MATERIAL™ ADVANTAGE

The Student Program for Materials Science and Engineering

*Everything Else Is Immaterial*

# WORLD MATERIALS DAY
# COMPETITION ENTRY FORM

**General Criteria: Promotion of the wider knowledge of materials and their importance in every day life to the benefit of younger people.**

Material Advantage Student Chapter Name: **Iowa State University - Material Advantage**

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Provide a brief summary of the outreach project performed for K-12 students:

**Each year, the Iowa State University Chapter of Material Advantage provides numerous outreach events for K-12 students in Ames, Iowa and its surrounding communities. Our outreach activities range from an extensive set of exciting materials science demos to various educational "hands-on" activities. We also volunteer to help local organizations such as after-school programs, youth groups, science fairs, and summer camps. Due to a strong volunteer base, our chapter is able to instill an interest of science and engineering within students of all ages.**

*Please return completed form along with a written report addressing the activities, approaches, and success of your outreach project to*

*Deborah Price*
*Student & Professional Affairs Administrator*
*TMS*
*184 Thorn Hill Rd*
*Warrendale, PA 15086*
*USA*
*Fax: 724-776-3770*
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# Outreach Activities Report For World Materials Day


Iowa State University
Material Advantage Student Chapter

# Introduction

The outreach endeavors of the Iowa State University Chapter of Material Advantage consists of three primary activities; namely, showcasing, recruitment, and volunteering. Our chapter has an extensive set of exciting Materials Science demonstrations that are an effective way to show audiences some of the neat things that materials scientists and engineers can do. Each semester, student members of Material Advantage present the demonstrations to about twenty different audiences, usually for middle and high school students who are visiting the ISU campus.

The university itself frequently asks our chapter to provide exciting activities for visiting students, such as those who are considering the ISU college of engineering and those who visit the university for events such as the state science fair. For these "recruitment" events, we typically perform a few demos at a table or booth while sharing information with prospective students regarding ISU, the College of Engineering, and Materials Science and Engineering.

Our chapter also helps the local community by volunteering at schools, after-school programs, youth groups, summer camps, etc. The activities we offer for these events are intended to spark an interest of science and engineering within young students. Such activities include demonstrating the concept of phase changes by making ice cream with liquid nitrogen and teaching the concepts of crystallography by modeling different crystal structures with gum balls and hot glue. In one case, several students volunteered to help teach 2$^{nd}$ graders about the different types of motion, such as spinning, sliding, falling, rolling, bouncing, etc.

Last year, our chapter was involved in over thirty outreach events. The following sections list and describe the primary activities that our chapter employs for its outreach events.

# Outreach Activities

## Demonstrations

From a recent poll of upperclassman in Materials Engineering at ISU, 79% of the students surveyed mentioned that materials demonstrations were a major influence in their decision to pursue an education in materials engineering. Last year, the Materials Science and Engineering faculty and Material Advantage students, together, presented over 75 demonstrations to audiences ranging from 20 to 200 people. These exciting performances are therefore a fantastic way to introduce and recruit many people towards fields related to materials science. The remainder of this section is devoted to briefly describing each demonstration.

**Crystallization Demo**

This demo is used to illustrate how atoms might appear if viewed with a powerful microscope and to show that the arrangement of the atoms (crystal structure) can be changed through various processing techniques. The demo consists of numerous ball bearings placed between two sheets of plexiglass so they can move around between the plastic sheets. This "model of an atomic plane" can be placed on an overhead projector so that larger audiences can easily view the demonstration. The concepts of dislocations, vacancies, and defects are also introduced and discussed.

**Tempering Steel**

This experiment demonstrates that ordinary steel is ductile, but it can be heat treated such that it becomes very strong. Two pieces of steel drill rod are tempered using a propane torch and water bucket for quenching. The use of steel in tools and structures is discussed.

**Optical Fiber**

A glass rod is heated and pulled into a long fiber. The use of fiber optics in telecommunications and laser surgery is discussed.

**Melting a Penny - Thermal Conductivity**

A penny is melted with a torch on a NASA space shuttle tile while it rests on (and protects) the presenter's hand. The importance of ceramics as insulating materials is discussed.

**Shape Memory Alloy**

A few pieces of NITINOL wire in the shape of "ISU" are given to audience members who then deform the wire. The wires are then placed in hot water and they spring back to the ISU shape. The use of shape memory alloys in braces is discussed, along with potential future applications.

