

West Side Science Club – Event #20– “Field Trip to Caltech”

Original Presentation

Date: 14 December 2013
Time: 10 am to 12 pm
Site: Caltech

Big Questions

- These questions are meant to frame the day’s event and might be written on the chalkboard
 - (1) What are some ways we can measure properties of plastics?
 - (2) What is it like to work in a chemistry lab?

Concepts

- Concepts to cover from the “Work of CCI Solar” Mind Map: Compounds- molecules, everything is chemistry; Engineering- synthesis, design; Sustainability- renewable vs non renewable

Lesson Plan

Student Objectives

- Learn how scientists can measure properties of substances
- Discover that knowledge of certain properties of a material can predict its function and performance

Schedule/Agenda

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| • Introduction and overview of the day | (15 min) |
| • Density | (45 min) |
| • Viscosity | (45 min) |
| • Lunch | (1 hr) |
| • Tensile strength | (1 hr) |
| • Wrap up | (15 min) |

Materials

Activity: Density

- Beakers, graduated cylinders, other graduated volumetric glass
- Small samples of the plastic materials

- Water
- Scale
- Calculator

Demo: Viscosity

- 2 Separatory funnels
- Teflon tubing
- Capillary tube
- Timer
- Styrofoam
- Acetone
- 2 beakers

Demo: Tensile Strength

- Awesome setup in Professor Ravichandran's lab

Safety

- Since we are working in the undergrad chemistry labs at Caltech and in a materials science research lab, safety glasses need to be worn at all times as well as long pants and closed-toe shoes.
- Anyone working with acetone need to be wearing gloves and working in the hood.

Review of Previous Events: Plastics

- Recall the activities: Thermoplastics, Bioplastics- cornstarch and milk protein, PPE- acetone/Styrofoam and melting grocery bags

Facilitation Questions

- What properties did each of the plastics you previously made have?
- Which materials do you think are heavier? Denser? Stronger?

Activity: Density

Procedure

1. Students select a material to measure the density of (a smaller piece of plastic)
2. First they must weigh it on a milligram balance and record this in their notebook
3. Next, fill a beaker or other graduated flask about halfway with water. Record the level of the water
4. Add the piece of plastic to the beaker and record the new level of the water
5. Do subtraction to figure out the displaced volume, which will be the volume of the plastic
6. Finally, divide the mass by the volume to obtain the density of the object

Facilitation Questions and Advice to Mentors

- Be sure the graduations are small enough to get an accurate reading of volume
- A good check for accuracy is if the object sinks or floats. If it has a density greater than 1 g/mL it should sink in water. Less than one it will float.

Demo: Viscosity

Procedure

1. The mentors will set up the viscosity apparatus as pictured below



2. Fill the tubing and bottom sep funnel with minimal solvent by pouring through the top funnel
3. Add acetone solution with small amount of Styrofoam dissolved to the top funnel with the stopcock closed.
4. Open the stopcock and start the timer to measure the time it takes for all the acetone-styrofoam solution to empty out of the sep funnel
5. Perform the experiment with more concentrated Styrofoam solutions
6. How do the times differ?

Facilitation/Concept Questions

- What does a longer time through the apparatus mean?
- What property of a plastic would you describe as viscosity?

Demo: Tensile Strength

Procedure

1. Go to Prof Ravichandran's lab
2. Have a postdoc shoot bullets at different plastic materials using their fancy device!

Facilitation Questions and Concepts

- What does it mean about a materials strength if it compresses or cracks?
- What similarities and differences do you see between the plastic materials? How about the metal and wood and rubber materials?

Check for Understanding

- If you were to make a new material, what would you measure to figure out if it is a strong, durable material?
- How would you make these measurements?

References

- (1) : " "
<http://www.>