Recycling Coalition of WV, Inc.

The Recycling Coalition of West Virginia (RCWV) is a non-profit environmental organization whose mission is to promote the effective and sustainable reduction, reuse, and recycling of materials otherwise destined for disposal. As an educational outreach, the coalition has developed lessons for West Virginia teachers so they and their students may recognize materials which may be recycled, realize that decomposition eventually restores some materials back to the soil, develop an understanding of the solid waste management practices related to recycling, incineration, sanitary landfills and hazardous waste disposal, and consider the role engineers play in solid waste management. The lessons align to WV CSOs, address content literacy, include text dependent questions, provide graphical representations of data, prompt students with investigations, and may be used across the curriculum instruction. Lessons may be modified in order to be used at different grade levels.

Recycling Investigations Lesson

Table of Contents

These following four lessons may be used in conjunction with the Investigation Lesson or as a separate resource. For electronic versions of this information or the Recycling Lesson Plans visit wvrecycles.com.

- ***Don't Waste the Moment-*** research the amount of waste generated in the school cafeteria;
- ***One Man's Trash is Another Man's Treasure-*** research the cost of waste disposal and possible savings when recycling and composting;
- ***Waste Not, Want Not-*** investigate and make decisions about composting; and
- ***Reclaiming and Replacing-*** investigate what happens when land fills get filled, then research and propose solutions to the problem.

Recycling Investigations

Overview

For more than thirty years, the U.S. Environmental Protection Agency (EPA) has been collecting data on the generation and disposal of municipal solid waste (MSW) in the United States. Waste reduction and recycling programs across the country are measured and used to determine the amount of waste generated. In 2012, Americans generated about 251 million tons of trash and recycled and composted over 87 million tons of material, which is equivalent to a recycling rate of 34.5 percent. On average of the 4.38 pounds of solid waste generated by every person each day, we recycle or compost about 1.51 pounds of that waste.

Recycling is the process of turning used waste and materials into new products. This prevents potentially useful materials from being wasted, as well as reducing energy use and pollution. The energy required to convert raw materials such as minerals, oil and trees into metals, plastics and paper is far greater than the amount of energy required to collect and recycle our paper, bottles and cans into new products. A wide variety of different materials can be recycled, including paper, plastic, glass, metal, textiles and electronic equipment. Historical evidence shows that humans have been recycling various materials for thousands of years.

If solid waste is discarded and separated by material, such as paper, cardboard, yard trimmings, food scraps, plastics, durable goods like furniture and nondurable goods like packaging or clothing, you would find the percent of the waste stream before recycling.

Use complete sentences and the graphs on page 2 to answer the questions below.

1. How did the annual amount of Municipal Solid Waste (MSW) change from 1960– 2012? Indicate the amount in million tons.

2. How much of a change was there in the annual per capita generation for that same time period?

3. What does per capita mean?

4. How did the annual amount of recycling of the MSW change from 1960– 2012?

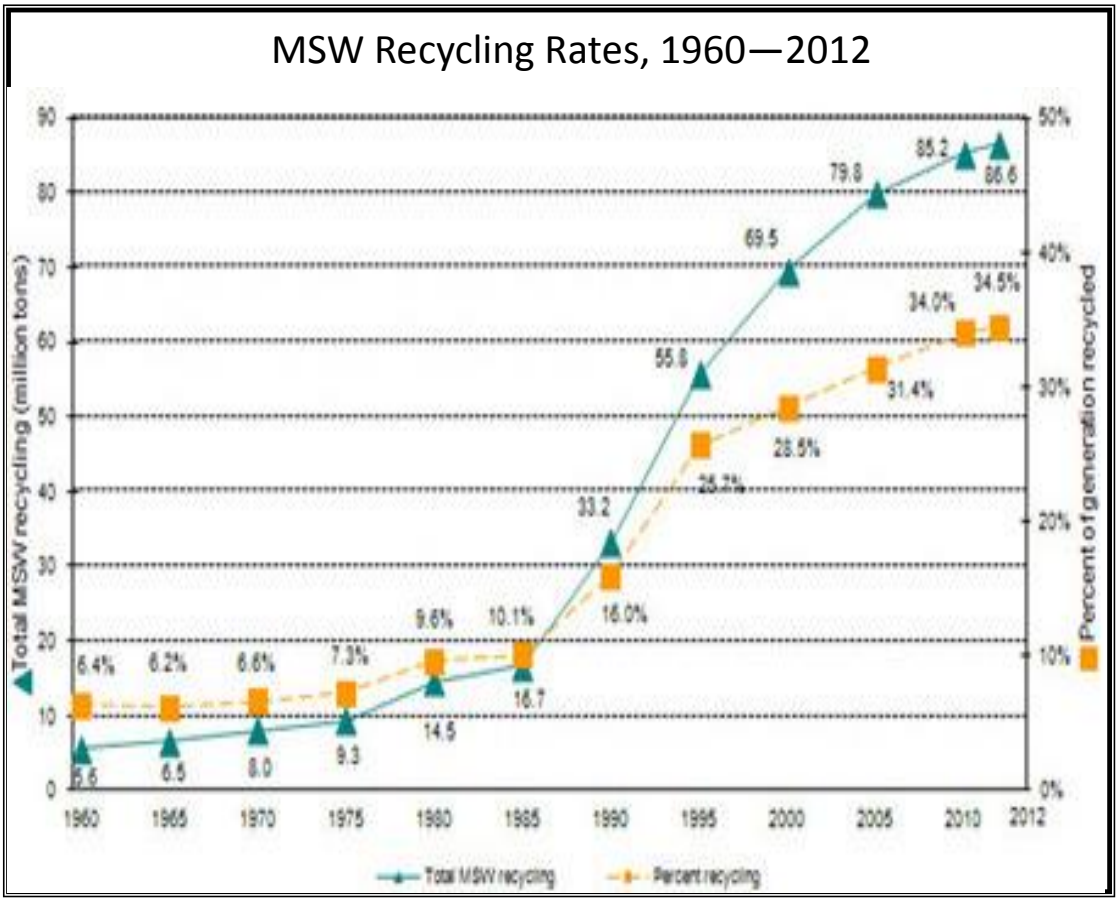
5. What percentage represents that change?

