Bag It!

When you go to the grocery, chances are you’ll be offered some plastic bags. This activity explores where they come from, how much they cost and how they can be re-used.

**PREPARE:**

- Replicate student activity sheet
- Using your newsletter or electronic communications, ask parents to help students complete the survey on plastic bags at the start of the Student Pages.
- Generate a map of your community using www.nationalatlas.gov or another source.
- Collect a variety of HDPE plastic bags from the stores in your neighborhood.
- If you want students to do the extension activity, collect plastic crochet hooks.

(This activity may take a week for your students to prepare the data, one class period for graphing, one for creating the flyer, one for the reading and discussion of scientific researchers, and an additional class period for the extension project.)

**MOTIVATE:**

- Show students a pile of plastic bags from local grocers and big box stores. Ask them where they come from and how many they use in a week.
- Ask students to work with their parents to create a log of the plastic bags that their family receives in a week and identify places where bags can be left for recycling.

**TEACH:**

Most plastic grocery bags are made of a hydrocarbon called HDPE (high density polyethylene.) The raw material for these bags can be oil or natural gas. In the process of making just one plastic bag about half a megajoule of energy is used. (That’s about 120,000 calories or enough for a child for 100 days.) The energy involved in just 15 plastic bags could drive a car a mile.

To make and burn a plastic bag, approximately four pounds of carbon dioxide are released into the air. But bags are valuable. Many products, including composite plastics that are used for building materials, fencing, and trash cans, can be made from recycled plastic bags. About 75 percent of the energy is saved when a second generation product is made through recycling.

Because of their structure, plastic bags aren’t easily sorted for recycling with the other materials collected at the curb. Most communities have special places where these bags can be recycled.

In the activity, students calculate how many bags their family uses in a year. (The average American uses more than 300!) They plot how far the energy “price” of those bags could take their car. Then they combine their resources to create another map--one that helps their families and neighbors locate plastic recycling centers.

As an extension activity, students can create a recycling project of their own--a “memory bracelet” that will remind them to recycle their bags.
REFLECT/ASSESS

Ask students to create a flyer that includes the community map of bag recycling locations and explains to readers why recycling is important.

EXTEND

Students can create a recycling project of their own, by weaving plastic bags into a “memory bracelet” according to the directions provided. If resources permit, beads spelling “Recycle” can be added.
Bag It!

Elementary students may be familiar with the terms paper and plastic in the context of shopping and packaging, but won’t have a sound knowledge of the chemistry or properties of the materials. Plastic is a polymer made from carbon. The carbon was fixed as energy from sunlight was used to bind atoms together into organic molecules. Almost all of the organic molecules we use to make plastics originated in ancient times (for example, during the Carboniferous period of the Paleozoic Era) and so we call them fossil fuels. That includes oil and natural gas, but plant materials can be used, too.

There are many forms of plastic; some are malleable and some rigid, some more dense than others. Because carbon can be bound in many ways, the varieties of plastics are almost endless. Chemical engineers can design plastics to serve an almost endless number of purposes, and can recycle plastics into new forms. High Density Polyethylene is one form, and is generally recyclable. But the thin layer HDPE bags that are normally provided with groceries or dry goods are not easy to separate from other forms of plastic in the process used for curbside recycling so they should be collected separately.

About 10 percent of the cost of our products goes into packaging. Recycling plastic bags saves about 75 percent of the energy that would be needed to make “second life” products from fossil fuels, and is twice as effective as burning the plastic. One common product, plastic lumber, which is made with scrap plastic bags, conserves trees and eliminates the need to use hazardous chemicals to treat wood that would be used outdoors. According to the U.S. Environmental Protection Agency (EPA) plastic recycling results in significant energy savings (an estimated 50–75 MBtus per ton of material recycled) compared with production of new plastics using virgin materials.

Answers to Questions in the Reading:

Where do green living things get the energy for photosynthesis? The energy for photosynthesis comes from sunlight. Not only plants but green algae and bacteria can use sun energy for photosynthesis.)

