



## Classroom Lesson Development

(to be posted on website)

Title of Lesson **Chemical and Physical properties of polymers**

RET Project Connection Flexible polymer transfer for high rate nanomanufacturing

RET Teacher Raphael Matty

School Dover High School

Town/District Dover New Hampshire

Subject(s) taught Chemistry

Subjects covered in lesson Chemistry, Environmental Science

Grades appropriate 9 - 10

Lesson duration 4 to 5 days

Goals/Objectives of lesson Improve understanding of chemical and physical properties.

- Students can identify different polymers based on the physical and chemical properties.
- Students can connect the ideas of recycling to the law of conservation of energy and sustainability.

Background information Students will need a basic understanding of chemical and physical properties as well as the vocabulary necessary to test, separate, and identify different polymers. Vocabulary includes - Chemical and Physical properties, Density, Organic compound, Polymer, Solute, Solvent, Mixture, Compound, Monomer, Melting point, Solubility, Combustion, Heat of combustion, Heat capacity.

Essential questions

- 1) What do the different numbers on the bottom of the plastic bottles mean?
- 2) Why do we number them?
- 3) How could we figure out which plastic is which if they were not numbered?

Links to Frameworks and Standards

National Structure and Properties of Matter; Scientific Investigations.

State Properties of Matter

Local

Materials required Samples of plastics #1 - #7; metric glassware; acetone; water; isopropyl alcohol; gas burners (torch); scale/balance; hot plates; copper wire; fume hood; infrared temperature sensor.

Lesson development Once background information is given on chemical and physical properties, and discussion is complete about plastic and polymers (with a focus on the essential questions); students will find definitions of the vocabulary words. A method or design for the lab will be created using student input beginning with small groups and opening into whole class question and sharing. Once students determine how and what they want to do, with a creation of a written procedure, the teacher will model the techniques by following the procedure while pointing out areas for modification and improvement. After students have observed the method and possible mistakes are looked at, the students will break into small groups of about 3 and perform each chemical or physical test in stations. Students will rotate through the stations until they have completed all chemical and physical tests. These tests include, density, solubility, a relative comparison of glass transition, and a copper flame test. Students will gather as much data as possible from each polymer and try to determine a method of identification based on the results. They will again be able to consult with the rest of the class and possibly design another test if they think they need more information. When a method of determining an unknown polymer is finalized each group will be given an unknown. The unknown will be a sample different in appearance from the previous six and the goal will be to correctly identify it and give evidence to support the claim.

- References
1. Mark Lawrence
  2. Brydson J., *Plastics Materials*. 7th Edition. Boston MA: Butterworth Heinemann, 1999.
  3. "Teachers Guide." *Faces in Polymers*. 2001. Chemical Heritage Foundation. 5 Aug 2008  
<<http://www.chemheritage.org/EducationalServices/faces/teacher/poly/home.htm>>.