Know your plastic!

Grades: 4
State Standards:
Grade: 4; Math 1.1 Formulate survey questions; systematically collect and represent data; coordinate graphs, tables, and charts. 1.2 Identify the mode(s) for sets of categorical data and the mode(s), median, and any apparent outliers for numerical data sets. 1.3 Interpret one and two variable data graphs to answer questions about a situation.
Preparation Time: 25 minutes
Activity Time: 50 minutes
Key Words: Plastic Polymers, petroleum hydrocarbons

OBJECTIVE

Students conduct a series of tests to determine the properties of different types of plastics. They will audit the plastic waste generated in their homes, understand the positive and negative impacts of using plastic. Learn about barriers to recycling some forms of plastic and the ways in which plastic is remade into new products. Students will graph their results.

MATERIALS

Test Your Plastic Polymers worksheet and Plastics at Home handout, Plastics Coding System; Several plastic dish pans or buckets for the float test. About a week before you begin this lesson, ask students to bring to class a variety of plastic containers that are empty and clean. (Optional) A plastic sandwich bag (soft film, not thick ziploc), a pencil, water.

BACKGROUND

Plastics are made up of building blocks called hydrocarbons, which are derived from petroleum or natural gas, also called fossil fuels. They are considered nonrenewable resources because the conditions under which they were formed no longer exist. Also, the mining, transportation and refining of petroleum creates a lot of pollution. By reusing plastics again and recycling what we can, we can help slow the virgin production of this natural resource. There are seven types of plastic, all with different scientific properties. Because of the differences in their properties, they cannot be melted together to form new plastic. It is difficult (with current technologies) to collect and properly sort the different types of plastic from one another which makes recycling opportunities for plastics more limited than some other materials. Today, plastic numbers 1 and 2 are commonly accepted in community recycling programs. In the future, technology and innovation will hopefully lead to greater collection, recycling and remanufacture of plastics into other useable products.

PROCEDURE

(Optional introductory activity.)

- Fill a plastic sandwich bag with water.

- Ask for a student volunteer who is brave to stand under the bag while you push a sharp pencil through it.

- Hold the bag over the volunteer's head. Jokingly tell the class that this event has never before been viewed on national television. Slowly rotate the sharp pencil in through one side of the bag and out the other side. No water should leak out. (Do not push the pencil through completely.)

- Ask the students to hypothesize why the bag did not leak when the pencil was pushed through.

- Explain where plastics come from and that the petroleum hydrocarbons are chemically altered from a monomer (one) into a polymer (many) molecular chains. As the pencil is pushed through the bag, it slips between these chains. Unbroken, the chains slide around the shape of the pencil, sealing in the water. A dull pencil, however, breaks the chains and causes the bag to leak. When the pencil is removed, the polymers may move somewhat towards their original shape, but not enough to close the large pencil hole.

- Have the volunteer carefully dispose of the water.

Activity

- Assign students to scientific teams of three to four people.

- Provide a set of unlabeled plastic samples from as many types of plastic that you could find and the worksheet "Test Your Plastic Polymers" for each group.

- Ask students to record each sample's plastic properties on the chart.

- Distribute a copy of "Plastics Coding System" to each group. Have students complete their charts by deciding which type of plastic each sample represents

- As a class, which plastic code(s) were rigid, clear and squeezable. On the blackboard fill out a pie graph.

- At home, have students fill out the "Homework" worksheet containing a survey and associated table.

Discussion

Encourage students to share their results. Discuss the different properties of the different types of plastics (i.e. stiff, light, flexible). Why are there many different kinds of plastics in use? Different resins are suited to different uses, depending on their strength, flexibility, and resistance to specific chemicals or heat (some bottles are filled with hot liquids).Why do plastics have to be separated before they can be recycled? Each plastic has a different set of properties and is used for specific purposes. Various plastics have different melting points, so if they are mixed together, the process becomes contaminated and no longer results in a reusable new plastic.

Explain to students that the recycling process for plastic containers includes: (1) sorting the containers by their resin types; (2) cutting the plastic into tiny pieces, called pellets; (3) melting the pellets; and (4) reshaping into new plastic objects.

