

Silly Putty!

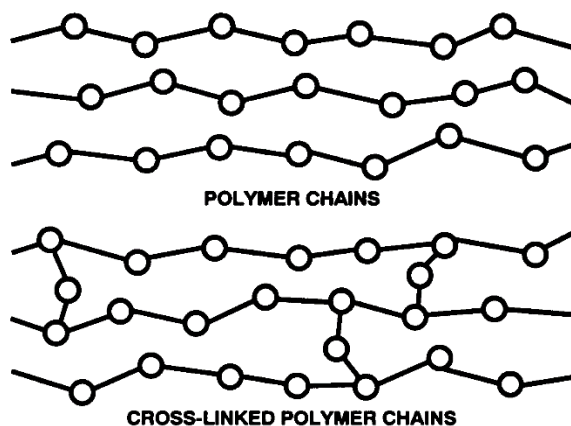
PURPOSE:

1. To get a basic idea of what polymers are.
2. To understand why adding borax to a glue-water mixture turns it “sticky.”

OPENING LESSON:

- A lot of materials occur *naturally*, meaning that they aren't made by people (wood, metal, etc.)
- When these materials aren't quite right to build things out of (whether they're too weak, brittle, or heavy for the situation), engineers make new materials that are a better match!
- Often, these human-made materials are based on **polymers**. What are those?
- Polymers are a repeating chain of tinier bits called **molecules**. The bulk material that the polymers make up will act in different ways depending on how heavily these individual polymers are linked together. Engineers can take advantage of this to “customize” their material!
- Take spaghetti, for example. When you have freshly cooked spaghetti, the strands flow like water because they are slippery. If you leave spaghetti out for a while to dry, the strands start to stick together and turn into a solid mass.
- Today, we'll see this science in action when we make... silly putty!
- Silly putty is just like the spaghetti example: when you add glue to water, it's like wet spaghetti and the substance is slippery. The glue and water mixture is made of polymer chains which are long and connect a bunch of polymers together. It looks like this (show picture).
- Add borax and the glue polymers stick to each other like drying spaghetti and form a putty-like material.
- When this happens it's called cross-linked polymers. The spaghetti-like polymer chains are being connected to each other which causes the mixture to be sticky and solid, which is what we call putty!

*Show picture throughout presentation



MATERIALS:

- School glue
- Borax
- Plastic Ziploc bags
- Food Coloring
- Warm Water
- Large bowl

ACTIVITY:

1. Fill a large bowl with $\frac{1}{4}$ cup warm water.
2. Add $\frac{1}{4}$ cup glue and stir.
3. Add in one drop of food coloring and stir again.
4. Then add one tablespoon borax and mix.
5. Once mixed, you can take the putty out with your hands.
6. Try to pull the putty really quickly. You should find that the putty doesn't stretch very far before it breaks. However, the more slowly the putty is pulled, the longer it can be stretched. Cross-linked polymers are capable of being stretched incredible lengths if they are pulled at slow rates, so try to stretch it the furthest you possibly can!
7. If you want to keep the putty in good condition longer, then you should keep it sealed in the bag and refrigerate it when not in use.

WRAPPING UP:

1. What is the putty made of? (chained polymers)
2. What is glue like by itself? (like a liquid, not a solid)
3. What makes the glue and water mixture turn into putty? (borax)
4. What kind of polymers are formed when the glue sticks together to form putty?
(cross-linked)
5. What other things do you think are made of polymers? (plastics, nylon, rubber, silk)