles

Federal Trade Commission has issued guidelines to ensure that products are properly and clearly labeled. Here are some basic definitions:

- Recycled-content products are made from materials that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process or after consumer use. Recycled-content products also include products made from used, reconditioned, and remanufactured components.
- Postconsumer content indicates that materials used to make a product were recovered or otherwise diverted from the solid waste stream after consumer use. If this term is not noted, or if the package indicates a total recycled content with a percentage of postconsumer content (e.g., 100 percent recycled, 10 percent postconsumer), the rest of the material probably came from excess material generated during normal manufacturing processes. These materials were not used by a consumer or collected through a local recycling program.
- Recyclable products can be collected, separated, or otherwise recovered from the solid waste stream for use in the form of raw materials in the manufacture of a new product. This includes products that can be reused, reconditioned, or remanufactured. These products do not necessarily contain recycled materials and only benefit the environment if people recycle them after use. Not all communities collect all types of products for recycling, so it is really only recyclable if your community accepts it.
- Products wrapped in recycled or recyclable packaging do not necessarily contain recycled content. They can be wrapped in paper or plastic made from recycled materials, which is a good start, but the most environmentally preferable packaging is none at all.

Consumers must remember to read further than the recycling symbol or the vague language to find specific and verifiable claims. When in doubt about the recycled content of an item, contact the manufacturer for information; this will also raise the company's awareness of shoppers' interest in environmentally preferable products.

## Buy-Recycled Facts

- Aluminum cans contain an average of 50 percent recycled postconsumer content, while glass bottles contain an average of 30 percent.
- How many recycled plastic soda bottles does it take to make...?
  1 XL T-shirt.....5 bottles
  1 Ski jacket filler.....5 bottles
  1 Sweater .....27 bottles
  1 Sleeping bag ....35 bottles
- Manufacturers in the United States bought $5 billion worth of recycled materials in 1995.
- One 6-foot-long plastic park bench can be made from about 1,000 plastic milk jugs.

(Sources: Aluminum Association, 2000; Glass Packaging Institute; Recyclers' Handbook by Earthworks Group, 1997; Anchorage Recycling Center, 2000; American Plastics Council, 1999; National Recycling Coalition)

## What Are the Benefits of Buying Recycled?

Important advantages to buying recycled content products include:

- Waste and Pollution Prevention: Manufacturing products with recycled-content generally creates less waste and pollution, ranging from truck emissions to raw material scraps.
- Resource and Energy Conservation: Making a new product from recycled-content materials generally reduces the amount of energy and virgin materials needed to manufacture the product.

- Economic Development: The Institute for Local Self-Reliance in Washington, DC, estimates that nine jobs are created for every 15,000 tons of solid waste recycled into a new product. These jobs range from low- to high-skilled positions, including materials sorters, dispatchers, truck drivers, brokers, sales representatives, process engineers, and chemists.
- Money Savings: Products such as re-refined motor oil, retreaded tires, and remanufactured automotive batteries will often cost less than their virgin material counterparts.

## What Are Some Emerging Trends?

A wider variety of recycled-content products are being produced every day. Some newly available items include electronic equipment, such as computers and printers, made from recycled parts; tape measures made from reconditioned and recycled parts; kitty litter made from recycled drywall; recycled-content plastic office products; and innovative clothing and accessories made from recycled tire inner tubes.

## Buying Recycled in Action

Consumers hold the power in their wallets and on their shopping lists. Whether buying items for home, school, or work, consumers must think about the environment and the future as they consider products and brands. Below are activities that will help promote buying recycled:

- Buying recycled-content products personally and encouraging the use of recycled products at school.
- Teaching children about "closing the recycling loop" by organizing a tour of a local facility that manufactures recycled-content products, such as steel products.
- Organizing an exhibit of recycled-content products.
- Asking local stores to stock more recycled-content products that you or the children can use in the classroom.

## Buying "Green"

In addition to buying recycled products, consumers can help protect the environment by buying "green": Green shopping can mean:

- Not buying things you don't need
- Buying energy-efficient products
- Buying used or reusable products
- Buying products that have no packaging or reduced packaging
- Buying recycled products or recyclable products
- Buying durable products that will last a long time

## Additional Information Resources:

Visit the following Web sites for more information on buying recycled products and solid waste:

- U.S. Environmental Protection Agency (EPA): <www.epa.gov>
- U.S. EPA, Office of Solid Waste site on buying recycled: <www.epa.gov/epaoswer/non hw/muncpl/buyrec.htm>
- King County, Washington Environmental Links: <www.metrokc.gov/environ.htm>
- Green Seal: <www.GreenSeal.org>
- The American Plastics Council: <www.plasticsresource.com>
- The Official Recycled Products Guide: <www.dep.state.pa.us/wm apps/recycledproducts>
- The Global Recycling Network: <www.grn.com>
- Buy Recycled Business Alliance: <www.nrc recycle.org/brba/index.htm>

To order the following additional documents on buying recycled and "green" shopping, call EPA toll free at (800) 490 9198 or look on the EPA Web site <www.epa.gov/epaoswer/osw/publicat.htm>

- *The Consumer's Handbook for Reducing Solid Waste* (EPA530 K 96 003)
- *A Collection of Solid Waste Resources* on CD ROM
- *Let's Go Green Shopping* (EPA530 K 04 003)

EPA's WasteWise Program helpline (800 EPA WISE) has additional resources available. These resources include information on the following:

- State Buy Recycled Contacts
- *Buy Recycled Guidebook*

social studies

# Recycling Rangers

## Objective

To help children recognize the similarities and differences among common recyclable items.

## Activity Description

Students play a sorting game and put different recyclables into the appropriate bin.

## Materials Needed

- Four recycling bins
- Recyclable materials listed in the box below

## Key Vocabulary Words

Paper
Plastic
Glass
Metals

## Duration

1 hour

## Skills Used

Communication
Observation/classification

## Activity

**Step 1:** Set up the four bins in the classroom and label them "Paper," "Glass," "Plastic," and "Metals." Make a pile of all of the recyclable items on the floor and ask the students to gather around them in a circle.

**Step 2:** Explain to students that by the end of the lesson they will become "Recycling Rangers" and learn how to recycle different items. Discuss with the students how different "garbage" items can be recycled into new products. Note that it is important to separate these items into different categories before they are used to make new products. Refer to the Teacher Fact Sheet titled *Recycling* on page 101 for background information on the recycling process.