Note: Students should be advised to never melt plastic themselves because the fumes are very dangerous to your health and to the air quality.

Extension
Discuss alternatives to disposal and reusable plastic products such as glass and stainless steel. Are there alternatives that are less harmful to the environment, safe, and still provide convenience of use?

ASSESSMENT

With the focus of recycling and reusing various plastics, students will have an understanding of unifying concepts and processes, physical science: matter

- Apply comparison concepts of gradient, scale, symmetry, quantification, and invariance

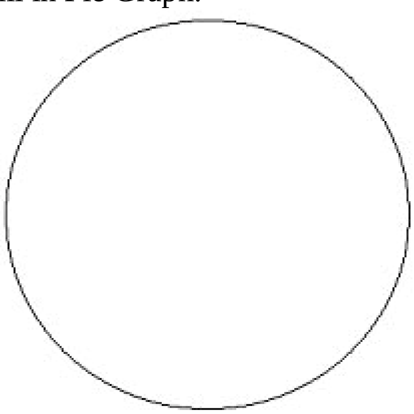
- Understand structure and properties of matter

Test Your Plastic Polymers

Number	**Semi-Rigid Y/N**	**Flexible Y/N**	**Clear Y/N**	**Opaque Y/N**	**Floats Y/N**	**Foam Y/N**	**Crinkly Y/N**	**Glossy Y/N**
1								
2								
3								
4								
5								
6								
7								

What is the percentage of #1 and #2 plastics you found compared to the other plastics?
(example: 11 out of 20 would be, 11 divided by 20, which is 55 or 55 percent)

Fill in Pie Graph:



Plastic Coding System / Plastic Bottle Properties

There are 7 different groups of plastics. Each group has its own Plastic Identification Code.

	Polyethylene Terephthalate (PET)	High Density Polyethylene (HDPE)	Polyvinyl Chloride (PVC)	Low Density Po□yethylene (LDPE)	Polypropylene (PP)	Polystyrene (PS)
Plastic ID Code	1 PETE	2 HDPE	3 V	4 LDPE	5 PP	6 PS
Clarity	Clear	Translucent	Clear	Translucent	Translucent	Clear
Moisture Barrier	Fair to Good	Good to Excellent	Fair	Good	Good to Excellent	Poor to Fair
Oxygen Barrier	Good	Poor	Good	Poor	Poor	Fair
Max. Temperature	120F	145F	140F	120F	165F	150F
Rigidity (Stiffness)	Rigid, Glossy Sinks in water	Semi-rigid, sinks in water	Semi-rigid, glossy, sinks in water	Flexible, not crinkly	Simi-rigid, low gloss	Often brittle, glossy
Resistance to Impact	Good to Excellent	Good to Excellent	Fair to Good	Excellent	Poor to Good	Poor to Good
Resistance to Heat	Poor to fair	Good	Poor to Fair	Fair	Good	Fair
Examples:	Soda bottles	Milk, water jugs, bleach bottles	Detergents, pipes	6-pack rings, bread bags, sandwich bags	Margarine tubs, screw on lids, straws	Styrofoam, packing peanuts, egg cartons
Resistance to Sunlight	Good	Fair	Poor to Good	Fair	Fair	Poor to Fair

7 Other

Note:

Plastic ID Code "7" is for the other plastics except above mentioned 6 groups. Properties; squeezable. Examples; ketchup and syrup bottles.

If the container is manufactured using a blend of plastics, eg two or more plastics (PET and any other polymer), the container should be identified 7.

HOMEWORK

Student Name:___________________________________

Look around your home for things packaged in plastic (# 1-7). Fill in the chart below.

Which plastic code number was the most common (occurred the most frequently)?

Which plastic code number(s) were rigid (not bendable)?

Which plastic code number(s) were clear in color?

Which plastic code number(s) were squeezable?

Product and size of product in a plastic container	Plastic container Code number	Recyclable in your community? Yes/No	Disposal method for this plastic (landfill or recycling center)	How can this plastic be reused?
1.				
2.				
3.				
4.				
5.				
