

Student Name: _____

Date: _____

Activity Sheet

Glued into Science- Sustainable Polymers

Aim
To produce polymer samples, test their material properties, and compare them to plastics found around your house.

Materials			
Water	Borax Powder	White Glue (eg: Elmer's)	4 Small cups
Spoon	Measuring spoons & cup	Ruler	Household plastics (shopping bag, snack/sandwich bag, rubber band, plastic bottle, plastic cup, etc.)
Scissors	Pen/Pencil	Paper	

Method: Making Cross-Linked Polymers (Silly Putty)	
1	Add 1 Tbsp of borax and 1/2 cup of water to a cup. Stir, but note that not all the borax will dissolve. The solution is now “saturated” with Borax.
2	Add 1 Tablespoon of glue to a different cup.
3	Add 1 Tablespoon of the saturated Borax solution to the cup and stir until it forms a solid. Label this cup (1:1 silly putty - 1 part glue: 1 part borax solution).
4	Repeat steps 2 and 3 to create two more different samples of silly putty. Change the ratio of glue and borax solution. Be sure to label your cups.



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Method: Making Observations of the Materials	
1	Collect your materials and write down at least two initial observations that you recognize about each household plastic that you have. Record in data table 1.

Data Table 1: Material Observations	
Silly Putty A (1:1)	
Silly Putty B ()	
Silly Putty C ()	

Method: Testing Material Properties	
1	<p>Cut the household plastics into strips 1 cm x 5 cm (3/8" x 2") and draw a line 1 cm in from either side (see picture).</p> 
2	Take your silly putty materials and flatten them, using a book or table. Try to keep the samples the same thickness. Cut each one into strips 1 cm x 5 cm (3/8" x 2") and draw a line 1 cm in from either side.
3	Press and bend each plastic material (including your cross-linked polymers). Rank them by how stiff (how hard they feel) they are (1 = stiffest). Do not stretch the samples yet!



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4	Place a ruler on a flat surface. Take one of the plastic samples and grab it on both sides with your thumb and forefinger. Position your sample so one end is at the “0” mark on the ruler.
5	Pull the sample at a slow, constant rate until it breaks or you cannot pull it any further. Record the length you pulled it to. If you have enough material, repeat this two more times and calculate the average.
6	Repeat steps 3-4 for all of your materials.
7	Look over your results and write up a discussion and conclusion based on the questions listed for each.

Results Table - Material Properties						
Material:	Stiffness Rank	Strength Rank	Stretch test 1 (cm)	Stretch test 2 (cm)	Stretch test 3 (cm)	Average Stretch (cm)
Silly Putty 1						
Silly Putty 2						
Silly Putty 3						

Discussion
What were the unique characteristics you observed of each polymer?
What materials were the stiffest and strongest?



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What materials were the softest and weakest?
What materials stretched the furthest?
Did any materials not stretch at all? Which one(s)?
Compare your crosslinked samples to each other; what was different between them and how did this change their properties?

Conclusion
<i>Write a conclusion in your based on the following questions. (Include additional information that you believe is helpful to know for this lab)</i>
Plastics have many different uses, requiring them to have different properties. Why do the household plastics you tested today behave differently?
Why did your cross-linked polymer samples behave differently?
Would you consider cross-linked polymers a good replacement for any of the household plastics you tested?



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All these plastics have different properties that are important for their unique use. But what happens when we are done with them? They are often thrown away and end up in landfills where they can persist for 1000's of years. We can combat this in two ways: **recyclable** and **biodegradable** plastics. You have likely heard of recyclable plastics. We collect these in bins and sort them according to the number on the plastic. They can then be reprocessed into new materials. Unfortunately, only 2% of plastics are recycled into new materials today.¹ Scientist are working hard to make this process cheaper, easier, and available for more plastics.

Biodegradable plastics are designed to break down and get consumed by bacteria and other microbes! In fact, the cross-linked polymer you made in this lab is biodegradable! Unfortunately, as you learned in this lab, it can be difficult to make them match the properties of the other plastics.

Lots of great research is being done today to improve the plastic properties of biodegradable plastics.



Recycling numbers found on the bottom of most plastics. Check with your local collection company to know which ones you can recycle.



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