

Student Name: \_\_\_\_\_

Date: \_\_\_\_\_

## **Activity Sheet**

### *Glued into Science- Classifying Polymers*

#### **Learning Objective:**

Students will be able to design and conduct an experiment in order to classify the different forms of matter that they create through the cross-linking of polymers.

#### **Problem:**

How will the composition of different materials affect their characteristics as pieces of matter?

#### **Background: Read and annotate the following text.**

The solution of school glue with borax and water produces a putty-like material that's elastic and flows very slowly. The glue is actually made of a polymer material. In simplest terms, a **polymer** is a long chain of identical, repeating molecules. You can use the image of tiny steel chains to understand why this polymer behaves the way it does. Each link in a chain is a molecule in the polymer and one link is identical to another. When the chains are in a pile and you reach in to grab one, that's what you get: one. If you dump them on the floor, they're not connected to each other so they spread out everywhere like water. The strands flow over each other like the liquid glue in the bowl. Something caused a change, however....

Let's say you toss a few trillion tiny, round magnets into the pile of steel chains. Now when you reach in to grab one strand, you grab hundreds because the magnets have linked the strands together. If the molecules stick together at a few places along the strand, then the strands are connected to each other and the substance behaves more like a solid. Sodium tetraborate is the chemical in Borax that hooked together the polymers in the glue to form the putty-like material. This process is called **cross-linking**.

#### **Materials:**

- glue
- blue sparkly glue
- water
- borax
- paper or plastic cups
- stirring rod
- paper towels
- compressional force scale
- 50ml graduated cylinder
- food coloring (optional)
- ring stand
- weight
- scale
- meter stick
- paper
- pencil
- marker



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**Safety:**

Do NOT consume or inhale any of the materials given in this lab. Materials may be toxic and harmful upon ingestion.

**Initial Observations:**

*In your science journal write down at least two initial observations that you recognize about for each material that you have been given.*

**Hypothesis:**

*If ..... then..... because... Statement using the problem stated above.*

**Procedure:**

1. In your science notebook create a data table and label it Data Table #1 so that it resembles the table below.

**Data Table #1-**

Substance 1	Substance 2	Substance 3

2. Label three cups substance 1, substance 2, and substance 3 with a marker.
3. With your group decide what materials you will mix together and how much of each material you will use. Remember that the total amount of material you make should not fill up more than half the paper.plastic cup you have been given. In order to mix these substances use the stirring rod that your group has been given. You should be mixing materials together that you believe will help answer the question and relate to your hypothesis
4. Fill your Data Table #1 to describe what substances you have created. **Be specific** by using the scale provided to your group!
5. Discuss with your group what tests you want to conduct in order to compare the different characteristics or traits of the materials that you have created. Write down these different tests that you plan to conduct with each material, you should have at least three different tests. Keep in mind the the independent variable for each test should be the material so everything else should be the same. Have your teacher check these tests.



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6. Create another data table called Data Table #2 in your science notebook like the one given below (note: you may need to add additional rows to your data table if you have more than 3 tests for your materials. Also use the last row of your table to use any words that describe your material (ex: elastic, non-elastic, sticky, stretchy, bendable, liquid, hard, color, etc.). You can also use this space to compare the different materials.

**Data Table #2-**

<b>Material:</b>	<b>Substance 1</b>	<b>Substance 2</b>	<b>Substance 3</b>
<b>Name of test 1</b>			
<b>Name of test 2</b>			
<b>Name of test 3</b>			
<b>Other Characteristics</b>			

7. Complete the tests that you have come up with and record their results in Data Table #2.
8. Return all materials to the appropriate location in the classroom.
9. Examine your results with your group members (also discuss and compare your results with at least two other groups) and answer the discussion questions, conclusion questions, and formulate a formal conclusion from your findings.

**Discussion Questions:**

*Answer the following questions in complete sentences in your science journal.*

1. Were there differences in the results for different substances for your tests? Explain.
2. Did you observe any big differences in the substances you created?
  - a. If not explain why you think this is the case. If yes explain why you think this is the case and what it is that makes them differ.
3. What test do you believe is the most helpful? Explain.



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4. Describe some of the characteristics that you observed through the tests that you conducted. What phase of matter do you believe your substances were?
5. What are some potential errors that may have occurred during this experiment?
6. Explain what you might do differently in order to create and test different substances if you were to complete this lab again.

**Conclusion Questions:**

*Answer the following questions in complete sentences in your science journal.*

1. Complete some research and explain why polymers are important in our everyday lives.
2. Explain what cross-linking is and what the substance is that crosslinks substances in this lab.
3. Draw and label a diagram in which you demonstrate the cross-linking of polymers that occurs in this experiment.
4. Explain the outcome of cross-linking.

**Conclusion:**

*Create a conclusion in your science journal based off of the following questions. (Include additional information that you believe is helpful to know for this lab)*

*Answer the problem stated in this lab. Explain whether or not your hypothesis was correct and why? What characteristics of each substance did you observe? What were things that were done to substances to give them different characteristics? Summarize your results. Explain any error that may have occurred in the lab. If there is something that you would do differently in the future explain what.*

