7.4 Making Slime

Grade 7 Activity Plan

Reviews and Updates

7.4 Making Slime

Objectives:

1. To show how polymers are assembled into different 3-D structures from the linking of monomer subunits (process of polymerization)
2. To show that cross-linking strengthens polymers and gives them new physical properties
3. To show the many places we can find polymers in everyday life
4. To create polymers from different monomers, and test their properties

Keywords/concepts: monomer, polymer, polymerization, cross-linking

Curriculum outcomes: 112-7, 113-1.

Take-home product: different types of slime

Segment	Details
African Proverb and Cultural Relevance (5 min.)	"A single bracelet does not jingle." **Congo**
Background (10 min.)	What are polymers? How are they formed? How plastics are made stiff or flexible? Why are polymers important? Make references to everyday items and examples that will allow students to better understand concepts.
Activity 1 (10 min.)	Use a modelling kit to explain the polymerization process and explain the concepts of monomer, polymer, and polymerization.
Activity 2 (10 min.)	Demonstrates to students how cross linking gives support to polymers using paper clips and pipe cleaner.
Activity 3 (15 min.)	Students are given time to examine various plastics around the classroom. They are then required to use the polymer code sheet provided to classify each polymer into their appropriate category.
Activity 4 (30 min.)	Students will make various polymers using common household items
Post-test (10 min.)	Cross-word puzzle

Suggested interpretation of the proverb: Sometimes one can achieve greater things with the help of others. For example, to create a beautiful symphony, many musicians are needed, not just one person. In today's activity you will learn one of the many merits of coming together. Many substances around us, and even inside us, are made of small repeating units called monomers that join together to form amazing and useful substances called polymers.

Cultural relevance:

Salime Sylla
Patent Inventor

Mali born Salime Sylla was part inventor to the primary substance used in creation of plastic. She along with her co-workers worked to terminate their experiment, despite discouragement from the company. They spent sleepless nights trying to come up with the derivative which most companies use today to make plastic. Her patent for this invention was sold to Hydro Quebec here in Canada and also the French National Centre for Scientific Research.

BACKGROUND INFORMATION

Polymers: molecules which consist of a long, repeating chain of smaller units called *monomers*. A polymer can consist of the same monomer being repeated, called a single-monomer formed polymer, or it can consist of more than one type of monomer, called a co-polymer. Within a co-polymer, monomers can be arranged in a number of different ways.
Monomer: simpler substance of which polymer is made. Monomers bond together to form polymers during a chemical reaction called polymerization.
Polymerization: The chemical reaction by which monomers bond together to form polymers.

People use manmade plastics such as polypropylene and polyvinyl chloride (i.e., PVC). Man-made plastic accounts for only a small percentage of polymers. Rubber and cellulose, which are natural polymers, are used to make everything from tires to cellophane to rayon. Deoxyribonucleic acid (i.e., DNA) and protein are also natural polymers.

Monomers and polymers occur both naturally and as man-made substances. The most common natural monomer is glucose, which can bond into very large carbohydrates, including cellulose and starch. Amino acids, which make proteins, and nucleotides, which form DNA and RNA, are two other examples of naturally occurring organic monomers. There are also many synthetic examples of monomers and polymers. Hydrocarbons, such as phenylethene and ethane, are monomers that are used to make plastics, including polystyrene, which is one of the most widely used plastics.

Polymers are made from monomers, which are small, single molecules such as hydrocarbons and amino acids. These monomers bond together to form polymers. The ways in which monomers are put together vary. One system of polymerization depends on how much of the original molecule is left when the monomers bond. In "addition polymerization", monomers are added together with their structure unchanged. This kind of polymerization could be likened to a kid playing with a Lego set. The Legos put together make a larger structure, but in the end the individual Legos are still discernable. Condensation polymerization results in a polymer that is less massive than the two or more monomers that joined to form it. This happens because not all of the original monomer is allowed to stay on the polymer. A good analogy might be what happens when kids try to make a popsicle-stick village. The popsicle itself has to be discarded (most often through eating!) in order to be able to use the stick itself.

Examples of polymers

Natural		
Polymer	**Naturally found**	**Makes**
Wax	Bee hives	Candles
Rubber (latex)	Sap of rubber trees	Tires
Cellulose	Cell wall of plants	Paper
Silk	Silk worms	Fabric
Keratin	Horns of sheep & rhinos, Human skin, nails & hair	

Synthetic		
Polymer	**Makes**	**Recycled into**
Polystyrene	Foam	Insulated jacket, Egg cartons Concrete
Polypropylene	Medicine bottle Underwear	Landscape border, Brushes & brooms Car battery
Polyethylene	Water bottles	More water bottles

Activity 1: Polymerization Demo

Purpose: To show how polymers are assembled into different 3-D structures from the linking of monomer subunits (process of polymerization)

Item	Quantity
Polymerization kit	1
If polymerization kit is unavailable:	
Small Styrofoam balls	10
Pipe cleaners	5
Paint	1-2 different colours

Procedure:

Use a modelling kit to explain the polymerization process and explain the concepts of monomer, polymer, and polymerization.

