



Try This at Home Science: Unleakable Bag

Activity Overview:

Learn about how to make an unleakable bag, and impress your friends with your science skills!

Materials:

- Sandwich Ziploc bag
- Water
- 10 sharpened pencils
- Large bowl or sink
- Towels for clean up

Try this!

1. Fill the Ziploc bag $\frac{3}{4}$ of the way with water.
2. Carefully squeeze out the excess air and securely close the bag.
3. Hold the bag in one hand over the large bowl or sink, in case of spills while you practice.
4. Use your other hand to take a sharpened pencil, and slowly push the sharpened end of the pencil through the bag so the pencil sticks out both sides.
5. Continue piercing the bag until all of the pencils are securely stuck in the bag.
6. Clean up from the activity by opening the bag over the sink, pour out water, then remove pencils and dry off before storing.

What's happening?

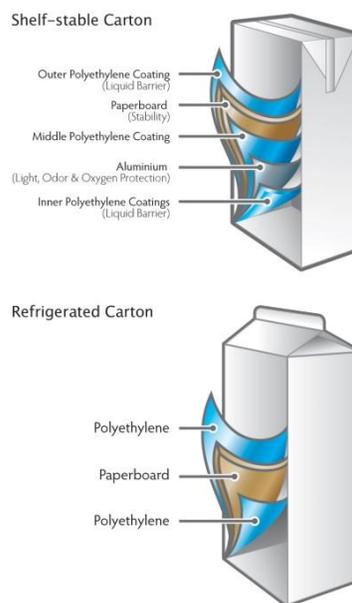
This activity looks like a magic trick, but it is actually a great way to observe how different polymer chains interact with their environment. Polymer chains are extremely long chains made by many identical molecules with chemical bonds. The long chains created are usually flexible and in the case of the polyethylene polymers in the Ziploc bag, they are *extremely* flexible. This means that as the sharpened pencil is pushed through the layers of bag, the tip of the pencil is pushing between the individual polyethylene chains. The polyethylene chains are not being broken; rather they move out of the way of the sharpened tip, thus, squeezing around the pencil and sealing the puncture which prevents any water from escaping the bag. The fact that the polymer chains simply move out of the way of the pencil allow us to put multiple pencils through the sides of the Ziploc without it leaking!



Where else do we find polyethylene chains?

Polyethylene polymer chains are used in a variety of products. Not only are the materials made from low-density polyethylene extremely strong, but they are also puncture resistant. This allows for polyethylene to be used in the manufacturing of plastic bags (the soft ones that do not crackle), garbage bags, artificial heart valves, plastic lumber, compost bins, and even the inside layer of milk cartons and storage tanks for chemicals and waste as they minimize or fully contain the smell of the compound stored.

Since polyethylene is chemically inert, meaning it will not interact with compounds contained by the polyethylene, it can be used to keep liquid from seeping through cardboard containers. Think about boxes of stock for soup, or even cardboard cartons of orange juice and milk. How does the liquid not soak into the cardboard? At least two layers of polyethylene are added to the cartons to enclose the liquids and the rigid paperboard layer. This ensures that even if the container is dented that no liquid should spill out.



Now try...

- Use completely round pencils and pencils with flat sides. What do you notice? Did the shape of the pencil change the results?
- Use a plastic grocery bag or a water balloon instead of a Ziploc bag. What do you notice? Which one leaked?

Additional Information

Watch a how-to video for this experiment here <https://www.pbs.org/video/zip-lock-bag-polymer-erjiah/>