

Module Title: Polymer Processing Demonstration: Happy/Sad and Other Balls		
Lab compiled by: Tom Stoebe, MatEd Partner	Address:	Email: tgstoebe@earthlink.net
Time to complete module: As a simple demonstration: 10 minutes with class discussion Full Experiment: (Introductory classes-90 minutes, Advanced classes-60 minutes)		
Description of module, lab or demonstration: Students will be introduced to several polymer processing variables and concepts. Upon completion of the activity, including answering all the provided questions, students should obtain a solid background of polymer structures and processing techniques (i.e. effect of temperature on various properties).		
Pre-requisite knowledge and skills: A general knowledge of the structure of polymer materials and their processing		
Materials Category:	Structure of Materials	<input type="checkbox"/>
	Metals	<input type="checkbox"/>
	Ceramics	<input type="checkbox"/>
	Polymers	<input checked="" type="checkbox"/>
	Composites	<input type="checkbox"/>
	Other	<input type="checkbox"/>
Target Grade Level(s) (Check all that apply)	Middle School 6-8	<input checked="" type="checkbox"/>
	High School 9-12	<input checked="" type="checkbox"/>
	Two-year College 13-14	<input checked="" type="checkbox"/>
	Four-year College 15-16	<input checked="" type="checkbox"/>
MatEd core competencies that the training meets: <ul style="list-style-type: none"> • 7.005 Describe the general nature of thermoplastics • 16.007 Describe how changes in manufacturing processes effect material properties 		
List of equipment and supplies needed: Happy/Sad Balls- Available from Flinn Scientific *An assortment of other balls (i.e. racquetballs, golf balls, etc.) should a further discussion on material processing be undertaken 30- safety glasses (PPE)		
Curriculum overview and notes to instructor:	Polymer structures differ from metals in that polymers are long chain molecules. Structural differences come from the degree of stiffness of the chain itself, the presence of molecules attached to the chain, and cross-links between chains. A micro-structural model of simple polymer chains in a product would look something like a pot of boiling spaghetti. Commercial plastics consist of polymer	

	<p>molecules with specific properties and specific additives needed to provide the desired properties of the product. In addition to changing the structure and adding other polymers to a plastic, changes in properties can also be related to changes in processing or production of the product. By experimenting with different types of balls, students can get an understanding of the influence of both structure and processing on a plastic product.</p>
<p>Mode of presentation: Demonstration, or should the full experiment be utilized an in-class laboratory activity</p>	
<p>Module</p>	<p>Procedure: Demonstration Bounce the "happy" ball on a table and note how high it bounces. Invite a student to do the same. Then substitute the "sad" ball that does not bounce. Discuss with the class what differences may exist and how they can find out.</p> <p>Procedure: Full Experiment (Part 1) Conduct the Happy/Sad ball demonstration as outlined on the attached page from Flynn Scientific (see http://www.eas.caltech.edu/openhouse/joint_cc_2003/handouts/degroot-Happy_Sad_Balls.pdf). Include the demonstration on bouncing, the effects of temperature, and the comparing of densities. Refer to the discussion on the Flynn page to lead the class to answer these questions:</p> <ol style="list-style-type: none"> 1. What makes the happy ball bounce so well? What are its important components? What would happen if one or more of these components were omitted when the ball is made? What if an incorrect amount of one of these components were omitted? 2. Compare the components of the sad ball to happy ball. Why are their properties so different even when they look alike? 3. Discuss the application of plastics with the components of the happy ball. The Sad ball. <p>Procedure: Part 2 Experiment with the bounce of several other types of balls. Investigate whether there are differences of properties with changes in temperature. Discuss with the class the differences and have them speculate why they are different. Have the class do internet research on the composition and processes used to make several different types of balls.</p>

References:	<p>Flinn Scientific. (2003). <i>Happy/Sad Balls</i>. Retrieved August 20, 2007 from, http://www.eas.caltech.edu/openhouse/joint_cc_2003/handouts/degroot-Happy_Sad_Balls.pdf</p> <p>St. Mary's University. <i>Happy and Sad Balls</i>. Retrieved August 20, 2007 from, http://www.ap.stmarys.ca/demos/content/mechanics/happy_and_sad_balls/happy_and_sad_balls.html</p> <p>Science First. (2006). <i>Happy/Sad Balls</i>. Retrieved August 20, 2007 from, http://www.sciencefirst.com/vw_prdct_md1.asp?prdct_md1_cd=40416</p>
Briefly describe how the effectiveness of the module was evaluated:	The effectiveness of the module was evaluated in "10 Simple and Effective In-class Experiments and Demonstrations for Materials Education." The review provides several notes and observations for the module.
Author Bio:	Dr. Tom Stoebe works with the National Resource Center for Materials Technology Education (MatEd) housed at Edmonds Community College. Dr. Stoebe is a Professor Emeritus in Materials Science and Engineering at the University of Washington and has been at the forefront of materials education in the United States.