Glued into Science- Classifying Polymers

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Subject: General Science

Grade Level: 6-12

Standards: Next Generation Science Standards (www.nextgenscience.org)

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.

MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

Schedule:

- Introduction to Polymers (45 min class period)
- Introduction to lab and student planning of substances (45 min class period)
- Creation of substances and conducting experiments (45 min class period)
- Discussions and conclusions (one-half to one full 45 min class period)

CCMR Lending Library Connected Activities:
Making Silly Putty
Instant Snow

Objectives:	**Vocabulary:**
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.	-Matter -Classify -Traits -Polymer -Cross-linking
Students Will: 1. Examine the materials they are given. 2. Create at least three different substances from the materials they were given. 3. Create and conduct an experiment that compares and helps to classify their man-made materials.	**Materials:** • glue • blue sparkly glue • water • borax • paper or plastic cups • stirring rod • paper towels • food coloring (optional) • ring stand • weight • scale • meter stick • paper • pencil • compressional force scale • 50 ml graduated cylinder
Safety	Do NOT consume or inhale any of the materials given in this lab. Materials may be toxic and harmful upon ingestion.


Science Content for the Teacher:

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.***

Classroom Procedure:

1. Figure out how many lab groups you intend to have. (Three students per lab group is ideal)
2. Give each lab group a scale, meter stick, 3-4 plastic.paper cups, a stirring rod, and spray bottle of borax.
3. Have the remaining materials (glues, water, cornstarch, food coloring, etc.) on the side of the classroom for students to access.
4. Have students refer to the student activity sheet for lab instructions.
5. After lab is complete, return all materials to their appropriate containers.
6. Students will write up a Formal Lab Report including a discussion and conclusion

Extra Activities:

- Have students hypothesize and create a material that would be most useful in holding a weight for an extended period of time.
- Oobleck Lab- Exploring Non-Newtonian Materials and trying to classify matter into solid, liquid, or gas.[1]

[1] "Oobleck - The Cornstarch And Water Experiment - ScienceBob.com." 2015. 15 Aug. 2016


- Exploring Polymers- Have students research what “Polymers” are... What are they? Why are they useful? What are some common examples of polymers. Have student create some sort of presentation (powerpoint, trifold, poster, or screen cast on what they have learned.

Resources:

"Slime Party - Elmer's Glue Borax Recipes - Steve Spangler Science." 2015. 11 Aug. 2016 <http://www.stevespanglerscience.com/lab/experiments/glue-borax-gak/>

"Easy Slime Recipe - The Lab - Steve Spangler Science." 2015. 15 Aug. 2016 <http://www.stevespanglerscience.com/lab/experiments/glue-borax-gak/>

"Oobleck - The Cornstarch And Water Experiment - ScienceBob.com." 2015. 15 Aug. 2016 <https://sciencebob.com/oobleck-the-corn-starch-and-water-experiment/>

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<https://sciencebob.com/oobleck-the-corn-starch-and-water-experiment/>

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 partners.	Provides an in-depth explanation of findings. Makes excellent and thoughtful comparisons to everyday life. Completes activity sheet and lab report clearly.
2	Participates in the discussion and activity; shows an understanding of polymers.	Completes work accurately and works cooperatively with partners.	Provides clear explanation of findings. Notes good correlations to everyday life. Completes activity sheet and lab report clearly.
3	Contributes to the discussion and activity, but shows little understanding of polymers.	Works cooperatively with partners, but makes some mistakes with the procedure.	Provides a limited explanation of findings. Struggles to make comparisons to everyday life. Completes some of the activity sheet and lab report.