Polymer Fun

Presenter's name: Terri Yerke
Age Group: Grades 5-6
Topic: Polymer Chemistry

Lesson Overview:
This lesson focuses on the occurrence of polymers in every day life. Students will be introduced to a basic concept of polymer chemistry and work in groups to produce a polymer, slime. Students will see first hand both the solid and liquid properties of polymers and therefore better understand what a polymer is.

Sources Consulted
1. Pflungfelder, Bob. Homemade Slime. Science Bob, 2005, <http://www.sciencebob.com/experiments/polymers.html>.
2. Van Cleave, Janice. (1993). 200 Gooey, Slippery, Slimy, Weird and Fun Experiments. (pg. 55). New York: John Wiley and Sons, Inc.
3. Trimpe, Tracy. Playing with Polymers. March 1999, <http://www.sciencespot.net>.
4. Dr. Bellamy. Silly Putty. K-12 Outreach: NSF Science and Technology Center for Environmentally Responsible Solvents and Processes. <http://www.science-house.org/CO2/activities/polymer/sillyputty.html>.
5. Dr. Bellamy. Spot the Polymer. K-12 Outreach: NSF Science and Technology Center for Environmentally Responsible Solvents and Processes. <http://www.science-house.org/CO2/activities/polymer/spot.html>.
6. Ashbrook, Peggy. "Nurturing Young Chemists." Science and Children Feb. 2006: pg. 20-22.

Objectives
After this presentation, students will be able to:
1. Describe a basic definition for a polymer and its properties.
2. List examples of every day polymers.
3. Apply their observation skills in order to examine and determine the properties of a substance.
4. List the benefits of polymers.

List of All Materials Needed per Student (include quantities):

Elmer's Glue (~1/8 cup)
Disposable Cups (2)
Food Coloring (few drops)
Water (3 Tbl.)
Borax (2 Tbl.)
Small Plate (1)
Plastic Spoon (1)
Tablespoon (1)
Wash Rag
Plastic Totes (1)
Ziplock Bag (1)

Filler: Silly Putty
White Glue (1Tbl.)
Epsom Salts (½ tsp.)
Water (½ tsp.)
small cup (1)
popsicle stick (1)
Ziploc bag (1)
plastic spoon (1)

Room Arrangement or Special Needs: Tables or desks in groups of 4 spread out throughout the room. A blackboard will be needed as well as a sink to wash hands.

Procedure:

Introduction: (3 minutes)
Welcome to Family Science Night! This program is sponsored by the Western U.P. Math and Science Center. Each year, science nights are held at 20 elementary schools throughout the Western U.P. The activities that you will see tonight are presented by Michigan Tech students from a variety of departments: chemistry, biology, engineering, education, as well as many others. The goal of tonight's family science night is for parents and students to have fun while learning about science.

Attention-getter: (4 minutes)
How many of you used something plastic today? Who chewed gum? Ate Jell-O? Who's wearing tennis shoes? Let's make a list of some of the plastic things you used today.

Activities: (25 minutes)
Polymer Introduction:
After looking at this list, you can all see that polymers are a very important part of our lives. The word polymer (write *polymer* on the board) means "many units." These units are called mers (write *mer* on the board.) A polymer is made up of many repeating units, sometimes 10, 50, 100, or many more (write *mer + mer + mer + mer + mer + mer = polymer* on the board.) These units are very small and cannot be seen by just looking at them. (Illustrate a polymer by showing a piece of string with many beads on it.)

Polymer Demo:
Who would like to be a volunteer? I need at least 6 of you. I need everyone to stand in a line in front of the chalk board and face the class. Each of you will be a mer. Who knows how we can form a polymer from you mers? Any ideas? We could hold each others hands, which would form a bond between each of you mers. We could also link elbows to form another type of bond. Which do you think would be stronger? The elbow linkage would be the stronger of the two bond types. So let's recap, a polymer is a chain of mers that are linked together by a bond. The strength of the bond between the mers determines the overall strength of the polymer.

Make a Polymer:
We are going to make a simple polymer today and use our observation skills in order to describe it. Each of you will receive a tub that has all of the ingredients that are needed. Before we start, let's recall some important experimental techniques. When conducting an experiment, it is very important that a scientist follows the steps correctly and in order. It is also very important that no one tastes any of the supplies.