**Step 3:** Ask the students to look at the different recyclable materials and discuss how they are alike and how they are different. Ask them

### Recyclable Materials

— Cardboard
— Newspapers
— Magazines
— Plastic soda bottles
— Plastic milk containers
— Glass jars or bottles
— Aluminum cans
— Steel food cans
— Other materials recycled in your community

Note: All materials should be cleaned and all sharp lids or edges should be removed or taped over to avoid injury.

to compare the colors, textures, and weight of the different objects. When handling the glass bottles, take great care not to accidentally break the containers. Also, note that some metal containers have sharp edges that can cause injury to the children.

**Step 4:** Moving through the pile one item at a time, ask the students to identify the material that each item is made from. Then, choose a student volunteer to place the item in the appropriate bin. For the older children, ask the student volunteer to also name another product that is made from that same material. If a student, for example, is holding a glass jelly jar, he or she could note that soda bottles are also made of glass.

**Step 5:** After the lesson is concluded, encourage students to go home that night and share what they learned with their parents.

## Assessment

1. Ask students to name some examples of recyclable items.
2. Have students explain why it is important to sort the different recyclable items.
3. Ask students what kinds of materials recyclable items are made from.

## Enrichment

1. Select a few objects from the lesson, ensuring a good mix of shapes and sizes. Ask the children to trace outlines of the objects and then color them in. Put the pictures up on the classroom wall to create a recycling art gallery.
2. Organize the class into teams of four children and give each group a different recyclable item. Ask the students to make a new object from the recycled items such as a crayon holder or paper plane.

art

# Follow That Bottle!

## Objective

To show students the various steps involved in recycling.

## Activity Description

While coloring, students will follow the path of the bottle in the *Follow That Bottle!* worksheet.

## Materials Needed

- Copies of the *Follow That Bottle!* worksheet for each member of the class
- Crayons

## Key Vocabulary Words

Recycling
Processing
Manufacturing
Factory

## Duration

1 hour

## Skills Used

Motor skills

## Activity

**Step 1:** Using the storyline in the *Follow That Bottle!* worksheet, discuss the life of a recyclable item, such as a plastic bottle, after it is placed in the recycling bin. Explain that items such as bottles, cans, and newspapers can be made into a new product—either the same kind of product or a completely different product—if they are recycled and not thrown away. (Refer to the Teacher Fact Sheet titled *Recycling* on page 101 for background information.)

**Step 2:** Read and then distribute the *Follow That Bottle!* worksheet and instruct the students to follow the bottle by coloring it with crayons as it is used, recycled, remanufactured, and made into a new product. As the students color, ask them what they think is happening in each section of the picture. Ask them, for example, if anyone has been to a factory or if they recycle at home.

**Step 3:** After talking about the life of the bottle, students can color the rest of the story board.

## Assessment

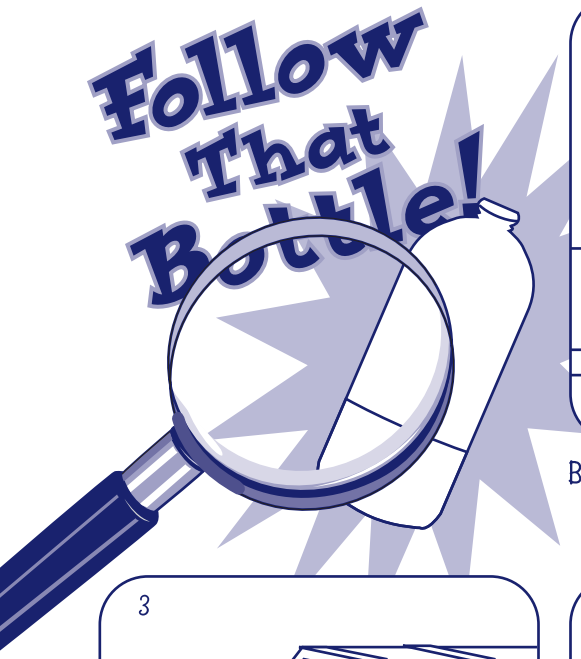
1. Have students explain what happens to a plastic bottle, or other recyclable, after it is placed in a recycling bin.
2. Ask students to describe their own recycling experiences. Do they use a bin?

## Enrichment

1. Instruct the students to draw a picture of themselves as they recycle common products.
2. Have students sort and separate recyclables from lunch for one week to get a sense of the items that can be recycled in your community. Prepare separate bins for each recyclable.
3. Ask students what happens to the plastic bottle if it does not go in the recycling bin.

# Student Handout

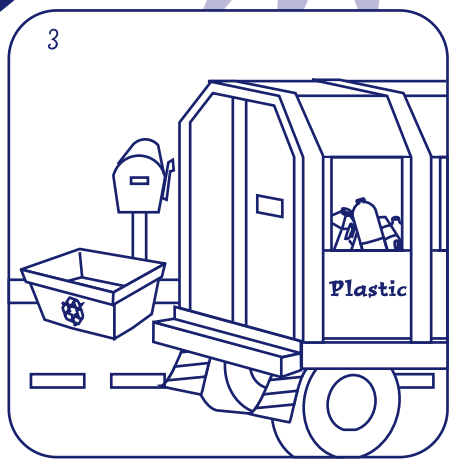
**Name:** _____



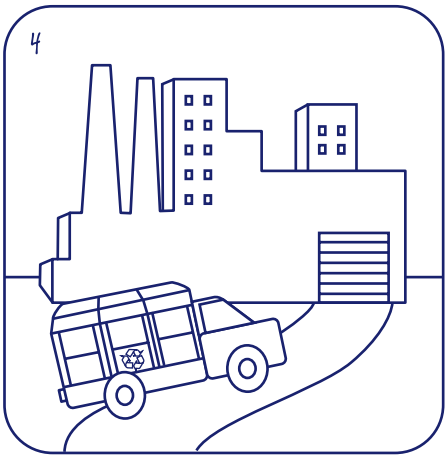


Billy drinks a soda.