Additional resources:
http://www.ausetute.com.au/polymers.html
http://sunfh.tripod.com/chem3.htm

Activity 2: Cross-linking

Source: http://www.pslc.ws/macrog/xlink.htm

Purpose: To show that cross-linking strengthens polymers and gives them new physical properties

Item	**Quantity (10 students)**
Paper clips	100 (have extra)
Pipe Cleaners	20

Procedure:

1) **Connect** two paper clips together end to end
2) Continue to add paper clips until there is a polymer that has **five** monomers
3) Repeat steps 1 and 2 so there are **two** chains
4) Line up the chains parallel to each other
5) Using a **pipe cleaner** connect the second paper clip in the polymer chain on the left to the second polymer on the right
6) Repeat the above step but on the fourth monomer. This mimics the cross-linked polymer-**rubber**

Activity 3: Polymers in Our World

Purpose: To show the many places we can find polymers in everyday life

Item	Quantity (10 students)
Various plastic items	Minimum 5
Milk*	1L
Acetic acid (Vinegar)*	60 mL
Hot plate*	1
Large pot*	1
Spoon*	1
Strainer*	1
Mixing bowl*	1

Suggested polymers: bags, syrup bottles, salad dressing containers, cables, yogurt containers, etc.

Procedure:

1) Examine the various plastics provided by mentor.
2) Refer to the "Plastic Code Sheet" to complete the table shown below (also in activity books).
3) Have students find/donate additional plastic items.
4) Add them to the table as done previously.

*See Activity 4 part 1

Activity Sheet (COPY ONLY)

Polymers in Our World

Polymer Name	Number of Items	Recycling Code

Polymer Code Sheet

PET/PETE - Polyethylene Terephthalate: most widely recycled plastic
Properties: Containers have a tough, slick surface, are semi-rigid, hard to scratch, and able to float in water.
Products: May be found in most pop and water bottles, peanut butter jars, and sometimes used in carpet fill.

HDPE - High Density Polyethylene
Properties: slightly waxy, semi-rigid to flexible, does not crack when bent and floats in water.
Products: May be found in nail polish containers, milk cartons, water jugs, some bleach bottles, grocery bags, antifreeze jugs, and baby wipe containers.

PVC/V - Polyvinyl Chloride
Properties: tough, smooth and forms a white line when bent. It is semi-rigid, scratches easily, and sinks in water.
Products: May be used in salad dressing bottles, vegetable oil bottles, mouthwash bottles, and bottles of hand sanitizer

LDPE - Low Density Polyethylene
Properties: slightly waxy, flexible, stretches, and floats on water.
Products: May be used in flexible bags for dry cleaning, produce and bread wrappers, shrink wrap, and 6-pack rings.

PP – Polypropylene
Properties: smooth, semi-rigid, floats in water, and does not scratch
Products: May be used in drinking straws, battery cases, some dairy tubs, bottle labels and caps, heavy duty microwavable containers, and rope.

PS – Polystyrene, EPS – Expanded Polystyrene
Properties: slick, smooth, surface and cracks when bent; PS sinks in water and EPS floats in water.
Products: May be used for packaging peanuts, plastic utensils, meat and egg trays, vitamin bottles, foam cups, and some carry-out containers.

Other
Other plastics are most often made of multiple layers of different types of plastics. These may include microwavable packages, snack bags, and many industrial plastics. These items are difficult to recycle and alternatives should be sought.
Products: Some ketchup bottles and snack packs

****Note: Some products may be packaged in a different type of plastic than listed on this code sheet. This code sheet is only to be used as a guide. Be sure to check the labels on all your plastics before coming to any final conclusions****

Activity 4: Making Slime

Source: http://www.sciencebob.com/experiments/plasticmilk.php

Purpose: To create polymers from different monomers, and test their properties

Item	Quantity (10 students)
Jars/containers with lid	11
Plastic Ziplocs (sandwich size)	40
Food colouring	4 colours: red, blue, yellow, green
Scale	1
Sodium borate (BORAX)	2g
Saturated borate solution	1 L hot water, min. 8 Tbsp BORAX
Water	2 L
Polyvinyl alcohol	250 mL
Graduated cylinder	5
Styrofoam cups	20
Popsicle sticks	20
White glue	500 mL
Corn Starch	5 cups
Whole milk	2.4 L (10 cups)
White vinegar	200 mL
Cheesecloth	10
Elastic Bands	10
250 mL beaker	10
Shaving Cream	1 Can
Gloves	11