Prepare Slime: follow Slime recipe handout (attached to lesson plan)

Identification:
Which of the ingredients contains a polymer? Glue. (Write *polyvinyl acetate resin* on the board.) Who can pronounce this word? The polymer in glue is called polyvinyl acetate resin. While making the slime, we altered (or changed) the behavior of this polymer. Can you think of any physical or chemical changes that took place during this experiment? Hint: there was a physical and a chemical change. Who knows the physical change that took place? The physical change occurred when we added water to the glue. Who knows the chemical change that took place? The chemical change occurred when we added the borax solution to the glue. The borax

ties together the polymer strands in order to make them stronger. This is called cross-linking. Now we have identified two ways to make a polymer stronger. Do you remember what they both are? We can use a product such as borax to cross-link the polymer strands or we can increase the bond strength between the mers.

Now that we have learned about polymers and their structures, let's have some fun and describe some properties of polymers. (Slime data chart is already drawn on the board, conduct tests as a class, record observations on the blackboard.)

Slime Tests (record observations on the blackboard):
1. Slow Poke Test – Slowly poke your finger into the slime. What happened?
2. Quick Poke Test – Quickly poke your finger into the slime. What happened?
3. Slow Pull Test – Slowly pull a piece of slime apart with your hands. What happened?
4. Quick Pull Test – Quickly pull a piece of slime apart with your hands. What happened?
5. Blob Test – Roll your slime into a ball and set it on a flat surface. What happened?
6. Bounce Test – Roll your slime into a ball and bounce it. What happened?

Three Stages of Matter:
What are the three stages of matter?

- solid – keeps own shape/doesn't flow/molecules are ordered and closely packed
- liquid – takes shape of container/flows and is runny/molecules more spread out
- gas – molecules really spread out

Let's identify the stage of matter present during each test.

So by looking at the data we collected, can we determine whether polymers are solids or liquids? Perhaps maybe both? Polymers have both solid and liquid properties at the same time! That is what makes them very unique and useful for so many things like we listed at the beginning of class.

Assessment of Student Learning: (1 minute)
What a polymer is?
What was the polymer that we used in this experiment?
What are polymers used to make?
What two qualities do polymers have?
Who can list some of the observations that we made about the slime?
What are some benefits of polymers?
-cheap to manufacture -flexible, easily moldable

Filler: Prepare Silly Putty

Take Home Handouts and/or materials:
Slime Recipes (attached to lesson plan)
Word Search (attached to lesson plan)

Cleanup: All slime must be sealed in a ziplock bag before leaving the classroom. All measuring items, stirring items, and ingredients must be placed back in the plastic tote. Students must wash their hands before leaving.

Safety Considerations: All students should wash their hands before leaving the room. Remind students that the slime is not edible and should be kept away from small children and pets.

Metamucil "Flubber"

You can create homemade "flubber" by using Metamucil.

(Metamucil can be found at most stores near the dietary supplements and is not harmful if ingested.)

1. Place 8-10 ounces of water into a shaker jar.
2. Place a teaspoon of the product into a shaker jar, close jar.
3. Shake vigorously for 60 seconds., then pour the contents into a standard size cereal bowl.
4. Place the bowl into the Microwave. Run at full power for 4-5 minutes....until the goo starts to "rise". It will look like bread-dough rising in a bowl, but much faster. When the bubbles are just about to overflow the bowl, turn off the microwave.
5. Let it cool slightly and repeat. The more times you repeat this process, the more "rubbery" the flubber gets.
6. After 5 or 6 runs, pour the goo onto a plate. With a spoon, stir the goo while it's cooling. (Be very careful, as this concoction will burn your fingers, let cool!)

Once it's cooled, you have a "non-stick" Flubber. Take a knife and cut it into different-size pieces. You can shape it into all kinds of neat things... use our imagination.

Note: If your first batch is "sticky" to the touch, you've used too much water. If prepared properly, it should feel cold and clammy to the touch, but should not stick to your fingers or anything else. If it does, try another batch with less water.

Flubber will keep for months if you store it in a baggy...it will last even longer if you refrigerate it.

-submitted by Randy Krumland
http://www.geocities.com/molerat1964/slime.htm

Silly Putty Recipe

1. In small cup, put ½ tsp. Epsom salts.
2. Add ½ tsp water.
3. Stir till salt is all or mostly dissolved.
4. Add 3 tsp. Glue to another small cup.
5. Add Epsom salt water to the glue and stir.