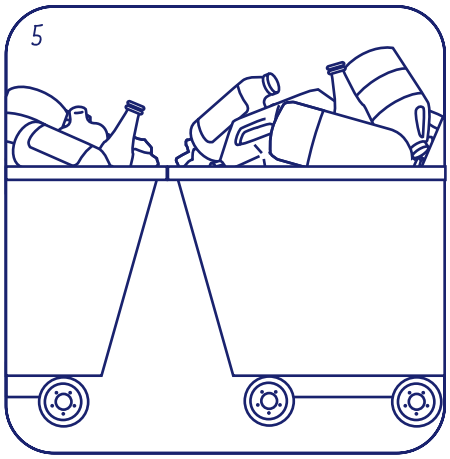

When he is finished, he puts the empty bottle in the recycling bin.



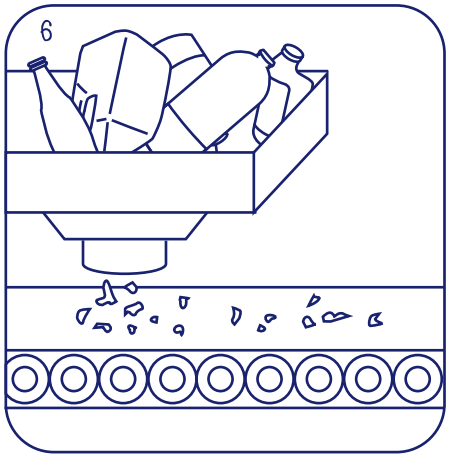

A truck comes to pick up the recycled bottles.



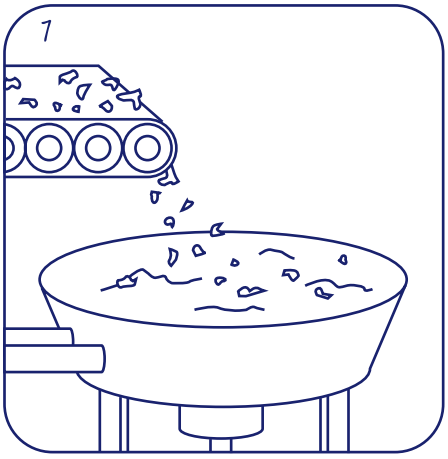

The truck takes the recycled bottles to a factory.



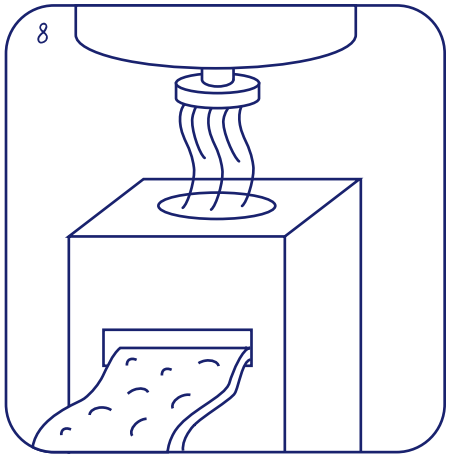

The bottles get separated by color.



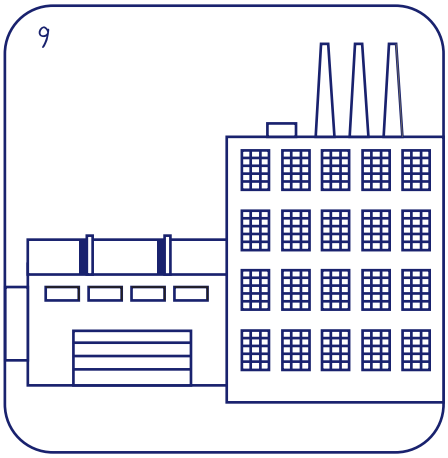

The bottles are ground up into little pieces.




The little plastic pieces are melted...

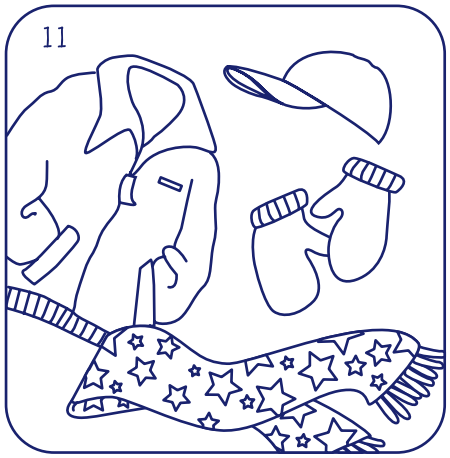



...and made into pieces of thread.

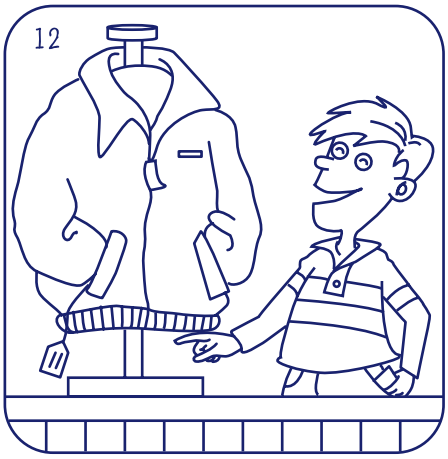



In another factory...


...the plastic thread is used to make clothing.




Jackets, scarves, gloves, and blankets can be made from recycled soda bottles...




...and are sold in stores.


Billy's favorite jacket is made from the soda bottles he recycled!

# Take-Home Recycling Kit

**Suggestion for Teachers:** You might want to find out what materials are collected for recycling in your community before beginning this activity.

language arts

art

## Objective

To teach students the value of recycling and encourage them to discuss recycling with their families.

## Activity Description

Students will assemble a take-home recycling kit.

## Materials Needed

- *Recycling Facts* handout for each member of the class
- Old magazines and newspapers
- Used cardboard
- Construction paper
- Markers and/or paint
- Glue
- Scissors
- Any other arts and crafts supplies available

## Key Vocabulary Words

Recycling
Processing

## Duration

2 hours

## Skills Used

Communication
Motor skills

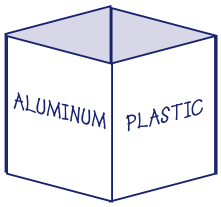
## Activity

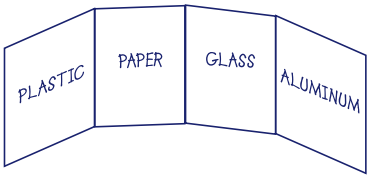
**Step 1:** Explain how recycling works and the important role we all can play by recycling items instead of throwing them away. (Refer to the Teacher Fact Sheet titled *Recycling* on page 101 for more information.) Review the information on the following *Recycling Facts* handouts with the students, pointing out the economic and environmental benefits of recycling.