Procedure:

Part 1:

1. **TO BE DONE BY MENTOR:** Heat up 2.4L milk until is warm but not boiling. **(should be done while doing previous activity)**
2. Add 200mL of vinegar and stir for about a minute.
3. Put cheesecloth over each 250 mL beaker and secure with elastic band.
4. Strain contents from saucepan through cheesecloth.
5. Left behind in the cheesecloth is a mass of lumpy blobs.
6. When it is cool enough, you can rinse the blobs off in water while you press them together.
7. Mold it into a shape and it will harden in a few days.

Part 2:

1) **TO BE DONE BY MENTOR:** Measure out 50 mL warm tap water into a graduated cylinder
2) Place water into jar
3) Using a scale, measure out 2g of sodium borate (borax)
4) Place sodium borate into water
5) Add 6 drops food colouring, if desired

6) Place lid on jar and shake until sodium borate has dissolved
7) **TO BE DONE BY STUDENTS:** Measure out 25 mL polyvinyl alcohol (PVA) and place into a bag
8) Add ~2 mL of sodium borate solution
9) Seal bag and mix until gel-like consistency is obtained. If too runny add more borate solution. If too thick, and more PVA.

Part 3:
NOTE: Wear gloves during the main mixing of the ingredients

10) **TO BE DONE BY MENTOR** (can be done before going to the school): Form a saturated solution of sodium borate in 1L hot water (min 8 Tbsp).
11) **TO BE DONE BY STUDENTS:** Measure 50 mL of glue into Styrofoam cup. Optional: can add several drops of food colouring.
12) Measure out 100 mL of shaving cream into the Styrofoam cup
13) Mix the glue, shaving cream and food colouring into the cup
14) Measure out 50 mL of preformed borate solution into a separate Styrofoam cup.
15) Slowly add borate to glue/shaving cream while stirring with Popsicle stick until the mixture no longer sticks to your hands.
16) Optional: Could repeat with different proportions; what happens with less borate? Less glue? More shaving cream?

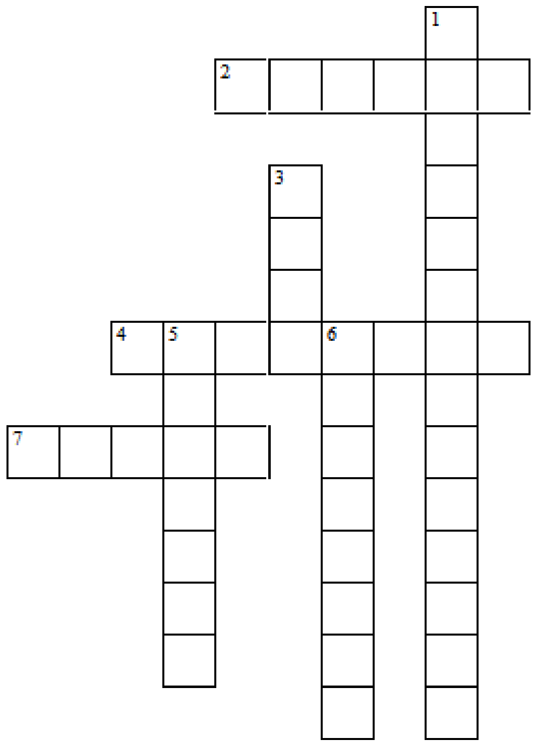
Part 4:

17) Mix ¼ cup of corn starch with ¼ cup of water in a Styrofoam cup.
18) Use hands to mix until it is a smooth texture.
19) Can change texture by adding another more corn starch.
20) Add food colouring if desired.

Video of plastic milk:
http://www.youtube.com/watch?v=pIvAI4lu1uA&NR=1&feature=fvwp

Post-test (COPY ONLY)

Polymers Puzzle



ACROSS
2 Critical element to organic chemistry
4 Long chains of carbon molecules bonded together
7 Country of origin of today's proverb

DOWN
1 Process of making polymers
3 Greek prefix meaning "many"
5 Branch of chemistry which studies mainly carbon
6 Small molecules which bond repeatedly to form polymers

Answers:

ACROSS
2 carbon
4 polymers
7 congo

DOWN
1 polymerization
3 poly
5 organic
6 monomers