IS ALL SLIME ENGINEERED EQUALLY? — LEARNING FACILITATOR'S GUIDE

Introduction

This activity will highlight the STEM career of chemical engineering. Participants should watch and discuss the career video if time permits.

Chemical engineers apply the principles of chemistry, biology, physics, and math to solve problems that involve the production or use of chemicals, fuel, drugs, food, and many other products. They design processes and equipment for large-scale safe and sustainable manufacturing, plan and test methods of manufacturing products and treating byproducts and supervise production. Occupational Outlook Handbook, Bureau of Labor Statistics, http://www.bls.gov/ooh/architecture-and-engineering/chemical-engineers.htm

Also see: https://cheme.stanford.edu/admissions/undergraduate/what-chemical-engineering

In the role of a chemical engineer, the participants will be doing something somewhat different than in other STEMgineering activities. Instead of designing and building a product, they will be designing a test for a chemical product. They will be taking on the role of quality control expert.

Safety and Precautionary Notes

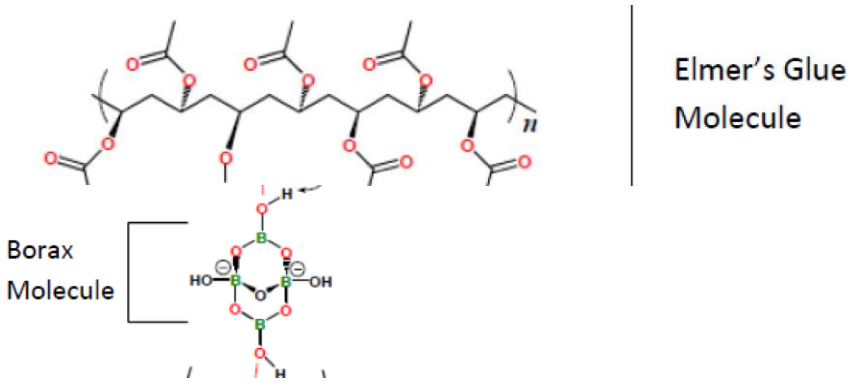
Borax can be an eye irritant. Participants should be cautioned not to touch their eyes and to wash hands after handling the slime. Safety goggles should be considered as a safety precaution.

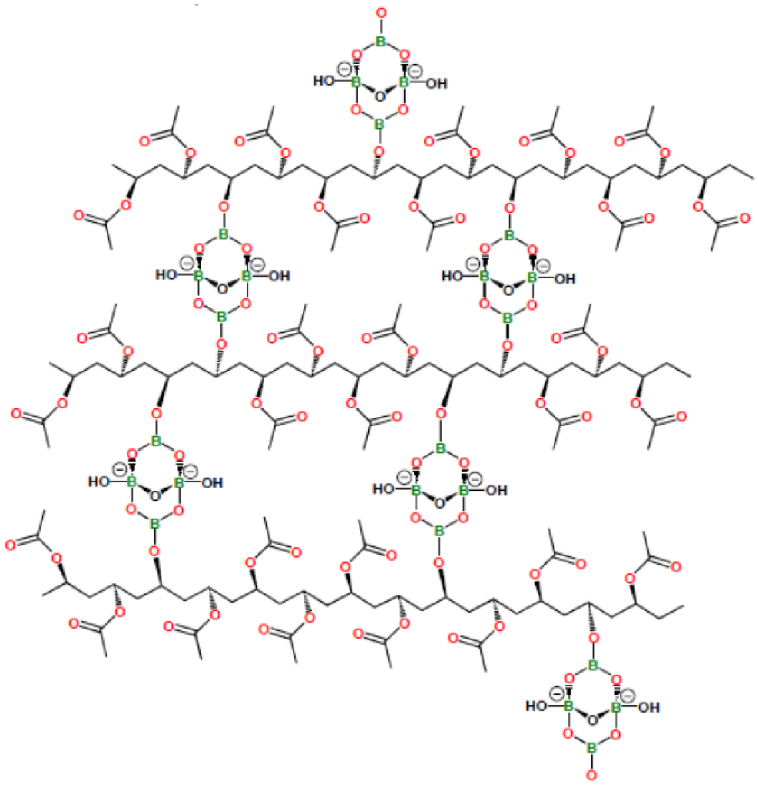
Food coloring will stain hands and clothes. Only one drop of food coloring should be used (optional) to minimize staining.

More information on slime chemistry:

Glue is made up of long, spaghetti-like molecules that sometimes get tangled together. That's why glue doesn't flow fast like water. Borax reacts with the glue to loosely tie the long molecules together.

The molecules of the new material, SlimeY, look more like a poorly woven rug than a plate of spaghetti. The new material feels and looks different from what you started out with.