The U.S. Environmental Protection Agency (EPA) data for the United States,

http://www.epa.gov/wastes/nonhaz/municipal/pubs/2012_msw_fs.pdf

MSW Generation Rates, 1960—2012

MSW Recycling Rates, 1960—2012

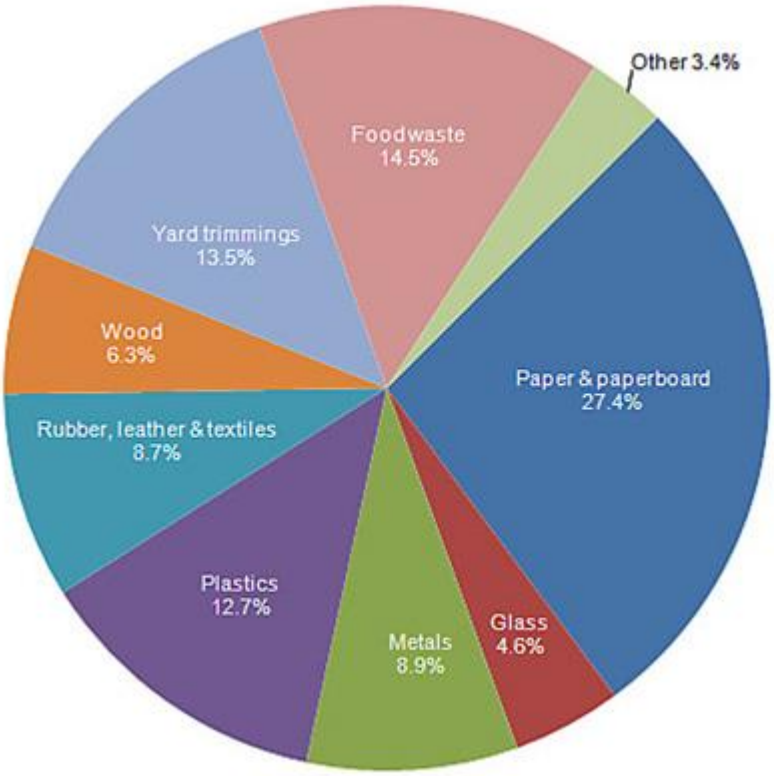


The U.S. Environmental Protection Agency (EPA) data for the United States,

http://www.epa.gov/wastes/nonhaz/municipal/pubs/2012_msw_fs.pdf

2012 Total MSW Generated (By Material)

251 Million Tons (before recycling)



Use complete sentences and the graph above to answer the questions below.

6. How many of the above listed items above can be recycled?

7. What percent of the materials above can be composted?

8. Which of these items are recycled in *your* community?

Municipal Solid Waste

In 2012, there were 251 million tons of waste discarded before recycling. The largest component of municipal solid waste is actually organic material including paper and cardboard, which comprise 27 percent and yard trimmings and food scraps that account for another 28 percent. Remember these percentages are based on weight and before recycling. Note that plastics account for about 13 percent, metals make up about 9 percent, and rubber, leather and other textiles are about 9 percent.