**Step 2:** Have each student cut the old cardboard boxes into four 8 ½- by 11-inch pieces and glue different colored sheets of construction paper to each side of the cardboard.

Connect each piece of cardboard with tape to form a placard that can stand on a table. Instruct the students to label each cardboard piece with one of the following recyclables: aluminum, glass, plastic, and paper (see examples below).

**Step 3:** Instruct the class to cut out or draw the appropriate recyclable for each cardboard



## Journal Activity

Ask students to interview their family members about recycling practices and views on recycling. Ask students to write a short article on their families' current views and how their recycling kit changed those views or practices.

placard using the magazines, newspapers, markers, and paints. Ask students to write information about recycling on each placard. Optional recycling facts are included on the attached handout and might assist students in this task.

**Step 4:** When the students are finished decorating their placards, ask them to take them home and affix them where their family keeps its recyclables or its trash to encourage families that don't already recycle to start. Ask students to share the information they learned about recycling with their parents. Explain how the placards serve as friendly reminders of the importance and benefits of recycling.

## Assessment

1. Ask students to list the ways recycling helps the environment and why these benefits are important.
2. Ask students what role each of us can play in recycling.

## Enrichment

1. If your community recycles, but the majority of the class' families do not recycle at home, have the students practice a "recycling pitch" to their parents using their placards and other facts about the benefits of recycling. Also, students could develop a commercial using their placards and draw a story board of it or create a skit that is then videotaped.
2. Make signs for the classroom or school recycling bin. Ask students to put cans, bottles, or other items from their lunches in the recycling bins in the classroom or school. When the bins are full, take them to a collection facility and use the money to buy treats for the class.
3. Organize a tour of a recyclables processing facility or a manufacturing plant that uses recycled materials.

Student Handout

# Recycling Facts

## Paper

- The average amount of recycled fiber in newspapers increased from 10 percent in the late 1980s to more than 30 percent today.

- By recycling or reusing 1 ton of paper, we save 17 trees, 7,000 gallons of water, 463 gallons of oil, 3 cubic yards of landfill space, and enough energy to heat an average home for 6 months.
- Americans recycled 36.7 million tons of paper and paperboard in 2001.

## Plastic

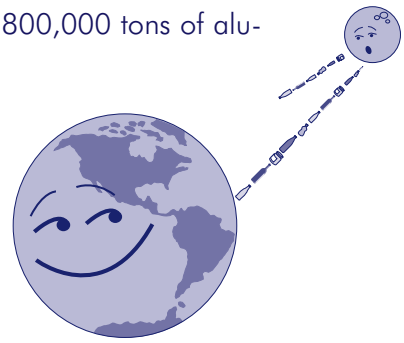
- Using fewer than five recycled plastic soda bottles, manufacturers can make one extra-large T-shirt.
- Milk jugs can be made into all different types of plastic objects, from park benches to boardwalks.
- Recycled plastic soda bottles can be made into "fleece" sweaters, long underwear, stuffing for sleeping bags, and other items.

- Americans recycled 1.4 million tons of plastics in 2001.

## Aluminum

- Recycling aluminum cans saves 95 percent of the energy required to make aluminum cans from scratch.
- Americans earn about $1 billion from recycling aluminum cans each year.
- Every minute, an average of 127,093 aluminum beverage cans are recycled in the United States.
- The amount of aluminum recycled in 2001 could have built 14 aircraft carriers.
- American's recycled 800,000 tons of aluminum in 2001.

## Glass



- If all the glass bottles and jars recycled were laid end-to-end, they would reach the moon and make it more than halfway back to Earth.
- Most bottles and jars contain at least 25 percent recycled glass.
- Every ton of new glass produced results in 27.8 pounds of air pollution, but recycling glass reduces that pollution by 14 to 20 percent.
- American's recycled 2.4 million tons of glass in 2001.

Sources: EPA, 2003; American Forest and Paper Association; Can Manufacturers Institute; www.green networld.com/tips/glass.htm.

math

science

social studies

# Making Glass From Scratch

## Objective

To teach students about the processes and resources used in the manufacture of glass and to introduce how recycling glass is good for the environment.

## Activity Description

Students make a glass-like substance using sugar and water.

## Materials Needed

- 1 cup sugar
- 1/4 cup water
- Hot plate and sauce pan or hot pot (to boil water)
- 8-inch square sheet of glass or a cookie sheet
- Newspaper
- Assorted glass objects

## Key Vocabulary Words

Glass
Heat
Energy
Natural resources
Reuse
Recycle
Resource
Minerals
Raw materials

## Duration

45 minutes

## Skills Used

Communication
Reading
Observation/classification
Problem solving

## Activity

**Step 1:** Discuss how glass is made (i.e., that sand, soda and lime are heated together at high temperatures), emphasizing the heat and energy required during the manufacturing process. Explain to students that glass containers can be remelted or "recycled" to make new glass containers, saving valuable resources in the process. (Refer to the Teacher Fact Sheets titled *Products* on page 25 and *Recycling* on page 101 for background on the manufacturing process.) During the discussion, allow students to touch a variety of different glass objects (e.g., beverage container, jelly jar, vase). Ask them to describe the colors, shapes, and textures of the different items.

**Step 2:** Begin the glassmaking exercise by heating the water. Tell students you are going to make "pretend" glass using sugar in place of the actual raw material, sand. Let students examine the sugar and describe it in terms of its color, texture, and shape. Point out the similarities between the sugar and sand. Have students describe the water and how it changes as the heat begins to make the water boil (e.g., after the sugar has melted it will look like a brown liquid). Point out the heat energy involved in making the water boil as well as the steam that is produced. Next, pour the sugar into the boiling water. Tell students to pretend the sugar is sand (minerals) from the ground.

**Step 3:** Stir the mixture vigorously over the heat until the sugar is dissolved (about 5 minutes). Ask students to describe the changes in the sugar and water. Tell them this is how glass looks before it cools.

**Step 4:** Put several layers of newspaper under a sheet of glass or a cookie sheet. (If you are worried about handling glass, use a cookie sheet—although students will not be able to see through it.) Carefully pour the mixture onto the sheet of glass and allow it to cool (about 15 minutes).

**Step 5:** Hold up the sheet of "glass" so students can see through it. By allowing it to set overnight, the "glass" will become frosted. The next day, ask students to describe the changes that occurred overnight and why (e.g., the water evaporated leaving sugar crystals behind).

