

SCSU CRISP CCSA Kit Pages 2016

Title of Module: Aerogels

Subject or Unit of Study: ____ Aerogels, Hydrophobicity, hydrophilicity ____

GRADE LEVEL ____ 5 – 12+ ____ **LENGTH OF DEMO/LESSON:** ____

STUDENT OBJECTIVES

Students will...

- Students will investigate the structural properties and applications of aerogels.
- The difference between hydrophilicity/hydrophobicity
- Why aerogel is a good material for oil spill cleanup applications

STANDARDS

See CRISP aligned standards document

MATERIALS

- 1 cup with $\frac{1}{4}$ cup of vegetable oil (per group)
- 1 glass with $\frac{1}{2}$ cup of water (per group)
- 1 plastic spoon (per group)
- 100 cc of millimeter-sized silica aerogel particles (Lumira® LA1000)
- 1 four-color box of liquid food dye (dropper style)
- soap, water and paper towels for cleanup
- Laser pen
- Small squares of aerogels

SAFETY

Do not ingest aerogels

Wash hand thoroughly after handling aerogels

LEARNER BACKGROUND

See Aerogels presentation from teachengineering.org. This is available on the CRISP website. Students should understand hydrophobic/hydrophilic properties

LEARNING ACTIVITY OR PROCEDURE:

From https://www.teachengineering.org/activities/view/duk_aerogel_lesson01_activity1

Before the Activity

- Gather materials and make copies of the [Aerogels in Action Worksheet](#), one per student.
- If possible, identify an outdoor location to conduct the activity, such as a pavilion or covered area. This activity can be done inside, but when used in small enclosures, the aerogels can make your throat dry, so try to conduct the activity in a location with good air exchange.
- *Tip for how to correctly use the word "aerogel" in a sentence:* In your mind, replace "aerogel" with the word "plastic" and think of how you would use that word in a similar context. For example: "plastics are useful materials" = "aerogels are useful materials," or "plastic has greatly impacted society" = "aerogel can greatly impact society." Source: <http://www.aerogel.org/?p=3>

With the Students

1. Take the class outside, bringing the activity materials.
2. Divide the class into groups of two students each.
3. Have one student from each group get a cup containing some vegetable oil. Tell these students that they represent oil tankers, each carrying a supply of oil.
4. Then have the second student from each group get a cup containing some water. Tell these students that they each represent a body of water, such as the ocean or a lake.
5. Ask students for their predictions on the following questions: Will the liquids mix? Which liquid is denser? When combined, which will be on the top? Which will be on the bottom?
6. Then go around to each group with the blue red and green liquid food coloring. Into each oil cup, add two or three drops of food coloring. (Alternatively, have the students help, going around with the other colors.) As you do this, ask the class: Is this liquid food coloring hydrophobic or hydrophilic? (It is hydrophilic.) Does it want to be with the oil or the water? Why?
7. Have student pairs try to mix the food coloring into the oil by shaking, spinning and/or stirring. Direct them to make observations about what happens. Expect them to notice how the food coloring does not dissolve, but instead makes little bubbles of itself in the oil.
8. Continue the hypothetical scenario by directing the "oil tanker students" to pretend to crash (perhaps they hit an iceberg or a whale or something fun) and "accidentally" spill the oil into the body of water (the cup of water). DO NOT HAVE STUDENTS STIR THE MIXTURE because if the food coloring is thoroughly mixed it will come out of the oil.
9. Direct the students to observe what happens. Then ask them: Were your predictions correct? Do oil and water mix? Does the oil sit on top of the water?
10. Continuing with the scenario, ask students to imagine the oil-contaminated water is an ocean or lake. We now have an environmental contamination problem. How might you remove the oil from the water to clean it up? This is a challenge that environmental engineers face all the time—water pollution. You cannot pour the oil off an entire ocean or huge lake, and you cannot scrape it off because the oil is too slippery and slimy.

11. Walk around to each group with the aerogel particles. Into each group's food coloring-filled oil, pour about 2 tablespoons of aerogel particles. As you are distributing the aerogel, ask the students to make some predictions. Ask them: Will these aerogel particles like or repel the oil? Will the aerogel like or repel the food coloring? What do you think the food coloring is going to do? (After a few seconds, expect the coloring to begin to fall out of the oil.) Why do you think the food coloring responded like that? (The hydrophobic oil and aerogel are attractive, both repelling the food coloring, while the hydrophilic water and food coloring are attracted to each other.) Listen to student observations, questions and conclusions, leading a class discussion so students understand what is happening.



Since aerogel and oil are hydrophobic, they are attracted, while the hydrophilic food dye is pulled towards the water.

12. Using plastic spoons, have students scoop the aerogel-oil mixture back into the cup the oil was in. The food coloring remaining in the water represents any hydrophilic material that may have been spilled with the oil.
13. Direct students to clean up. Have them pour the water down the sink and throw the cups of oil into the trash.
14. Hand out the worksheets for students to individually complete by the end of class or as homework.

ASSESSMENT:

Student worksheet is available online

ADDITIONAL RESOURCES:

Apply any links or additional information for students or teacher including videos, websites, etc.

TEACHER NOTES:

Describe any tips/tricks for implementing this lesson/demonstration that might be helpful to future educators. Provide answer keys if applicable.

STEM CAREERS:

Aerospace Engineer
Environmental Technician
Manufacturing Technician
Materials Scientist
Researcher
Conservation Scientists
Environmental Scientists
Health and Safety Engineers
Industrial Engineering Technicians
Industrial Engineering Technologist
Materials Engineers

