Lesson: Plastic Polymers

Grade: 4-5
Subject: Science
Objectives:
Students will:

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

Teaching Time: 45 minutes

About a week before you begin this lesson, ask students to bring to class a variety of plastic containers that are empty and clean (#1-#7). Cut pieces approximately two inches square from each plastic sample. (Label one master key set for yourself with a permanent marker.)

(Continued...)

Lesson concept borrowed from South Carolina Dept. of Health and Environmental Control and the California Integrated Waste Management Board's curriculums.
(See Acknowledgements.)

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.

Procedures:

(Optional introductory activity.)

Materials needed: a plastic sandwich bag (soft film, not thick ziploc), a pencil, water

- 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.

(CORE lesson)

- 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.

Materials: worksheet, Test Your Plastic Polymers and Plastics at Home; handout, Plastics Coding System; Several plastic dish pans or buckets for the float test.

Reflection/Response:

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

Extensions:

- Find out which plastics are recycled in your area. Plastic containers marked with plastic number codes 1 and 2 are commonly recycled.
- Discuss the negative aspects of using a nonrenewable resource and ways to slow our consumption of these resources.
- Assign the activity "Plastics At Home" as homework. Share reuse possibilities with the class.

Oregon Common Curriculum Goal:

Science: Unifying Concepts and Processes, Physical Science: Matter

- Apply comparison concepts of gradient, scale, symmetry, quantification, and invariance
- Understand structure and properties of matter.

Grade 5 Benchmark:

Students will:

- observe and record change in phenomena for a period of time.
- sort data and display in a logical sequence.
- distinguish among solids, liquids, and gases.
- identify unique properties of each state of matter.

Worksheet: Plastics At Home - *An Investigation*

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?
Example: gallon of milk	*2*	*YES*	*Recycling Center*	*For a storage container; planter; piggy bank.*
1.				
2.				
3.				
4.				
5.				
6.				
7.				

Using your Plastic Coding System handout, list some of the positive environmental qualities of plastic and some of the negative._____

_____

Worksheet: Test Your Plastic Polymers

Group Name:_____

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

Handout: Plastics Coding System

Abbreviation	Scientific Name	Properties	Examples	Environmental Qualities
PETE 	polyethylene Terphtahalate	usually clear or green, sinks in water, rigid, glossy	soda bottles butter jars	recycled into fleece coats, carpet, surfboards
HDPE 	high density Polyethylene	semi-rigid, sinks in water	milk, water jugs juice, bleach bottles	recycled into plastic lumber products like picnic tables
PVC 	polyvinyl chloride	semi-rigid, glossy sinks in water	detergent/cleaner bottles, pipes	the by-products from manufacturing are known to cause cancer; recycled into handrails, house siding
LDPE 	low density polyethylene	flexible, not crinkly	6-pack rings, bread bags, sandwich bags, grocery bags	recycled in small amounts into bags
PP 	polypropylene	semi-rigid, low Gloss	margarine tubs, screw-on lids, straws, car bumpers	used in the auto industry, difficult to collect for recycling; recycled into car bat tery cases
PS 	polystyrene	often brittle, glossy	Styrafoam, packing peanuts, egg cartons	no longer made with CFCs, but the by-products from manufacturing degrade air quality; recycled into pencil holders, tape dispensers
Other 	multi-layer Plastics	squeezable	ketchup and syrup bottles	layered aspects make this difficult to recycle; recycled into benches, marine pilings