

## Getting Silly with Putty

**Author(s):** Prof. Chris Ober

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**Subject:** Chemistry

**Grade Level:** Elementary and Middle School

**Standards:** *Next Generation Science Standards* ([www.nextgenscience.org](http://www.nextgenscience.org))

**MS-PS1-1.** Develop models to describe the atomic composition of simple molecules and

extended structures.

*New York State- Intermediate Science* ([www.emsc.nysed.gov/ciai/](http://www.emsc.nysed.gov/ciai/))

**Standard 1-** Analysis, Inquiry and Design

**Standard 4.3-** Matter is made up of particles whose properties determine the observable characteristics of matter and its reactivity.

**Standard 7-** Interdisciplinary Problem Solving

**Schedule:** One 40-minute class period



<p><b><u>Objectives:</u></b></p> <p>Students will be introduced to the concept of polymers and their structure, as well as properties associated with them.</p>	<p><b><u>Vocabulary:</u></b></p> <p><b>Molecule</b>  <b>Compound</b>  <b>Monomer</b>  <b>Polymer</b></p>
<p><b><u>Students Will:</u></b></p> <ul style="list-style-type: none"> <li>* Gain an introduction to polymers and their subunits</li> <li>* Make silly putty to illustrate some properties of polymers</li> <li>* Discuss vocabulary embedded throughout the activity</li> </ul>	<p><b><u>Materials:</u></b></p> <p>All-purpose white glue              Saturated solution of sodium tetraborate (Borax) in water              Food coloring              Dixie cup              Craft stick or spoon              Eye dropper              Activity Sheet 1: <i>Getting Silly with Putty</i></p>
<p style="text-align: center;"><b>Safety</b></p>	<p>This activity does not contain any safety concerns. All materials can be disposed of in the trash.</p>



## Science Content for the Teacher:

Polymers are substances whose molecules have high molar masses and are composed of a large number of repeating units. There are both naturally occurring and synthetic polymers. Among naturally occurring polymers are proteins, starches, cellulose, and latex. Synthetic polymers are produced commercially on a very large scale and have a wide range of properties and uses. The materials commonly called plastics are all synthetic polymers.

Polymers are formed by chemical reactions in which a large number of molecules called monomers are joined sequentially, forming a chain. In many polymers, only one monomer is used. In others, two or three different monomers may be combined. Polymers are classified by the characteristics of the reactions by which they are formed. If all atoms in the monomers are incorporated into the polymer, the polymer is called an *addition polymer*. If some of the atoms of the monomers are released into small molecules, such as water, the polymer is called a *condensation polymer*. Most addition polymers are made from monomers containing a double bond between carbon atoms. Such monomers are called olefins, and most commercial addition polymers are polyolefins. Condensation polymers are made from monomers that have two different groups of atoms which can join together to form, for example, ester or amide links. Polyesters are an important class of commercial polymers, as are polyamides (nylon).

## Preparation:

1. Photocopy print materials (*Activity Sheet 1*) for each student.
2. Create a super-saturated solution of sodium tetraborate by mixing Borax and water (1 tablespoon of dry Borax per 1 cup of water). Adding more Borax is fine but adding too little means there won't be enough borax to polymerize the glue molecules.
3. Distribute materials evenly for each student.

## Classroom Procedure:

### *Engage (Time: 15 mins)*

Ask students where clothing comes from: cotton, plants, and animals. What about metal? From mined substances, rocks; Paper products? From trees, plants. What about plastics? Most students will not know that plastics are from petroleum products. Explain that chemists design and make molecules with special properties by performing chemical reactions to hook atoms into long chains called polymers. Plastics are, therefore, made of polymers.



Have several groups of students stand in a straight line and link hands, explain that each student is a molecule and together they form a polymer. Now pretend the Borax is being added, ask the 'chains' to move through and under each other's arms, causing them to tangle. Now, considering that the 'molecules' are no longer able to flow like a liquid, ask students to predict how the addition of Borax will change the properties of the polymer.

***Explore (Time: 15 mins)***

Distribute necessary materials (including Activity Sheet 1: Getting Silly with Putty) to each student. Ask them to follow the instructions on the sheet, and allow them to work in pairs to answer the extension questions.

***Explain (Time: 10 mins)***

Have students present their findings and their answers to the lab questions to the class. Also discuss the Supplemental Information with them and challenge them to think of some natural and synthetic polymers, and how these affect their everyday lives.

## **Assessment:**

The following rubric can be used to assess students during each part of the activity. The term "expectations" here refers to the content, process and attitudinal goals for this activity. Evidence for understanding may be in the form of oral as well as written communication, both with the teacher as well as observed communication with other students. Specifics are listed in the table below.

- 1= exceeds expectations
- 2= meets expectations consistently
- 3= meets expectations occasionally
- 4= not meeting expectations



	Engage	Explore	Explain
1	Shows leadership in the discussion and polymer activity, displays good understanding of polymers.	Completes work accurately while providing an explanation for what is observed. Works very well with partner.	Provides an in-depth explanation of findings. Makes excellent and thoughtful comparisons to everyday life. Fills out worksheet clearly.
2	Participates in the discussion and activity; shows an understanding of polymers.	Completes work accurately and works cooperatively with partner.	Provides clear explanation of findings. Notes good correlations to everyday life. Fills out worksheet clearly.
3	Contributes to the discussion and activity, but shows little understanding of polymers.	Works cooperatively with partner, but makes some mistakes with the procedure.	Provides a limited explanation of findings. Struggles to make comparisons to everyday life. Fills out some of the worksheet.
4	Does not participate in discussion or activity. Shows no understanding of polymers.	Has trouble working with partner. Does little to complete the procedure.	Is not clear in explanation of findings. Does not fill out worksheet.

## **Supplemental Information:**

### What do you know about Polymers?

#### *Getting to Know Polymers*

Polymers: Large molecules made up of simple repeating units. The word is derived from,

*poly*...Greek word meaning "many."

*mer*...Greek word meaning "part."

Monomer: The simple repeat unit that makes up a polymer.

*mono*...Greek word meaning "single."

Examples of Natural Polymers: spider silk, rubber, proteins (DNA), and cellulose (most abundant organic compound on the planet, found in wood and plants).

Examples of Synthetic Polymers: fibers (polyester, nylon), coatings (paint), adhesives (glue), rubber, plastic (polyethylene, polypropylene & polystyrene).

Expected Lifetime: Centuries, except for a few biodegradable ones, which is why recycling is so important.

## **Acknowledgements:**



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

B.K. Hixson and M.S. Kralik, *Jr. Boom Academy*, The Wild Goose Company, 1992.

