



# GREEN-EDU Learning Activity

Title: How green is your glue?

Author(s): Anatolia College

## Summary

### Lesson plan summary

Through this lesson plan students will learn about green Chemistry, Students will learn to follow a protocol . They will count and measure and understand the importance of precision when following a protocol.. Students will test the glue and think about how they can make it efficient and greener using the principles of green chemistry. This lesson plan is adapted from Beyond Benign

Subject	Green Chemistry
Topic	Cleaning up our oceans
Age of students	Elementary 6-12
Preparation time	30 Minutes
Teaching time	180 Minutes
Online teaching material (links for online material)	<p><i>Introducing Green Chemistry: The Science of Solutions</i>  <a href="https://blossoms.mit.edu/videos/lessons/introducing_green_chemistry_science_solutions">https://blossoms.mit.edu/videos/lessons/introducing_green_chemistry_science_solutions</a></p> <p><a href="https://www.acs.org/content/acs/en/education/outreach/celebrating-chemistry-editions/2020-ncw/making-glue.html">https://www.acs.org/content/acs/en/education/outreach/celebrating-chemistry-editions/2020-ncw/making-glue.html</a></p> <p><a href="https://www.instructables.com/Make-your-own-glue/">https://www.instructables.com/Make-your-own-glue/</a></p> <p><a href="https://www.beyondbenign.org/lessons/green-glue/">https://www.beyondbenign.org/lessons/green-glue/</a></p>
Offline teaching material	<ul style="list-style-type: none"> <li>▪ "12 Principles of Green Chemistry" from Figure 4.1: (p.30). 12 Principles of Green Chemistry from <i>Green Chemistry: Theory and Practice</i> (1998) by Anastas P and Warner J. By Permission of <a href="#">Oxford University Press</a>.</li> <li>▪ <a href="#">American Chemical Society Green Chemistry Institute</a></li> <li>▪ <a href="#">EPA Green Chemistry</a></li> <li>▪ <a href="#">Beyond Benign</a></li> </ul>



- <https://www.youtube.com/watch?v=PqxMzKLYrZ4>
- <https://www.youtube.com/watch?v=RzkJkEKV8Yk>
- <https://www.youtube.com/watch?v=IDhapt7nw4A>

## Aim of the lesson

By the end of this lesson students will:

- 1) Understand what Green Chemistry is
- 2) Understand the importance of following a protocol
- 3) Learn to measure and calculate quantities.
- 4) Use the design cycle to evaluate and test a product

## Trends

STE(A)M Learning , Collaborative Learning, Problem solving



## Activities

Name of activity	Procedure	Time
Introduction to Green Chemistry	<ol style="list-style-type: none"> <li>1. Start the lesson with <b>introductory questions</b>: What does a chemist do? What are some chemical products? What do you think about when you hear the words "Green Chemistry"? What is environmental science?</li> <li>2. Students can watch the introductory video ...</li> <li>3. Students will be introduced to <b>the 12 Principles of Green Chemistry</b>. <b>Activity:</b> Think about what Green Chemistry means to you. Present the 12 principles in your own words. Students will be divided in groups. Each group will be assigned with a green Chemistry principle and will be asked to present it with a skit, a drawing or even a song to their classmates.</li> </ol>	45 min
The story of Glue	<ol style="list-style-type: none"> <li>1. Ask students where glue is used and if they could imagine a world without this invention</li> <li>2. Explore the site history of glue. <a href="http://www.gluehistory.com/">http://www.gluehistory.com/</a></li> <li>3. Make a glue history timeline</li> </ol>	45min
Make your own glue	<ol style="list-style-type: none"> <li>1. Explore glue ingredients <a href="http://www.gluehistory.com/glue-making/glue-ingredients/">http://www.gluehistory.com/glue-making/glue-ingredients/</a></li> <li>2. Choose an ingredient that you would like to use for your glue</li> <li>3. According to level of students students could either write their own protocole of follow a standard protocol for making glue</li> <li>4. Make one or two recipes of glue. Each team could choose and follow one recipe and then compare the results</li> </ol> <p>Protocol adapted from Beyond Benign <a href="https://www.beyondbenign.org/lessons/green-glue/">https://www.beyondbenign.org/lessons/green-glue/</a></p> <p>Supplies: (per student group)</p> <ul style="list-style-type: none"> <li>• 1 clear cup</li> <li>• 1 spoon</li> <li>• 1 fork</li> <li>• ¼ cup (60ml) hot water (graduated cylinder)</li> <li>• 2 tablespoons (30ml) powdered milk</li> <li>• 1 tablespoon (15ml) white vinegar</li> <li>• 2 coffee filters</li> </ul>	90 min



- Paper towel
- 1/8-1/4 teaspoon (approximately 4 pinches) baking soda

(Shared supplies)

- Hot pot
- Waste container (ex. old converted milk jug, bowl, etc)
- Small cups for baking soda

Procedure:

1. Add 30ml (2 table spoons ) of powdered milk to the cup.
2. Measure 60ml of warm water.
3. Add this water to the powdered milk and stir until dissolved.
4. Add 15ml (one tablespoon) of vinegar to the mixture and stir. The milk will separate into solid white chunks (curd) and a yellowish thin liquid (whey).
  - Stir with spoon until the milk is well separated.
5. Remove the curd from the whey.
6. Place the curd onto two coffee filters and squeeze some of the liquid back into the cup.
7. Dispose the whey
8. After the cup is empty, drop the lump of curd back in.
9. Use the fork to break the curd into small pieces.
10. Add 15 ml (one tablespoon) of hot water.
11. Add 1/4-1/8 teaspoons of baking soda.
12. Mix thoroughly.
13. The glue is complete.
  - If the mixture is too thick, add a bit of hot water.
  - If it is too lumpy add another pinch of baking soda and stir.

Cornstarch glue

Ingredients

1 cup Cornflour or Cornstarch



	<p>1 tablespoon of white vinegar</p> <p>2 teaspoons of Salt</p> <p>4 cups of Hot Water</p> <p>Other glue recipes can be found in  <a href="https://www.instructables.com/Make-your-own-glue/">https://www.instructables.com/Make-your-own-glue/</a></p>	
Test your glue	<p>Test your glue</p> <p>Have students make their super glue rubric / criteria</p> <p>Use the glue to make a collage or or build a tower or bridge</p>	45 min
How green is your glue?	Students reflect on the green chemistry principles. How green is the glue they made? Could we make our glue greener?	