Plastics by the Numbers

Objectives

Students will be able to:

- ➡ recognize the role of plastics in our society,
- ➡ describe the differences in plastic composition,
- ➡ demonstrate the separation of plastics for collection and recycling, and
- ➡ explain the recyclable nature of different types of plastic.

Method

Students will discover and identify several physical properties of plastics and record this information in a chart to better understand plastic use.

Materials

- Handouts – "Plastic Container Identification Code" and "Plastic Container Worksheet" (included in this lesson)
- Collection of plastic items displaying the recycling symbol (several examples of all seven types)

Time

1 Hour

Vocabulary

- recycle
- source reduction
- waste

Background

The generic word plastic refers to a wide range of materials. This can be confusing since there are 45 basic families of plastics and each can be made with hundreds of variations. Plastics are made from crude oil and natural gas. Basic compounds of carbon, hydrogen, oxygen, and nitrogen are extracted and combined to produce plastics. Plastics are extraordinarily diverse. From contact lenses to soft drink bottles to computer consoles to automobile airbags, plastics are a family of materials that, through technology, can be used in many different forms.

The plastics industry has developed stronger and more versatile products, allowing manufacturers to do more with less, thereby conserving resources and reducing waste. Plastics manufacturers have invested in technologies that make their products lighter and more energy-efficient. Lightweight plastics often enable companies to ship more products using less fuel. For example, plastic grocery bags use 70 percent less materials now than they did 25 years ago.

Plastics prevent waste by keeping perishable foods fresh longer and by helping protect products from damage, breakage, and spoilage. Some plastic products are durable and easily reusable.

Many communities across the country now recover some type of plastic for recycling, with residents actively participating in curbside or drop-off recycling programs. These collected items are being used by

the plastics recycling industry to make new products such as bottles, office supplies, carpeting, jackets, and even hiking boots.

Since different plastics offer different properties that can be engineered to meet the requirements of a broad range of applications, the success of a product is often dependent on matching the right plastic with the right properties to the right application.

The Society of the Plastics Industry resin identification code enables recyclers to separate the resins by type, ensuring that the recycled plastic is as homogeneous as possible to meet the needs of the end markets. Biodegradable and compostable plastics are increasingly being introduced. These plastics are primarily reproduced from renewable resources (i.e. corn, switchgrass, and grain). These plastics most frequently may be labeled Number 1 or 7.

Local recycling education programs frequently use both the number on the plastic container and product type that may be recycled, as an example "We accept Number 1 and Number 2 plastic containers for water, soda/pop, milk, and similar consumable beverages." A recycler may be challenged to indentify the type of plastic by locating the number on the container and some recycling programs are eliminating the reference to the number or plastic identification code.

Procedure

1. To begin the lesson, ask students to share with the class their favorite type of cake. List on board or use computer to project list onto screen. Ask the students to compare and contrast the ingredients to make different types of cake including questions like do they all have the same ingredients, do some have fruit and others don't. Briefly discuss how these are categorized as cake and yet they are different. You may want to make this an assignment before class for students to research the ingredients for their favorite cake.
2. Introduce the topic of plastics to the students. Brainstorm types and uses of plastics. Different plastics are suitable for different uses. Discuss the need for manufacturers to choose resin type carefully.
3. Give the students copies of the handout "Plastic Container Identification Code." Discuss the components of the handout. Practice pronouncing the full name of each type of plastic.
4. Give the students copies of the handout "Plastic Container Worksheet."
5. Ask students to sit in a circle around the pile of plastic containers they have brought in or that you have provided. Have each student select a container and begin to record the required information on the "Plastic Container Worksheet."
6. On your signal, ask students to begin passing the containers to the right, again asking them to log the required information on their worksheets. Keep the stream flowing until all blanks are filled or until seven types are entered. Students may "draw" from the pile if necessary to keep the activity moving.
7. Have the students share their conclusions based on the data recorded on their charts.
8. In the center of the circle or on a table, group the containers by their plastic code numbers. Discuss the properties of each.
9. Find out the types of plastics that are collected for recycling in your community. Set apart those numbers and/or container types. Have students describe differences in these containers and others to consider why these are recyclable.

Assessment

- Ask students: What role does plastic play in our society? Describe the plastics identification code, including numbers and descriptions of each. Why do we need a plastics identification code?

Technology Connection

Websites to consult:

- American Chemistry Council (http://www.americanchemistry.com/s_plastics/sec_learning.asp?CID=1102&DID=4256
- Society of the Plastic Industry (http://www.plasticsindustry.org/)
- National Association for PET Container Resources (http://www.napcor.com)
- Association of Manufacturers of Polyester Film (http://www.ampef.com)
- Association of Postconsumer Plastic Recyclers (http://www.plasticsrecycling.org)
- Environmental Protection Agency "Recycle on the Go" initiative (http://www.epa.gov/epawaste/conserve/rrr/rogo/index.htm)
- Mohawk Industries - learn about carpet made from recycled PET (http://www.mohawkflooring.com/carpeting/everstrand/default.aspx)
- PET Container Recycling Europe (http://www.petcore.org)
- PET Resin Association (http://www.petresin.org/)
- Society of Plastics Engineers (http://www.4spe.org)

Enrichment

- Using the handout “Enrichment: Plastic Container Survey” have students survey their homes and/or grocery store. In class, analyze the data collected on the survey sheet.
- Based upon the information collected from other research and reports, have students describe the role of home, school, and community in plastics recycling efforts. Discuss the relationship between the SPI code (SPI stands for Society of the Plastics Industry) and plastics recycling. How can home, school, and community participate in collection and recycling programs?
- Using information provided students will explore the density of plastic. They will learn differences in the composition of different types of plastic, how their compositions impacted whether the plastic can be recycled, and why water bottles are easily recycled when plastic cups are not. They will also learn why all #2 coded plastic cannot be recycled.