When putty has formed, experiment with it on waxed paper. Store in Ziploc bag.

http://www.activityvillage.co.uk/slime_recipes.htm#Silly_Putty_Recipe

Crazy Cornstarch Recipe

1. Put one small paper cup full of cornstarch into a plastic bowl.
2. Slowly add and stir in one half of the paper cup filled with water.

This is somewhat messy, because it is a runny slime.

NAME:_____

POLYMER FUN

C	H	E	M	I	S	T	R	Y	S	Y	T	F	T	E	E	P
E	A	L	N	E	A	E	X	B	O	E	S	U	A	L	H	S
S	O	L	I	D	X	L	J	E	O	T	V	N	B	A	W	Z
E	L	E	V	S	W	P	S	T	D	E	S	A	S	L	P	F
W	I	I	O	F	O	K	E	Y	O	N	T	E	N	U	X	O
M	Q	E	M	B	C	E	X	R	R	C	C	J	G	M	S	R
P	U	G	H	E	G	A	M	I	I	H	A	M	E	R	O	M
O	I	L	W	A	Q	U	C	D	A	M	H	E	N	O	L	O
L	D	Y	T	E	F	X	O	N	B	C	E	T	V	F	D	A
Y	N	M	W	H	G	I	G	P	I	A	E	N	V	A	H	T
M	T	S	C	E	R	E	A	G	O	D	O	F	T	W	A	S
E	A	K	A	E	X	T	S	A	B	C	H	T	A	S	N	M
R	Y	I	P	O	K	E	T	E	S	T	J	Q	U	I	G	F
S	C	I	E	N	C	E	W	E	E	L	E	M	E	N	T	S
Z	V	D	U	D	J	E	V	U	R	E	R	Y	K	T	E	C
W	V	R	Y	D	U	N	K	T	V	S	V	I	Y	B	S	I
C	B	J	R	W	U	K	J	Y	A	F	T	D	U	N	T	E
M	E	Y	R	J	W	F	Z	P	T	S	O	T	U	E	K	N
B	O	N	D	S	S	U	R	M	I	V	T	E	O	N	L	T
L	P	Y	M	E	R	Y	D	M	O	R	D	X	T	B	J	I
O	M	G	I	O	Y	T	E	C	N	T	J	T	W	D	G	S
B	B	H	A	E	T	H	E	R	S	I	V	U	T	W	D	T
T	K	W	E	A	C	J	U	O	F	H	I	R	K	Y	H	C
E	R	N	B	M	L	L	I	D	B	K	Y	E	G	N	M	H
S	C	C	O	L	O	R	T	A	I	P	B	K	W	P	Y	E
T	H	E	C	C	C	H	T	S	E	T	E	C	N	U	O	B
C	I	T	H	M	L	P	G	T	A	E	W	E	D	T	E	V

BLOB TEST
BONDS
BOUNCE TEST
CHEMIST
CHEMISTRY
COLOR
ELEMENTS
EXPERIMENTS
FORMULA
FUN
GAS
HANG TEST
LIQUID
OBSERVATIONS
ODOR
PERIODIC TABLE
PHASE CHANGE
POKE TEST
POLYMERS
SCIENCE
SCIENTIST
SLIME
SOLID
TEXTURE

T. Yerke 2006

HOMEMADE

What to do: Mix about a teaspoon of the Borax into a cup of water and stir (it usually doesn't fully dissolve).

SLIME TIME! 

1. Fill the plastic cup with about 1/2 inch of glue.
2. Add a few drops of food coloring and stir.
3. Add 9 teaspoons of water to the glue and stir.
4. Add 6 teaspoons of the Borax solution and stir well.
5. Lift out the spoon with the goo and place it on the dish.
6. Let it sit for about 30 seconds and then pull it off the stick and play with it!

Pflungfelder, Bob. Homemade Slime. Science Bob, 2005, <http://www.sciencebob.com/experiments/polymers.html>.

Slime Observations
Data Sheet

Conduct each of the following tests and record your observations in the blank boxes.

Test	Observations	Stage of Matter
Description: *(color, texture, and odor)*		
Slow Poke Test: *(slowly poke your finger into the slime)*		
Quick Poke Test: *(quickly poke your finger into the slime)*		
Slow Pull Test: *(slowly pull on a piece of slime)*		
Quick Pull Test: *(quickly pull on a piece of slime)*		
Blob Test: *(let your slime sit for a few minutes)*		
Bounce Test: *(roll your slime into a ball and drop on the table)*