

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

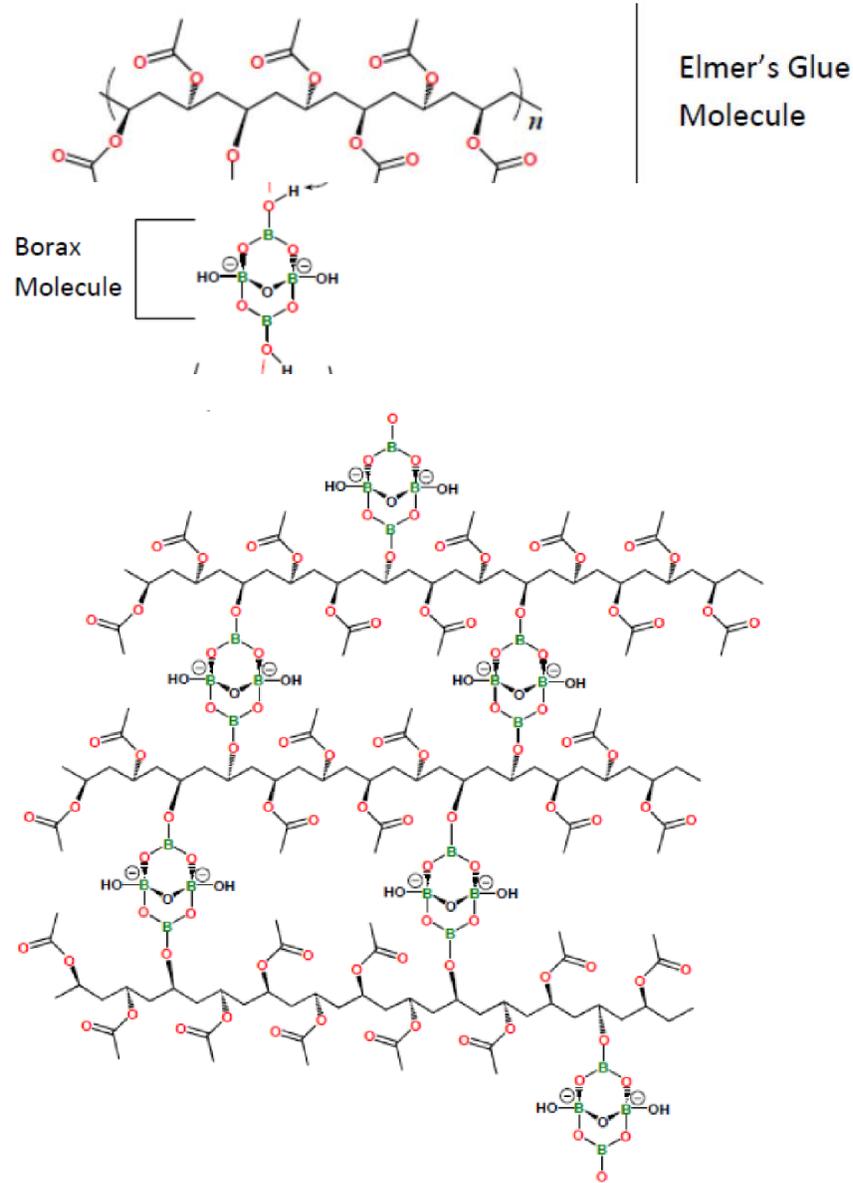
Borax can be an eye irritant. Participants should be cautioned not to touch their eyes and to wash hands after handling the slime. Safety goggles should be considered as a safety precaution.

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 and that is 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.



1. Materials

- Mixing bowl
- 4 oz. bottle Elmer's Glue
- Measuring cup
- Teaspoon for mixing and measuring
- 1 teaspoon Borax
- Food coloring
- Rulers, meter sticks, yard sticks, or tape measures
- String
- Tape
- Paper and pencil/pen for making plans and recording test results

2. When participants are designing their own test, they may want to use additional materials. You should be prepared for requests. You can make whatever rules you feel are appropriate. 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 – 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 – wrap up and clean up

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

The Design Challenge Notes

1. When making slime although the ingredients should be measured, the amounts are not critical. Be prepared for spills and clean-up.

2. Step 6: The answers to Check Your Understanding

CHOICES Please drag all applicable in the following.

It is created by combining two different substances.

The linked molecular structures make it flexible.

It has a molecular structure that is repeated.

3. Step 7a - Answers will vary for the observations of slime.

4. Step 7b. 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 can photograph their tests, and describe the test results. 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 9 (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 write down the test results. Ask if their tests are accurate and reliable.

6. If they carry out the test(s) they design for SlimeY they possibly may be able to use the same criteria (listed in the design evaluation rubric) or they may establish 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. Discussion can be used to share and talk about the tests they designed. Encourage use and understanding of the terms accurate, reliable and precise.

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.
2. Engineering is iterative. It would be great to 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.