



Polyethylene Bags

Grades: 6-8

Science Standards: Content Standard A: Science as Inquiry; Content Standard B: Physical Science;

Purpose: To discover the physical properties of low density polyethylene (LDPE) and high density polyethylene (HDPE) bags used in packaging food.

Links: Technology, Chemistry

Materials: (for a pair of students)

One zip-type bag - quart size or sandwich size

One HDPE grocery bag

Sharp pencil (safety concern)

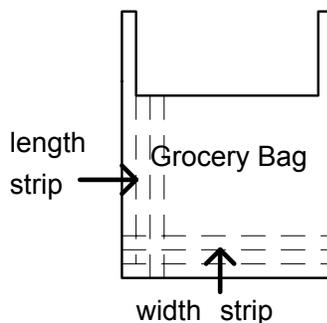
Sink or pan to catch water

Scissors

Ruler

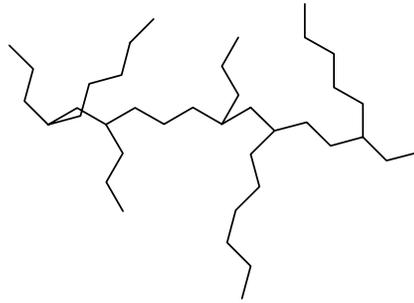
Procedure:

1. Take the zip-type bag (LDPE) and inflate it by blowing air into it. Seal it. Squeeze it. Does the air come out? Is the seal good? Write your observations.
2. Unseal the bag and half fill it with water. Zip it closed. Hold the bag over a sink or pan. Take a sharpened long pencil and insert it into the bag so that the point goes in one side and out the other. What happened to the water in the bag?
3. While the bag is still over the sink or pan, gently remove the pencil. What do you observe? _____
4. Take the HDPE (high density polyethylene) grocery sack and cut strips of the bag with scissors. Cut two inch or 5 cm wide by 7 inch or 18 cm long strips following this pattern. Cut two strips for each direction and make four total strips. Label a strip "L" for length and "W" for width. Gently pull on each strip until you break it. What did you observe?



Conclusions:

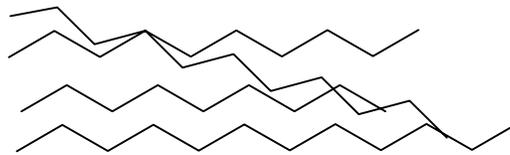
1. The plastic zip bag is made out of low density polyethylene (LDPE). This molecule looks like this:



How would you explain the "pencil in the bag of water" observations?

2. LDPE allows light to pass through the plastic. Is this bag transparent?

3. The grocery bag is made of HDPE where the molecules have a similar structure to the picture of LDPE. There is a difference! Here is HDPE.



How would you explain the tearing of HDPE based on this molecular structure?

4. HDPE does not allow light to pass through. Is this bag transparent?

5. The "bag machine" in the factory making grocery bags must arrange the molecules of HDPE in a certain direction. If you were the mechanical engineer in charge of this machine, how would you have the HDPE extruded or squeezed out of a machine to make the bags? Here is a sketch of the bag. Place the molecule chains in the direction appropriate to make the strongest bag for the customer. (Place them lengthwise, widthwise or diagonal.)



6. When an HDPE grocery bag gets wet, what happens to its strength?

7. Write an experiment to test your hypothesis about the wet bag question. List the steps of your procedure.

a.

b.

c.

d.

e.

f.

g.

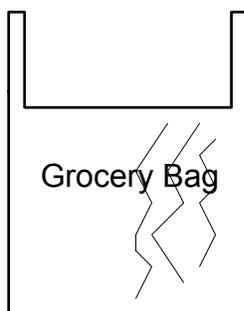
8. If the consumer did not have LDPE sandwich bags, zip-type bags and food wrap, what are some alternatives for storage of food products? Would the alternatives keep the food fresh as long as the plastic bags?

Teacher Notes for Polyethylene Bags:

The pencil can be inserted into the LDPE bag filled with water and it will not leak so long as the pencil is in place. The polyethylene molecules will be moved apart by the pencil but will "bunch" around the pencil to make a temporary seal. When the pencil is removed, the hole through the plastic is present and water will leak out.

LDPE is one of the most widely used packaging materials in the market. It is low in cost compared to wood and metal. It very tough, flexible, a barrier to moisture, chemical resistant, and light weight. Sixty-five percent of the LDPE used in the world is for films and sheets to make garbage bags, grocery sacks, garment bags, shrink film, stretch film, pond liners, construction and agriculture film and food packaging. Grocery sacks made of LDPE are soft and do not have a "rustle" sound. They are transparent. Fresh produce bags are sometimes made out of LDPE

The HDPE grocery bag is extruded from the machine where the length of the bag has the molecules going in the long chain direction. So when you pull on the lengthwise piece, the chains stretch and then break the bonds. When you pull between the chains on the width strip, they separate easily. The bag is designed so that the stretch is in the lengthwise direction.



High density polyethylene is one of the largest volume plastics in packaging today. Some of the products made from HDPE are: gallon juice and milk jugs, cosmetic bottles, caps, pails, crates, bag liners, grocery bags, cereal wrappers, snack-food wrappers, dairy cups, pallets, tubs, water tanks, and shipping containers. Milk jugs are manufactured to keep the container light weight while the jugs for bleach are designed for higher environmental stress-crack resistance. HDPE containers are opaque or translucent but never transparent due to the molecular structure of the polymer. HDPE grocery sacks have a "rustle" sound when you squeeze or rub them. A survey in 1995 found that over a third of all HDPE milk, juice and water jugs are being recycled.

Take a PS cup (polystyrene cup – clear and brittle) and crack it. Where does it crack? It tends to crack along the lines of the polymer chains. The crack is parallel to the chains.

HDPE grocery bags do not decrease in strength when they are wet. Students' procedures will vary about their ideas for testing their hypotheses. LDPE bags preserve food for us. They also keep food fresh. Alternatives, that are not very good, are wax paper, aluminum foil (expensive) or paper boxes.