What is a fossil fuel? It is an organic natural resource made in ancient times; oil, coal and natural gas are fossil fuels. Most fossil fuels contain the energy captured by photosynthesis millions of years ago.

Why is it important to re-use a material that contains the energy of ancient sunlight? This process takes a very long time. We normally consider these resources to be “non-renewable.”

What products come from fossil fuels? Gasoline, natural gas, asphalt, plastics, many drugs and synthetic fabrics are just a few.

What science question is Dr. Pol trying to answer? He is investigating new ways to use recycled fossil fuels. Can you think of other uses for plastic bags that come from the store? Answers will vary.
Bag It!

Collect Data:
Everyone uses plastic bags at some time. They are found at many stores. How many do you use? With your family, count the plastic bags that you use in a week. Make a chart and bring it to class. Then explore the stores near you. Are there any bins for recycling plastic bags?

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Think Like a Scientist:
Plastic bags are made from oil or natural gas. These are valuable fossil fuels. To make them, we must get the fuels from where they are stored. That is usually under the ground. Then the molecules in them must be changed so that we can make products like plastic or use them for other things. That involves heat and chemical changes.

Did you know that it takes about as much energy to make fifteen plastic bags as it takes to drive a car a mile? Divide the number of bags you used this week by 15, and decide how many miles you could drive if you could capture that energy. Get a map of your community. Start at your school. Imagine you could use the energy from your bags to fuel your car. Draw a route that goes that many miles. Where did you end up?

But plastics don’t need to be burned. When we are done using them to carry things the molecules from the fossil fuels can be used again to make new products. Read the story of how scientists are learning to recycle plastic bags and answer the questions.

Check It Out!
Using information you and your classmates collect, mark on your map the places where you can recycle your plastic bags after you use them. Then take your map and use it to illustrate a poster or flyer that will help your family and neighbors find places to recycle their bags.

Go Farther:
Create a product that shows a use for recycling and reminds people to send those valuable bags to a place where they can be reused.
Making a Reminder Bracelet

Step 1: Collect clean plastic bags of different colors.

Step 2: Cut the bags into strips about 1 cm wide.

Step 3: Use the strips to crochet 3 chains about 10 cm long.

Step 4: Braid the strips and tie them at the end.
Recycling Research

Dr. Vilas Pol is a materials scientist who works at Argonne National Laboratory, IL. He has invented a new way to breathe new life into used plastic bags, plates, and glasses. His process allows us to not only recycle more plastic bags and actually convert them into highly valuable dry products. The process converts the original polymer molecules back into carbon and hydrogen atoms.

Plastic bags are made of hydrocarbons, fossil fuels like oil or natural gas. One of the atoms in fossil fuels is carbon. This carbon was made into organic materials like oil or gas millions of years ago by photosynthesis. You can find carbon in almost every food, in all living things, and in non-living things like the lead in your pencil and the fuel we burn.

Dr. Pol has developed a unique way to heat the used bags to a high temperature, and change the carbon atoms within the materials. His new carbon product can be used as the material for an electrode to make modern batteries and as an additive for lubrication in car engines. Scientists are using such carbon to make a very valuable black paint material or printer ink. The work of ‘upcycling of plastic bags’ is performed at Argonne National Laboratory, a U.S. Department of Energy laboratory whose mission is "energy, environment, & security." [http://www.anl.gov/]

Watch the Video: Plastic bags to Batteries: A Green Chemistry Solution at [http://www.youtube.com/watch?v=q17Bd6tOMHI](http://www.youtube.com/watch?v=q17Bd6tOMHI) This video lays out, in a clear and engaging format, the reasons why plastics are so hard to get rid of or recycle effectively—and then presents a refreshingly original solution.

Think About It!

Words to know:
- Atom
- Molecule
- Plastic
- Fossil fuel
- Carbon
- Renewable
- Photosynthesis

Where do green living things get the energy for photosynthesis?

What is a fossil fuel?

Why is it important to re-use a material that contains the energy of ancient sunlight?

What products come from fossil fuels?

What is the scientific question that Dr. Pol is trying to answer?

Can you think of other uses for plastic bags after they come from the store?