9. What is the largest component of municipal solid waste?

Investigate MSW

What about West Virginia; how much MSW do we generate?

Greenbrier County Solid Waste Authority accepts numerous recycled materials at the drop-off center which is open 24/7 and located at 812 Monroe Avenue, Ronceverte, WV.

Recycling MSW

In 2012, significant amounts of material from each category were recycled or composted. The highest recovery rates were achieved in paper and cardboard, yard trimmings, and metals. As a nation, we recycled more than 76 percent of the paper, cardboard and packaging we generated. Over 19 million tons of yard trimmings were composted, which is almost a five-fold increase since 1990. Recycling these three materials alone kept almost 29 percent of MSW out of landfills and incineration facilities.

Recycling has environmental benefits at every stage in the life cycle of a consumer product. Starting with

the raw material with which it's made to the final method of disposal, recycling reduces the impact on the environment. For starters, recycling a material verses making the product from raw materials, recycling reduces greenhouse gas emissions which contribute to global warming. Recycling also reduces air and water pollution associated with making new products from raw materials. Recycling also provides significant economic and job creation impacts right here in the USA.

In 2012, the 86.6 million metric tons of municipal solid waste we recycled and composted prevented carbon dioxide equivalent emissions comparable to removing the emissions from over 33 million passenger vehicles. The benefits from recycling are cleaner land, air, water, overall better health, and a more sustainable economy.

Use complete sentences to answer the question below.

10. In 2012, as recycling rates increased, what decreased?

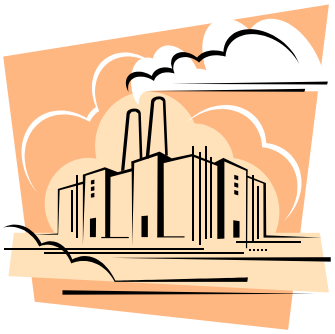
Investigate Recycling MSW

A. Where is recycling done in your community to recycle?

B. What can you do to promote recycling?

C. Research what can be done with recycled plastic. How many examples can you find?

Incineration



To reduce solid waste volume sometimes a controlled burning process called combustion or incineration is used as a method to dispose solid waste. In addition to reducing volume, incinerators can convert water into steam to fuel heating systems or generate electricity. Incineration facilities can also remove materials for recycling. Over one-fifth of the U.S. municipal solid waste incinerators use refuse derived fuel that are equipped to recover recyclables first, then shred the combustible fraction into fluff for incineration.

Pollution control technologies significantly reduce the gases emitted into the air during incineration, including scrubbers, or devices that use a liquid spray to neutralize acid gases, and filters which remove tiny ash particles. The temperature at which the waste is burned also has an effect on the environment.

Burning waste at extremely high temperatures destroys chemical compounds and disease-causing bacteria. Regular testing ensures that residual ash is non-hazardous before being landfilled. About ten percent of the total ash formed in the combustion process is used for beneficial use such as daily cover in landfills and road construction.

Sanitary Landfills

Tucker County Solid Waste Authority Landfill is located between Davis and Thomas, West Virginia

Modern landfills are well-engineered facilities that are located, designed, operated, and monitored to ensure compliance with West Virginia and federal regulations. Solid waste landfills are designed to protect the environment from contaminants which may be present in the solid waste stream. Dumps are not lined to protect the environment. All sanitary landfills used in West Virginia are lined with two layers of plastic, rocks and clay, which protect the surrounding soil and groundwater from being contaminated. Each day the top layer of garbage is covered with soil or another alternate daily cover, to control odors and prevent animals from scavenging. A solid waste authority solid waste facility siting plan prevents the siting of landfills in environmentally-sensitive areas. On-site environmental monitoring systems monitor for any sign of groundwater contamination and for landfill garbage juice or leachate. Many of West Virginia's landfills collect potentially harmful landfill gas emissions that are a bi-product as materials decompose within the landfill. This gas is converted into energy and sold or burned to eliminate carbon dioxide from becoming a greenhouse gas.

Use complete sentences to answer the question below.

11. Why is the incineration process done at very high temperatures?

Investigate Incineration and Sanitary Landfills

Where is trash taken when it leaves your home? Your school?

Hazardous Waste Disposal

Leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients are considered to be household hazardous waste (HHW). These include products like paint, cleaners, batteries, oils and pesticides which contain potentially hazardous ingredients.