Materials

- Pieces of cut up plastic number 1-7
- Plastic bottle #1 with cap
- Container of water for each group
- Salt

Enrichment Density Procedure

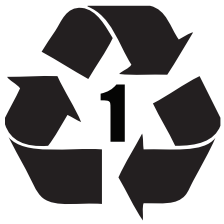
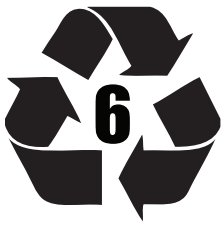
1. To begin Enrichment, ask students to think about a pancake and a biscuit - although they are made of the same ingredients, (water, eggs, flour and milk) there are different quantities of these ingredients within each item. Pancake batter is runnier than biscuit batter making it easier to pour whereas biscuit batter is more easily molded. Also, once you make the batter for each item, you cook them at different temperatures but for differentlengths of time. Pancakes cook relatively quickly at a high direct heat on the stove, while biscuits have to be put in an oven and given time to bake. Plastics are the same way. They all have the same initial components which constitute being plastic and relate to the number they are given (i.e. 1-7); however, the individual makeup within each product dictates our ability to recycle it.
2. Explain to students that some of these plastics will sink and some will float. Demonstrate float or sink with an empty bottle with the cap on. Why does it float? Now take the cap off and fill it with water? Why does it sink?
3. Discuss with students how the shape of an item can affect its ability to float or sink. Divide students into small groups. Hand out Plastic Container Worksheet and mark float or sink under observable package properties column.
4. Have students predict which pieces of plastic will sink and which will float. Allow students to examine the plastic in small groups.
5. Put plastic pieces in the water and record observations.
6. Discuss why floating litter would be a problem for aquatic animals.
7. How would the plastics behave if the water was very salty (like the ocean)? To test this, add several heaping tablespoons to the water and stir well. Retest plastics.

Sample of how plastic pieces will react.

Material	Floats or Sinks
#1 plastic bottle with cap	Floats
#1 plastic bottle without cap	Sinks
#1 plastic non-bottle	Sinks
#2 plastic bottle with cap	Floats
#2 plastic bottle without cap	Floats
#2 plastic bag	Floats
#3 container (with or without cap)	Sinks
#4, 6-pack ring	Floats
#4 plastic bag	Floats
#5 plastic container	Floats
#6 expaned	Floats
#6 non-expanded	Sinks
#7 PLA bio-based plastic	Varies
# 7 plastic bottle	Varies

Enrichment adapted from RE3.org

Definitions

	**PETE (or PET) – polyethylene terephthalate**
	Commonly used to package soft drinks, water, beer, juice, sports drinks and other beverages, as well as edible oils, salad dressing, peanut butter, various condiments and sauces, and non-food products like household cleaners and personal products.
	**HDPE – high density polyethylene**
	Commonly used for milk, cider and water jugs, as well as detergent, fabric softener and bleach.
	**V or PVC– vinyl/polyvinyl chloride**
	Often used for salad dressing bottles, vegetable oil bottles, mouthwash, and PVC pipes.
	**LDPE – low density polyethylene**
	Used for flexible bags for dry cleaning, trash, produce, bread and shrink wrap. Recycled LDPE is often used to make grocery bags.
	**PP – polypropylene**
	Usually found in drinking straws, battery cases, some dairy tubs, bottle labels and caps.
	**PS – polystyrene**
	Commonly used for materials like expanded: packaging peanuts, meat and egg trays, and non-expanded: drinking cups, plastic utensils/cutlery, and yogurt cups.
	**OTHER**
	Other plastics are often made of multiple resins or layers of different types of plastics. These may include microwavable packages or snack bags. Compostable plastics are usually included as 'other.'

Source: NAPCOR

Student Activity Sheet
Plastic Container Worksheet

Name: _____ **Date:** _____

Container Sample	Letter Code	Type of Product	Observable Package Properties
Numeric Symbol	Examples: PET, HDPE, V or PVC, LDPE, PP, PS, Other	In this column, write the name of the product or sketch its shape	Examples: flexible, rigid, transparent, opaque, translucent, color, white, creases when crushed, sink or float, other…
			
			
			
			
			
			
			

Student Activity Sheet

Enrichment: Plastic Container Survey

Name: _____ **Date:** _____

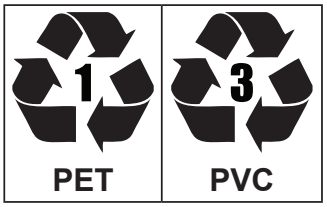
Directions

1. Conduct a plastic package survey in a grocery store or at home.

Which store or aisles?

Which rooms at home?

2. Look at the bottom of each plastic package. Find the Society of the Plastic Industry (SPI) code. Record the number symbol and the letter code, e.g.:



Student Activity Sheet

Name: _____ **Date:** _____

Data Analysis and Conclusion

Analyze your data. Count how many times you found each code.

_____

_____

_____

_____

_____

_____

_____

Which was the most frequent? _____ Which was the least? _____

Calculate the percent for each code. If you filled in all 50 boxes, count the number of boxes for each code, then multiply the number by 2 to get the percent; or use this formula:

$$\frac{\text{counts for a code}}{\text{counts for all codes}} \times 100 = \text{percent of the code in total}$$

What surprised you about your results? (You may use the back of this page to write your answer.)