What's the Difference?

Suggested Age: 10-12
Time: 30 minutes

The word "poly" comes from the Greek word "many," and "mer" means parts. Polymers are made of many long chain-like molecules that are aligned together or twist in various shapes. All polymers are made of small repeating molecules, called monomers. Polymers are long-chain, sheet-like, or even three-dimensional, very large molecules made up of many smaller molecules. How the molecules and chains bond can result in a variety of properties. This demonstration will teach children about the properties of cross-linked polymers. There are many types of synthetic polymers that we can see all around our house. A synthetic polymer is a polymer that is made by humans and does not occur in nature. If you look at many synthetic polymers, there are recycling codes, which are used not only for recycling companies, and we can use these codes to understand more about the properties of the polymer.

In this activity we will:

- See that recycling codes have significance and provide information about the polymer used to make the product.
- Recognize that the arrangement of polymers can change their physical properties.

Materials

- Plastic household items (milk container, orange juice container, water bottle, plastic toys, butter tub, six pack rings, etc.)
- Paperclips
- Other materials may be used in place of paperclips such as gumdrops or clay

Activity

Seven different types of plastics have recycling codes. Normally, the recycling code is found directly on the product.

Have you spotted these recycling codes before? What do they look like?

Take a moment to examine some of the plastics around you to find recycling codes.

What are some of the codes that you see? Are there some that you have noticed in the past? Are there some you notice more frequently than others?

After you are finished looking for recycling codes, examine your polymers to find the recycling codes, “2” and “4.”

Which household items have recycling codes “2” and “4?”

An example of a household product with the recycling code of 2 is plastic milk containers. An example of household products with the recycling code of 4 is plastic food wrap and six pack rings.

Looking for recycling codes.

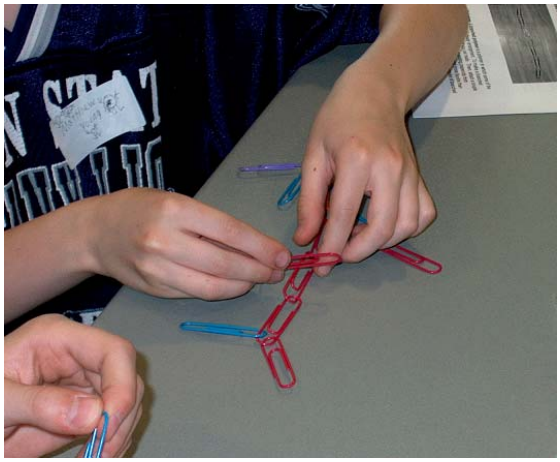
The two materials we will be working with in this activity are HDPE (High Density Polyethylene) and LDPE (Low Density Polyethylene); their recycling codes are listed below:

HDPE - High Density Polyethylene: plastic milk containers

LDPE - Low Density Polyethylene: 6-pack rings, food wrap

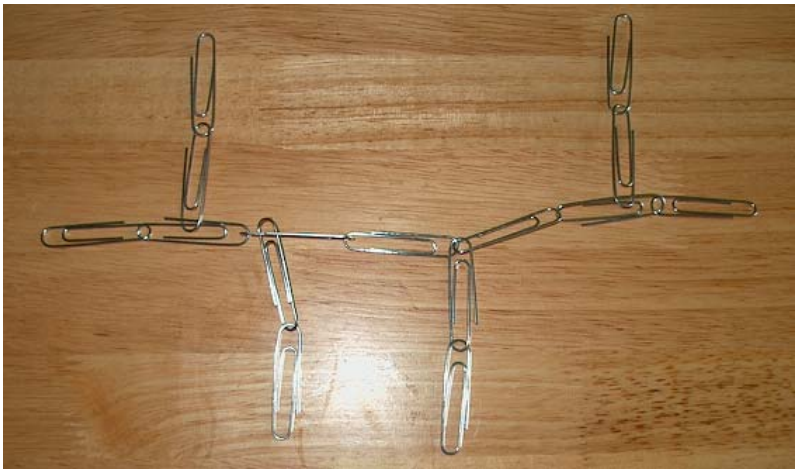
So, what is the difference between a plastic milk bottle and plastic food wrap?

You may notice that plastic wrap is thin, transparent and flexible. The milk bottle is thicker and somewhat rigid. However, both of these objects are made of individual monomers of a substance called polyethylene. The difference in their properties is because of the arrangement of the polymer chains.
Now, build a Model to Discover the difference between HDPE and LDPE



In HDPE, the monomers of polyethylene are relatively straight and can pack very closely together. Because of the rigid arrangement, HDPE is very strong and durable. Using paperclips make a linear polymer arranging all of the paperclips side by side. Then, pull on each end of the chain and notice the rigid structure of the polymer chain. This rigid structure demonstrates the strength and rigidity of an object made from HDPE.

In LDPE, the branches prevent the chains from packing closely. Because they are not packed as tightly, there is a lot of empty space between chains LDPE is more flexible and weaker than HDPE. Take your linear polymer and make some branches on it like this:



When your polymer chain is completed, pull on each end and notice what happens to the paperclips. They still have a rigid backbone; however, there is some movement because all of the paperclips are not in the same row. Some of them will dangle when you pull the paperclips tight. This demonstrates the flexibility in objects that are made from LDPE.

While pulling on the branched polymer chain, Chad notices that the branched polymer has a looser structure than the linear polymer.

Extension Activities

Build a bigger model

If you were to place polymer chains polymer chains on top of each other, which model would take up more space? Build a model to demonstrate this for both linear and branched polymer chains. Build three or four polymer chains and lay then on top of each other, then measure the area that each model took.

Extension 2: Check your local recycling program

Does your city or local township have a recycling program? Which types of materials do they collect? Why are some types excluded from many programs? Do they recycle any non-polymer materials?

References

http://scifun.chem.wisc.edu/chemweek/polymers/polymers.html