Preparation

1A. Slime Ingredients:

- 8 4 oz. bottles Elmer's Glue
- ½ cup Borax
- 1 box food coloring

1B. Materials to make and test slime:

- 8 mixing bowls
- 8 measuring cups
- 16 Ziploc bags for storing slime or sending it home
- 24 plastic spoons for mixing and measuring
- Rulers, meter sticks, yard sticks, or tape measures
- String
- Tape
- Paper and pencil/pen for making plans and recording test results
- Other materials that might be used for the designed quality control test

1C. Materials per group:

- 1 mixing bowl
- 1 4 oz. bottle Elmer's Glue
- 1 measuring cups
- 2 Ziploc bags for storing slime or sending it home (assumes 2 per group)
- 3 plastic spoons for mixing and measuring
- 1 teaspoon Borax

2. When the participants are designing their own test (Step 1.12), they may want to use additional materials. You should be prepared for requests. You should make whatever rules you feel are appropriate for this based on your group and site. Some possibilities are paper clips, paper, tacks, hangers, pieces of wood, wax paper, and aluminum foil.

3. Timing – If 75 minutes is allocated for this activity, the approximate breakdown of the time should be:

10 minutes – computer introduction
10 minutes – making slime
20 minutes – doing the prescribed quality control tests
25 minutes – designing and carrying out their quality control test.
10 minutes – computer follow-up

Note – more time or several sessions could be utilized, if desired.

4. Be sure to go through the computer experience yourself before you do the activity with a group!

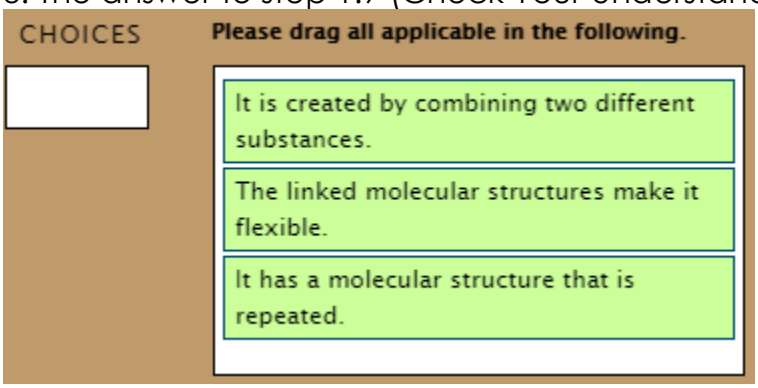
The Design Challenge Notes

The participants should sign on to STEMgineering as individuals but should do the experimenting, designing, building, and testing in groups.

1. Step 1.6 (Develop Knowledge about SlimeY) – making slime. Although the participants should be measuring the ingredients, the amounts are not critical. Be prepared for spills and clean-up.

2. Step 1.7 (Your observations of SlimeY) – Answers will vary

3. The answer to step 1.9 (Check Your Understanding)



4. Step 1.10 (Develop Knowledge about Testing SlimeY) A good test needs to be accurate (gives correct information about what is being tested) and reliable/precise (you get the same results, when repeated). Participants should photograph their tests, and also write down the test results, using the words on the computer, and post them to the design journal and/or wall by photographing their data. The SlimeY tests will use the following criteria:

Test Rating Rating	1	2	3
Bounciness	does not bounce	bounces one time	bounces more than once
Stickiness	falls from upside down, non-porous surface after one minute	falls from upside down, non-porous surface after five minutes	falls from upside down, non-porous surface after ten minutes
Stretchiness	stretches 18 inches	stretches two feet	stretches three feet or more

5. Step 1.12 (Create Your Own Test for SlimeY) Point out that their test should focus on "at least one specific characteristic." They can consider devising a test that measures two or all three of the characteristics. Learners should photograph their tests, and also write down the test results, using the words on the computer, and post them to the design journal and/or wall by photographing their data. If

time, participants should try each other's tests. Ask the group members if their tests are accurate and reliable.

6. If they carry out the test(s) they design for SlimeY in step 1.12, they possibly may be able to use the same criteria (listed above in #5 or in the program at step 1.11) to evaluate the SlimeY previously or design their own criteria that is specific to their test.

Reflection

As with all the STEMgineering activities, the reflection part is crucial to the participant's experience. Small group or full group discussion can be used to share and talk about the tests they designed. Remember to encourage the terms accurate and reliable/precise. (See #4 above.)

Final notes:

If time allows or if additional sessions can be scheduled, three important aspects of engineering can be addressed:

1. Sharing of ideas and designs. Participants can meet as a group and share their test designs and discuss their work and what was helpful and what was not.
2. Engineering is iterative. It would be great if groups could go back and "try again:" modify their design, use new ideas – ultimately try to improve on their work.
3. What it's like to be a chemical engineer.