

A Piercing Experience

"You'll get the point"

A Lesson adapted from Operation Chemistry, sponsored by the American Chemical Society.

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Grade:2-12

Outcome:

The students will be able to identify and understand the concept of polymers as chains of molecules by role playing chains of molecules and through piercing a balloon with a bamboo skewer.

Proficiencies:

1. Identify and explain monomers and polymers as molecules and chains of molecules respectively.
2. Explain the polymer structure of a balloon in general terms (eg.. plate of spaghetti).
3. Understand and illustrate that there is space between molecules.
4. Hypothesize and relate other polymer substances.

National Science Education Standards (NSES, 1996) :

Content Standards in Physical Science:

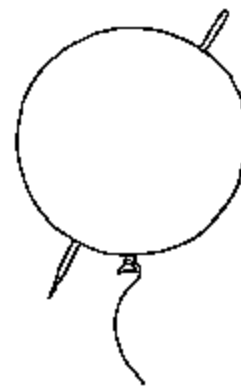
TABLE 6.2. PHYSICAL SCIENCE STANDARDS		
LEVELS K-1 Properties of objects and materials Position and motion of objects Light, heat, electricity, and magnetism	LEVELS 5-8 Properties and changes of properties in matter Motions and forces Transfer of energy	LEVELS 9-12 Structure of atoms Structure and properties of matter Chemical reactions Motions and forces Conservation of energy and increase in disorder Interactions of energy and matter

NSES: Science As Inquiry Standards:

- An appreciation of "how we know" what we know in science.
- Understanding of the nature of science.
- Skills necessary to become independent inquirers about the natural world.
- The dispositions to use the skills, abilities, and attitudes associated with science.

Background information for teacher:

"It is possible to punch a bamboo skewer through an inflated balloon without popping it if one first considers the properties of the balloon. Balloons are made out of thin sheets of rubber latex which in turn are made from many long intertwined strands of polymer molecules. The rubber is stretchy because of the elasticity of the polymer chains. When the balloon is blown up, the polymer strands are stretched. The middle area of the balloon stretches more than the tied end and the nipple end (opposite the tie). A sharp, lubricated point can be pushed through the strands at the tie and nipple ends because the polymer strands will stretch around it. A sharp, lubricated point pushed through the strands at the side of the balloon will



(usually) pop the balloon because the strands are already stretched and will break. Once a tear begins, it enlarges as the air rushes out of the balloon." (1994, American Chemical Society, Operation Chemistry, Polymers Unit p.4)

Safety: Caution the students that the bamboo skewers are sharp and could cause bodily harm if pointed at or jabbed into another person either on purpose or by accident. Discourage any movement around the room holding skewers.

Materials:

- 1) A 10 or 12 inch balloon for each participant.
- 2) A bamboo skewer 10 -12 inches long. (Usually the smaller Shishkabob skewers work well and are available at any grocery store)
- 3) A large bottle of cooking oil.
- 4) a 3 ounce cup for every five people. (the cups are for the oil)

Engagement:

- Teacher holds up a balloon and a bamboo skewer and asks the class what is going to happen when the skewer is pushed into the balloon. (This is a partially inflated 12 inch balloon inflated to about 6 inches)
- Dip the skewer into the oil and gently twist and push the skewer through the thick nipple end of the balloon. Continue to gently twist and push the skewer until it penetrates the surface of the balloon.
- Continue to gently twist and push the skewer through the balloon until it starts to poke out through the area around the knot. Continue to gently twist and push until the skewer penetrates the knot end of the balloon.
- Ask the students if this is what they thought that the balloon and skewer would do.

Exploration:

- Allow each student to try this activity until they are successful. (note: you might have to give some hints as to where to pierce the balloon to be most successful - encourage "testing" in different places).
- Try to set a new record of skewers through the balloon. The record is eleven in a balloon with a 9" diameter!!

Explanation:

Once most or all of the students have successfully pierced the balloon ask the students if they have any questions about this activity that they would like answered.

Several questions may be:

Why doesn't the balloon pop?

What is the purpose of the oil?

Why did the balloon pop when I pierced it in the side and not at the ends?

What would happen if I used different kind of skewer?

What would happen if I used a different kind of balloon?

Before answering these questions, do a **role play** of what this would look like at the molecular level.

Role Play:

Have everyone get into a large circle and ask what are the smallest things that you can think of? (Atoms & Molecules)

- Explain that a molecule is the same thing as a monomer.
- Have 1 person come up and be a monomer.
- Have a second person come up and be a monomer.
- Then say that in order for a molecule to bond to another there must be a catalyst
- Clap hands to show a catalyst - have the two monomers join 1 hand
- We now have a Dimer.
- If I attach a third - we now have a Trimer.
- Attach a fourth - explain that when we have a lot of monomers attached we use the word Polymer.
- To illustrate that polymers are chains of molecules - group the students into chains of 4-5 by holding hands. Allow each chain to freely move around the room. Note that the beginning and end of each chain has a free "hand."
- Next explain that you will produce a catalyst that will attach the chains together
- Each free end must go to another chain and find a bond of two and make it a bond of 3. This simulates the polymer chains (cross polymerization or cross linking) together to form a surface / structure. We have now constructed a polymer mass that makes up the surface of a balloon - called latex. Explain that it looks like a plate of spaghetti under a good microscope.
- Now - reenact the piercing - Become a well lubricated skewer.
- Deflate and then inflate the group as you would with a balloon.
- Show what would happen if you went through the stretched out "side" of the balloon (it would pop).
- Then go through the dense end (a place with lots of people connected together) demonstrating the end of the balloon.
- Gently push and twist - break a few bonds to show that happens but also talk about molecular space - the space between molecules.
- Finish the process by coming out through the other dense end of the balloon.

Return to the board and answer the questions that the students have on the board from the demonstration. (refer to background knowledge section).

Elaboration:

Have the students go home and find another polymer surface or container that they could also pierce with a sharp object without the object leaking (while the sharp object remains in the surface or container)

Possible suggestion: A ZipLock bag full of water.

Evaluation:

Formative: Through teacher questioning, monitoring and observing that the students are gaining knowledge about polymers. Questions on the board are a good indicator. See if the students are learning through the piercing exploration and ask questions as to why they are following a specific line of inquiry

Summative: In a science notebook, have the students draw and label a diagram with an explanation about how this process works. Conclude with a statement about polymers.

Closure: State to the children that Polymers are simply long chains of molecules that are attached to one another to make up things. Most things in the world are made up of polymers in one form or another.

Clean -up: Be sure to get the skewers from the students for safety reasons. Clean up balloons and any oil spills that may have occurred.

References:

Operation Chemistry State of Matter Unit (1994) American Chemical Society & National Operation Chemistry.