Improper disposal of HHW can include pouring them down the drain, on the ground, into storm sewers, or in some cases putting them out with the trash. The dangers of such disposal methods might not be immediately obvious, but improper disposal of these wastes can pollute the environment and pose a threat to human health. Many communities offer a variety of options for conveniently and safely managing HHW. Check the label for specific disposal recommendations.

Did you know about recycling paper?

- Recycled paper can be made from three different types of paper; mill broke is paper scrap and trimmings, pre-consumer waste is paper that was discarded before consumer use, and post-consumer waste is paper that was discarded after it was used by a consumer, such as old newspapers.
- One ton of recycled office paper saves approximately: 4,100 Kwh of energy; 9 barrels of oil; or 54 million BTU's of energy. [U.S. EPA]
- The average American uses seven trees a year in paper, wood, and other products made from trees. This amounts to about 2 billion trees per year! ["50 Simple Things Kids Can Do To Save The Earth"]
- Public sector investment in local recycling programs pays great dividends by creating private sector jobs. For every job collecting recyclables, there are 26 jobs in processing the materials and manufacturing them into new products. [National Recycling Coalition]
- In 2012, Americans recycled about 65 percent of the paper they used. Nearly 80 percent of America's paper mills are designed to use paper collected in recycling programs, and depend on paper recycling to supply the raw materials they need to make new paper. [American Forest and Paper Association]
- Recycling all of its office paper waste for one year, an office building of 7,000 workers could reduce greenhouse gas emissions by 546 Metric Tons of Carbon Dioxide Equivalent. This is the equivalent to taking nearly 400 cars off the road that year. [U.S. EPA]
- West Virginia's recycling centers, transfer stations, waste haulers and landfills paid out in excess of $73,628,882 salaries and wages in 2011, creating an estimated 2,078 jobs. [West Virginia Solid Waste Management Board]

Use complete sentences to answer the question below.

12. What are the three categories of papers which may be recycled?

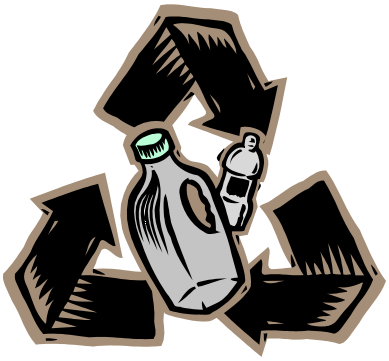
Investigate Recycling Paper

A. How much paper is thrown away from your school everyday? Every week?

B. What are the organizations or businesses in your community that use a lot of paper?

C. Is there a place in your community where paper may be recycled? Where?

Did you know about recycling plastics?



- According to the National Association of PET Container Resources, the total weight used in the U.S. in 2012 polyethylene terephthalate (PET) plastic bottles was 5.586 billion pounds.
- Recycled plastic bottles make hundreds of everyday products, including fleece jackets, carpeting and lumber for outdoor decking. PET plastic bottles were recycled in 2011 at a rate of 30.8 percent.
- Enough plastic bottles are thrown away each year to circle the earth four times. ["The Recycler's Handbook" by Earth Work Group]

- It takes 2/3 less energy to produce a plastic bottle from recycled materials verses a plastic bottle made from raw (virgin) materials. The process of recycling plastic bottles is complicated by separating out different grades or types of plastic.
- By recycling a single plastic bottle, enough energy is conserved to light a 60 watt light bulb for six hours. PET bottles can be recycled into fiber used to weave new carpets or clothing. It takes nineteen 20 oz. PET bottles to make one square foot of carpet or one extra large T-shirt.
- What can you do in your community to recycle any plastic?

Use complete sentences to answer the questions below.

13. What may be done with recycled plastics?

14. Contrast the energy needed to make plastic when it is made from raw materials and recycled materials.

Investigate Recycling Plastics

A. How much plastic is thrown away from your home every week? Every year?

B. Are there things which may be done differently so that the amount of plastic thrown away may be reduced? Explain.

Did you know about recycling aluminum?

- It takes energy to recycle, but it also saves energy over producing a product without any recycled content.
- Recycling one aluminum can saves enough energy to run a television for three hours.
- Making an aluminum can from virgin materials takes 20 times more energy than it takes to recycle an old can. [Reynolds Metal Company]
- Recycling one aluminum can saves the energy equivalent to one cup of gasoline. [U.S. EPA]
- A used aluminum can that is returned for recycling will be recycled into a new can in about 60 days.
- Recycling one ton of aluminum saves approximately 10 cubic yards of landfill space. [U.S. EPA]
- Even though aluminum is one of the most recycled materials today, about half of all cans are not recycled.
- There are 33 cans in one pound of aluminum.

Use complete sentences to answer the questions below.