**Step 6:** As an optional exercise, illustrate glass recycling by scraping the dried "glass" back into the pan (pretending it is small pieces of crushed, recycled glass), adding water, and reboiling the mixture. More sugar will need to be added to repeat the procedure. Ask students which resources were replaced when the crushed glass was used to make the new glass (minerals, energy).

## Assessment

1. Ask students what materials are used to make virgin (nonrecycled) and recycled glass bottles. Older students may illustrate the process, labeling the natural resources used to make glass and show which ones are replaced when recycled glass is used as a raw material.
2. Have students describe how recycling glass is good for the environment.

## Enrichment

1. Perform a molding glass exercise. For this project, you will need one wide-mouth glass jar per group of four to six students, and one stiff straw or glass tubing, balloon, and rubber band per student. To begin, divide the class into small groups of four to six students and give each group a wide-mouth jar. Next, give each student a straw or glass tubing, balloon, and rubber band. Assist students in attaching the balloon to the straw with the rubber band. Ask students to take turns putting the balloon into the jar and blowing it up until it takes the shape of the jar. Explain that this process illustrates how glass is molded into a jar or other shape during the manufacture of glass containers.
2. Bring samples of handmade glass to class and show students the bubbles in the glass formed by a person blowing air into the hot glass mixture. Point out the irregularities that identify the glass as handmade. Visit a glass blower, if possible. These individuals often participate in local crafts festivals or similar events.
3. Ask students to look around their homes for glass products that could be recycled to make new glass. Ask students to make a list of the items and bring the list to class. Have students share their lists and then discuss which items can and cannot be used for recycling (for example, items not commonly accepted for recycling are lightbulbs, mirrors, windows, etc.).

# Handmade Recycled Paper Planters

science

art

## Objective

To show students how easy it can be to make products from recycled items.

## Activity Description

Students will make planters from recycled paper.

## Materials Needed

- Large stack of newspapers
- Scissors
- Three to five 2-gallon buckets
- Water
- Egg beaters
- Magnifying glass
- Plant seeds for each student
- Planting soil
- Paper drinking cups

## Key Vocabulary Words

Recycle
Fibers
Decompose
Pulp
Virgin materials
Resources

## Duration

2-3 hours

## Skills Used

Motor skills

Note: Try to reuse a cup-shaped container instead of using paper drinking cups. For example, you could use reusable plastic drinking cups, plastic planter molds, or milk containers.

## Activity

**Step 1:** Introduce the concepts of recycling and decomposition to the class. Explain that making items from recyclables rather than virgin materials benefits the environment by saving natural resources. (Refer to the Teacher Fact Sheets titled *Recycling* on page 101 and *Natural Resources* on page 5 for background information. The *Composting* fact sheet on page 141 contains information on decomposition.)

**Step 2:** Discuss with the class how paper is made. Explain that most paper is made from only trees, while other paper is made from a combination of trees and old newspaper or used office paper (in addition, a small percentage of paper is made from other fibrous materials such as cotton, papyrus, or rags). Discuss how when recycled paper is used to make new paper, less trees need to be cut down. Help students explore the environmental implications of this.

**Step 2:** Have each student cut up two full pages of newspaper into ½- to 1-inch square pieces.

**Step 3:** Ask a few student volunteers to fill the buckets 1/3 full with paper and the remaining 2/3 with water (1 part paper to 2 parts water).

## Journal Activity

Ask students to write a story about their seedling's journey from its first days in the planter to when it takes root in the ground outdoors.

**Step 4:** Let the mixture sit overnight. By the next day, the newspaper fibers will be soft and ready to pulp.

**Step 5:** On the second day, have students take turns pulping the fibers with the hand beater until the paper and water look like mush. Explain that the pulping process breaks down the fibers into a form that can be bonded together again to make recycled paper. Have students look at the pulp with a magnifying glass to see the loose wood fibers.

**Step 6:** Give each student a plastic cup-shaped container. Instruct them to mold the pulp to the inside of the cup, squeezing out as much of the water as possible. The pulp should be 1/4- to 1/2-inch thick on the inside of the cup.

**Step 7:** Let the pulp dry completely over the next 3 days.

**Step 8:** After the pulp has dried, take the handmade recycled paper cup out of the drinking cup.

**Step 9:** Give each student a seed and instruct them to plant it in the cup using the planting soil. Keep the planters in the classroom and have the students care for the plants. Discuss how much sunlight and water their plants need.

**Step 10:** Send the students home with their planters when the seedlings have sprouted and are ready to be planted in the ground. Instruct the students to place the whole cup with the plant in it into the ground.

Students in an urban setting could either plant their seedlings in a local park or decorate their planters and donate the seedlings to a local nursing home. (Students also could give a presentation on recycling to the elderly when they drop off their planters.)

**Step 11:** Discuss how the planter will decompose in the soil and the plant will take root in the ground. Explain that they have just completed the recycling loop by sending the nutrients from the paper cup back into the soil.

## Assessment

1. Ask students where paper comes from.
2. Ask students to explain how making paper from used paper benefits the environment.
3. Ask students how and why the planter will decompose in the ground.

## Enrichment

1. On the blackboard or as a handout, work with the students to diagram and label all of the steps that occur in making paper from recycled materials versus making paper from only virgin materials. Discuss the differences.
2. Instead of sending the students home with the seedlings, start a garden at the school and tend it regularly with the class.
3. Have students discuss what else they can do to reduce the number of trees being cut down to make paper.

math

science

# Recycling...Sorting It All Out

## Objective

To help students test and better understand the properties of different recyclable materials.

## Activity Description

Students rotate to different stations to evaluate recyclable items and learn how to sort them into different categories.

## Materials Needed

- Recyclable items listed below
- Magnets
- An aquarium tank or other large container filled with water
- Rocks or other items that vary in density
- Balance scale
- Scissors
- Tablespoon of sand
- Copies of the *Sorting Statistics Worksheet*
- Calculators (optional)

## Key Vocabulary Words

Sorting
Recyclables
Magnetism
Density
Mass
Matter

## Duration

1 hour

## Skills Used

Communication
Research
Computation
Observation/classification

## Activity

**Step 1:** A day or two before the lesson, ask students to bring in different recyclable items from home or collect items left over from lunch. See the box at right for the list of materials to request. Be sure to clean these items before the lesson and remove any sharp edges. Store these items in a utility closet or some other storage room at the school until you are ready to conduct the lesson.

**Step 2:** To begin the lesson, discuss how waste is reduced by recycling. Explain how after recyclables are collected from businesses and homes, they are sent to a facility where they are sorted into different categories of materials. Explain that it is important for recyclers to tell the difference between materials because they end up being recycled into different products. (Refer to the Teacher Fact Sheet titled *Recycling* on page 101 for more information on this process).

**Recyclable Items**

Steel food cans
Aluminum soda cans
Plastic detergent bottles
Plastic milk jugs
Newspapers
Magazines
Notebook paper
Cardboard boxes

## Journal Activity

Ask students if they can think of an innovative way to sort recyclables? Ask them to describe or draw their invention.

**Step 3:** Organize three different stations throughout the classroom.

Station One should include the steel and aluminum cans, a magnet, and an information sheet about magnetism. This sheet should explain that magnets are pieces of iron or steel that can attract other metals.

Station Two should include the plastic items and a large container (e.g., an aquarium) filled with water, along with scissors and a few heavy and light objects. You should prepare an information sheet explaining that density refers to how compact an object is. As an example, note that a bowling ball is much more dense than a foam rubber ball of the same size because the bowling ball is more compact and made of heavier material.

Station Three should include the paper items and a scale. An information sheet should explain that mass refers to the amount of matter in an object. You can weigh an object on a scale to determine its mass.

**Step 4:** Once the stations are set up, hand out worksheets, break the students up into groups of three, and explain that students should rotate from station to station in their groups and fill out their worksheet as they go. Students can discuss answers within their groups.

**Step 5:** At Station One, have students experiment with the magnet and the different cans to discover that some of the cans are attracted to the magnet while others are not. At Station Two, students should compare the density of various plastic items. Students can compare the density of other items with plastic, and can cut up plastic into pieces to see how density is affected. At Station Three, students can place various paper items on the scale and record the different weights.

**Step 6:** Discuss the questions from the worksheet. Students should understand that recycling sorting facilities use magnets to separate the steel cans from the rest of the collected recyclables. They should also understand that density is important because it can be used to identify and separate different items. Recycling sorting facilities use sinking/floating exercises to sort plastics from other materials, such as crushed glass, since plastic containers float. Students should also understand that sorting facilities use scales to weigh the recyclable materials they receive so they know how much material is being recycled.

## Assessment

1. Ask students to explain magnetism. Ask them why only some objects are attracted to magnets. Which ones?
2. Ask students to explain density and how to test for it.
3. Ask students what mass means. Have them explain how to test something to determine its mass.
4. Have students list some of the techniques that sorting facilities use to separate different recyclables.

## Enrichment

1. Visit a local recycling materials recovery facility to see firsthand how the different recyclables are sorted.
2. Ask students to draw their own recycling sorting facility. Ask them to start with a pile of recyclables at one end and show how the different recyclables would be separated (e.g., magnets, conveyor belts) as they move through the facility. Ask them to decide whether their diagram will only involve machinery or whether it will involve people to sort some of the items. Ask them to label each of the different stations in the facility and describe how each station works.

# Sorting Statistics

**Name:**

_____

## Station One

**1.** How many steel cans are at Station One? Use the magnet to find out. Now, multiply that number by the number of students in your classroom. If you recycled 56 percent of these cans, approximately how many would that be? As a nation, we recycled 56 percent of our steel cans in 1998.

_____

_____

**2.** How would magnets help workers at a recycling sorting facility?

_____

_____

**3.** Suppose you have 10 aluminum cans—5 containing recycled aluminum and 5 with no recycled content (made from bauxite, the primary ore). Next, suppose it takes 5 watts of energy to make a can with recycled aluminum and 100 watts to make a can from bauxite. How much energy does it take to make the 5 recycled-content cans? How about the 5 nonrecycled cans? Note that it takes 95 percent less energy to make an aluminum can from recycled aluminum versus making one from scratch.

_____

_____

**4.** Calculate the aluminum can recycling rate for Anywhereville, USA, given the following information:

- 1,938 pounds of aluminum cans were recycled
- 3,370 pounds of aluminum cans were produced
- There are an average of 33.04 cans per pound

Number of cans recycled:

_____

Number of cans produced:

_____

Recycling rate:

_____

## Station Two

**1.** Does the size and shape of an object affect its density? Test a few different types of plastic objects in the water and record your results. You can cut up some plastic and try some other objects for comparison—record all results.

_____

_____

**2.** How is testing for density helpful to a recycling sorting facility?

_____

_____

**3.** Note that the following formula is used to determine the density of an item: density = mass (grams)/volume (centimeters$^3$). Now, assume a piece of garbage—a popcorn bag—has a mass of 12 grams and a volume of 5 centimeters$^3$. What is its density?

_____

_____

**4.** Note that water has a density of 1.0 g/cm$^3$. Items that have a density of less than 1 float in water, while those that are more than 1 sink. Do plastic bottles have a density greater or less than 1?

_____

_____

## Station Three

**1.** Describe the characteristics of the different types of paper. How are they similar? How are they different? Consider color, texture, glossiness, thickness, etc.

_____

_____

**2.** Assuming you recycle 7 newspapers a week, 365 days a year, how many newspapers do you recycle per year?

_____

_____

**3.** Using the scale at Station Three, weigh a newspaper to determine its mass. Using your answer from question 2, what is the total mass (in pounds) of the newspapers you recycle each year? In tons? (There are 2,205 pounds in a ton.)