15. Contrast the energy needed to make aluminum when it is made from raw materials and recycled materials.

16. If your school or organization collected and recycled 5000 aluminum cans, how many pounds of aluminum would you have?

Investigate Recycling Aluminum

A. What is being paid for a pound of recycled aluminum?

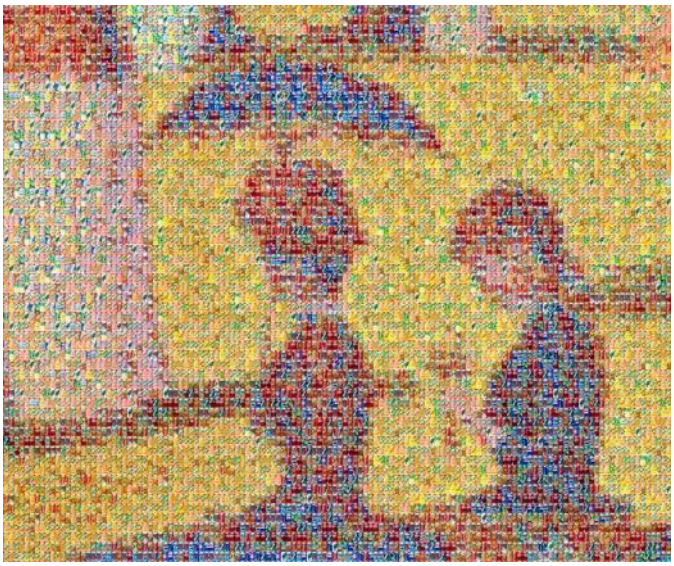
B. How much money could your school or organization earn if they had collected and recycled 5000 aluminum cans?

Every day it is estimated that people generate about 4.4 pounds of trash. Overall, the U.S. recycles approximately 32 percent of its waste, which saves an equivalent amount of greenhouse gases by removing 39.6 million cars from the road. Increasing the recycling rate to 35 percent would reduce greenhouse gas emissions by an additional 5.2 Million Metric Tons of Carbon Dioxide Equivalent. [U.S. EPA]

Consumption Visual Impact Exercise

448 discarded cans were arranged to make the image to the left.

Approximately 7,600 cans were used to make the image to the right.



The image above was made by arranging 106,000 cans, the amount that is used in the USA every thirty seconds.

Glossary

Biodegradable– Capable of being broken down especially into harmless products by the action of living things. Items that aren't biodegradable will take a very long time to disintegrate and are therefore more wasteful.

Buy-back Centers– Locations where certain materials (metals and aluminum) are exchanged for money.

Closed-loop Recycling - When a product is recycled and used again in the same form; example- used aluminum cans are melted into scrap and then combined with mined ore to create a new can.

Curbside Collection – When recycling vehicles are used to pick up waste material intended for recycling along residential streets.

Drop-off Centers - Where waste materials are placed at a specified location so they may be collected for recycling.

Landfill – A facility where trash is taken and buried in the land for the purpose of permanent disposal.

Leachate - A liquid that moves through or drains from a landfill. The liquid may either exist already in the landfill, or it may be created after rainwater mixes with the chemical waste. Modern landfills are designed to prevent liquid from leaching out and entering the environment; however, if not properly managed, the leachate is at risk for mixing with groundwater near the site, which can have dire effects.

Lightweighting - Making less garbage from the start. Example– some plastic bottles are made with less material today than 15 years ago. Using less material on every bottle means that less waste is produced and fewer natural resources are consumed.

Municipal Solid Waste (MSW) - More commonly known as trash or garbage which comes from our homes, schools, hospitals, and businesses; includes materials like packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries.

Material Recovery Facilities (MRFs) - Facilities where wastes are separated either mechanically or physically, and material is recovered for the purpose of recycling and reuse.

Pre-cycle – Active process of making purchasing decisions based on products made from materials or with packaging that can be readily recycled.

Reduce - To make something smaller or use less, resulting in a smaller amount of waste. Buying products with less packaging is one way to reduce the amount of waste.

Reuse - Instead of throwing something away; pass those materials on to others who could use them again. Rather than throwing broken items in the garbage, repair broken items rather than replace them when they break. When you do decide to replace something large and "reusable," be sure to donate the old one to a charity like Goodwill, Salvation Army or Habitat for Humanity.

Recycle - Cans, bottles, paper, and cardboard can be remade into either the same kind of thing or new products. Making new items from recycled ones also takes less energy and fewer resources than making products from brand new materials.

Source Reduction - Reducing waste before you purchase it or by purchasing products that are not wasteful in their packaging.