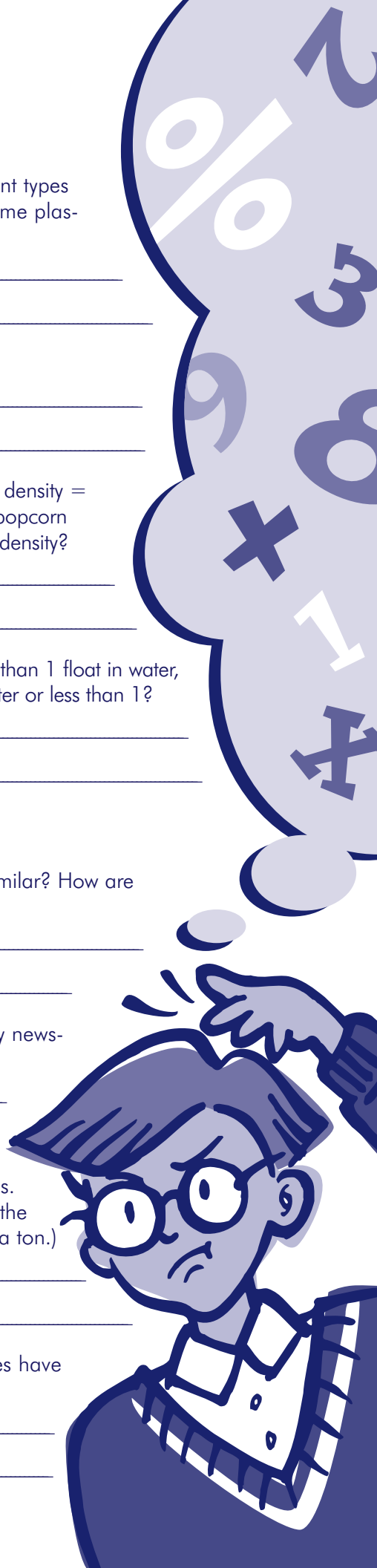
_____

_____

**4.** Assuming that each ton of paper recycled saves 17 trees, how many trees have you saved by recycling your newspaper each year?

_____

_____



math

science

art

# Designing the Ultimate Can Crusher

## Objective

To help students understand simple machines and manipulate materials and tools to build their own machine.

## Activity Description

Students work in teams to design and construct a machine to crush aluminum cans. Students then vote for the best design.

## Materials Needed

- Construction items listed in the box below
- Hammer
- Saw
- Screwdriver
- Pliers
- Wire cutters
- Ruler and/or measuring tape

## Key Vocabulary Words

Recycling
Recyclables
Compaction

## Duration

Set-up/design: 1 hour
Construction: 1 to 2 hours

## Skills Used

Research
Computation
Motor skills

## Activity

**Step 1:** Several days before the lesson, ask students to bring in different construction items from the list to the right. Be sure to store these items in a safe place at the school where students cannot access them and hurt themselves. Also, note that this lesson will work best in a shop room or similar area with plenty of open space and room for students to work.

**Step 2:** To begin the lesson, introduce the concept of simple machines—levers, pulleys, etc. Next, explain how simple machines are used in the recycling process. Recycling facilities use machines, for example, to crush aluminum cans

### Construction Items

Aluminum cans
Rope
Wire
Hinges
Screws
Nails
Wood scraps
Bricks
Blocks
Other construction items

## Journal Activity

Ask students to describe the most challenging part of designing their can crusher. Ask them how they overcame this challenge.

to make them easier to store and ship since they require less space when crushed (Refer to the Teacher Fact Sheet titled *Recycling* on page 101 for more information on this process).

**Step 3:** Divide the class into small groups of four or five students.

**Step 4:** Place a few aluminum cans on the floor. Ask a volunteer to crush the cans with his or her foot. Have students identify what is involved in crushing a can. Ask them to describe what happens to the can.

**Step 5:** Have students examine all of the construction materials brought to class. Explain that the job of each group is to use these materials to design and construct a can crushing machine. Each group should use at least one "simple machine" in their construction.

**Step 6:** Tell students that they should begin the project with a design phase. You may want to spend several class periods on this stage. Ask students to work together to draw a diagram for how their can crusher would work. Have them make a list of all of the items they will need for their machine. Make sure these items are already in the classroom or can be brought from home. Ask students to write instructions for how they will build their can crusher. Encourage them to take measurements and be as detailed as possible.

**Step 7:** Review each group's designs carefully to ensure they are reasonable given the materials required and time frame of the assignment. Ask each group to explain to you how their machine will work.

**Step 8:** Conduct a safety lesson regarding the appropriate use of the tools. Ask students to use caution and remember that the tools are not toys.

**Step 9:** Under close adult supervision (you might need adult volunteers to help), ask students to begin the construction phase. It may take several class periods for students to complete their can crushers. Have students follow their directions carefully and encourage them to ask questions throughout the process.

**Step 10:** Once all of the machines are constructed, tell students that it is time to test them. Ask each group of students to demonstrate to the class how their can crusher works. Allow other students to ask questions.

## Assessment

1. Ask students to explain why it is important for recycling facilities to crush the aluminum cans.
2. Ask students why it is important to develop a detailed design first rather than immediately building a machine.
3. Have students explain why it is important to test the machine.
4. Have students explain how the machine makes crushing cans easier than doing it by hand.

## Enrichment

After everyone has demonstrated their crushers, have each student rank each project on a scale of 1 to 10 for each of several categories, such as: total cost of materials, ease of use, efficiency, size, safety, effectiveness, time to construct, etc.

1. Organize a recycling drive for aluminum cans at your school. The can crusher contest can be used to draw attention to the drive. The can crushers designed by the students can be used to help store the cans more easily before they are taken to a recycling center.
2. Invite a local recycling coordinator or recycling professional to your class to talk with students about what he or she does. Ask the visitor to bring in pictures of baled, crushed recyclables as well as samples of recycled products, if possible.

# Learn to Recycle

Art

Language Arts

## Objective

To teach students the specifics of recycling in their community or help them understand why their community does not recycle.

## Activity Description

Students will research local recycling options, including where to recycle, what can be recycled, and how to prepare recyclables.

## Materials Needed

- Supplies for presentation (will differ depending on format)
- Phone
- Computer with Internet access

## Key Vocabulary Words

Materials Recovery Facility (MRF)
Processing
Recyclables
Recycling

## Duration

Day 1: 1 hour+
Day 2: 1 hour

## Skills Used

Communications
Research

## Activity

**Step 1:** Explain to students that local governments and private companies usually manage solid waste and recycling. It is important that they understand what can be recycled to ensure proper recycling processes. (Refer to the Teacher Fact Sheet titled *Recycling* on page 101.)

**Step 2:** Assign specific research tasks to different groups of students. One group should make calls, search the Internet, or visit the local library to find out where to recycle locally (e.g., curbside service, drop-off locations). Another group should find out what items can be recycled and how to prepare those items for recycling (e.g., rinse plastic bottles and remove lids). Another group can discover how, when, and where to recycle nonstandard items (e.g., paint, electronics, packing peanuts, motor oil, batteries, hangers, fluorescent light bulbs, scrap tires).

Research can be conducted in the classroom, after school, or at home.

If students speak to a recycling official, have them inquire about recycling collection methods. Are the items separated by type or mixed together and sorted later? How does collection at businesses differ from household collection or collection at apartment buildings?

Students may also inquire about where their recyclables are sent after they are collected. What types of products are made from their recyclables? How are the materials processed to create other products?

**Step 3:** Each group should work together to present their findings. The presentations can be verbal, computer-based, artistic, etc. Presentations could be aimed at persuading a neighbor, family member, another student, or others, to recycle.

## Enrichment

1. Using the research already collected, or by doing additional research, have the students take a closer look at recyclables. Visit trade association and other Web sites to find out three facts for specific commodities (e.g., aluminum, glass bottles, paper, plastics, steel cans). What do the numbers imprinted on plastic containers mean? What percent of recycled steel is used to make a new steel can? How long does it take for aluminum cans to be recycled? Sample sites include <www.epa.gov/msw/reduce.htm>, <www.cancentral.com>, <www.afandpa.org>, <www.plastics.org>, <www.recycle-steel.org>, <www.gpi.org>, and <www.epa.gov/epaoswer/non-hw/muncpl/faq.htm#11>. List the facts in the worksheet and use it as the basis for a class discussion.
2. Use the information gathered to create a brochure, fact sheet, or video explaining "How to Recycle" in your community. Make copies for students of all grade levels to share with their parents or hand out at community events/locations (e.g., local library, township administration building). Coordinate with your local recycling officials to see samples of similar publications they may have produced or to have them check the accuracy of the information you are providing.
3. Start a school recycling club that students can join to learn about recycling and to serve as the recycling watchdog at school and within the community.
4. Let students see first hand what happens to trash and recyclables by taking a field trip to the local landfill and recycling center.

# Recycling: Just the Facts

Name: _____


## Assignment:

## Research Sources:

## Facts Learned:

Classroom Activity

Grades 4-8

science

math

# Recycling Includes E-Cycling

## Objective

To introduce students to electronics recycling.

## Activity Description

Assess different types of household electronics, their lifespan, and opportunities for recycling them.

## Materials Needed

- Worksheet: Electronics Inventory
- *Life Cycle of a Cell Phone* Poster (to order a free poster, call EPA at (800) 490-9198 and reference document number EPA530-H-04-002)

## Key Vocabulary Words

Recycle
Demanufacture
Life cycle
Remanufacture

## Duration

Two classroom periods

## Skills Used

Observation/classification
Communication

## Activity

**Step 1:** Provide students with an overview of the life cycle of electronics. The "life cycle" includes all aspects of the life of the electronics—from mining raw materials to manufacturing to disposal or recycling. Use the information below as well as the *Life Cycle of a Cell Phone* poster as sources of information for this discussion. Students can complete the activities on the poster as part of the classroom activity. You can also consult the Web site <www.plugintoecycling.org> for more background information.

Ask students to think of ways they can conserve the precious resources locked inside used electronics and how they can prevent pollution from disposal. Have them create a personal "to do" list addressing these issues.

Electronics are made from many different resources, including plastic (made from petroleum) and various metals (mined from the earth). That's why recycling electronics is so important to recover these materials to use again. Recycling electronics requires demanufacturing, or dismantling, them, which is labor-intensive, but it yields valuable resources that can be used to make new electronics or other products. In 1998, more than 112 million pounds of materials were recovered from electronics including steel, glass, plastic, and precious metals.

Electronics (especially computers) become outdated very quickly and need to be replaced often. In fact, nearly 250 million computers will become obsolete in the next 5 years. When no longer used, electronics are often thrown away, ending up in landfills and incinerators. Electronics can contain substances that can contaminate the soil and ground water. In fact, TVs and computers can contain an average of 4 pounds of lead (depending on their size, make, and vintage) as well as other potential toxics like cadmium, mercury, beryllium, nickel, zinc, and brominated flame retardants.

**Step 2:** For homework, ask students to take stock of the electronics in their home using the Electronics Inventory worksheet. They should inventory their entire household, noting all electronics—from computers to DVD players to calculators. They should estimate each item's life span and recyclability (e.g., computers must be replaced every few years, while calculators last longer). In addition, they should also think about where and how each item can be recycled/reused (e.g., donated to charity, sent back to the manufacturer, demanufactured).

If time permits, students may also want to contact electronics companies or use the Internet to find out which companies offer take-back programs for used electronics. Students can ask the companies or search the Web to find out if the products in their homes contain recycled-content materials or are designed for easier recycling.

Students may also want to contact their local government's solid waste office and ask for recommendations about recycling or donating used electronics.

**Step 3:** Discuss the results of the students' electronics inventories (see Assessment for discussion questions).

## Assessment

Ask students which electronics have the longest life span and why. Is it because of technology changes or better physical design? Do the newer models have more or fewer environmental impacts? How often do people need to buy new models of electronics? What else did students learn from their home inventories? How does what they learned apply to other items in their home?

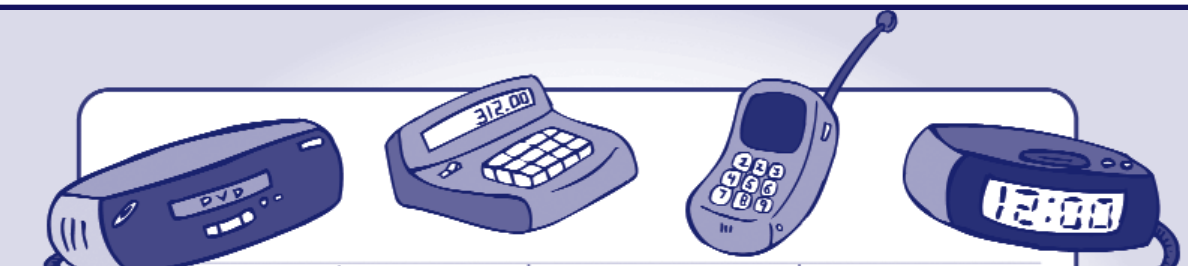
## Enrichment

1. Invite a local recycling official to speak to the class about electronics recycling and/or local electronics recycling events.
2. Take a field trip to an electronics recycling facility.
3. Ask students to think about questions they could ask electronics store employees the next time they are shopping. Do they accept used electronics for recycling? Do they know an organization that accepts them?

Student Handout

# Electronics Inventory

Name: _____




| Product | Life Expectancy | Recyclable or Reusable | Where to Reuse/Recycle |
|---|---|---|---|
| | | | |