**Happy and Sad Balls – Cross-linked Polymers**

An audience member is asked to compare and contrast two seemingly identical polymeric spheres. Each ball is then dropped to the floor. One ball (the happy ball) bounces while the other ball (the sad ball) falls flat. The process and effect of cross-linking is explained and the use of this property in super balls and bouncy balls is addressed.

**Athletic Contest – Electromagnetic Induction**

A volunteer is asked to try and catch a magnet that is falling through a pipe. The presenter and volunteer each grasp a pipe vertically with one hand. The free hand of the presenter holds the magnet at the top entrance to the pipe. The volunteer's free hand rests above the presenter's free hand.

The presenter then drops the magnet through the pipe and the volunteer tries to catch it with their free hand. The audience will see that it is easier to catch the magnet as it falls through a copper pipe rather than a PVC pipe. The concepts of electromagnetic induction and eddy-currents are addressed.

**Ferrofluid**

Ferrofluid is poured into a Pyrex dish and a magnet is brought near the bottom surface of the glassware causing the suspended iron particles to coagulate and form ‘spikes’ that are aligned with the penetrating magnetic field lines. Applications of ferrofluid such as controllable and on-demand sealing are discussed.

**Racquet Ball – Glass Transition**

A racquetball is submerged in liquid nitrogen. While it cools, marshmallows are frozen and distributed to the audience. The racquetball is then thrown against a wall and destroyed. The effect of temperature on mechanical properties is discussed. (Liquid nitrogen tends to be very exciting for audiences, so a brief discussion and questions regarding the liquid often occur during this demonstration).

**Tempered Glass**

A pane of tempered glass is spanned across two chairs. The presenter stands on the pane and comments on the incredible amount of compressive strength that tempered glass possesses. The process of thermally tempering glass is discussed. The glass is then shown to be weak in tension by cutting the corner of the pane with a set of pliers. The manufacturing process and applications of tempered glass are discussed.

# Oobleck

Oobleck is a non-Newtonian fluid that is created by mixing cornstarch and water. It is shear thickening; that is, its viscosity increases as it is agitated quickly and is therefore unlike most any other fluid that people encounter from day to day. A simple explanation is that it acts like a liquid if agitated slowly, but acts like a brittle solid when agitated quickly.

For activities such as the State Science Fair, our chapter helps younger students make their own batches of oobleck while teaching them about viscosity. For VEISHA 2010, Iowa State University's annual celebratory week, our chapter created an entire "sidewalk" of oobleck for "pedestrians" of all ages to enjoy, as shown in the following photographs.

The duality in mechanical behavior described above is shown in the photographs below; where, a young boy holds some of the fluid in this hands as it slowly flows like syrup, while a girl is pulling the fluid apart thus forming a crack.

# Crystallography

Our chapter has developed an activity that helps students visualize some of the basic crystal structures while enjoying a tasty treat. The students are assisted as they construct models of face-centered cubic and hexagonal close-packed unit cells using bubble gum and hot glue. Once constructed, the students have models that are helpful for visualizing slip planes, interstitial sites, atomic packing, etc.



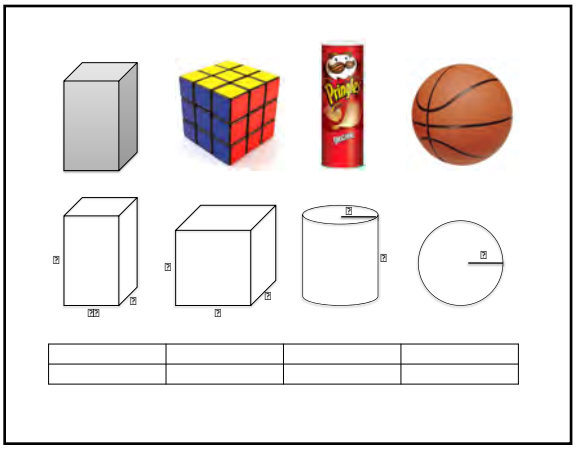



# Volume Activity

Two members from our chapter developed a lesson plan to teach 3rd graders how to calculate volume. The lesson begins with a discussion about dimensions (1D, 2D, 3D) and the units associated with area and volume. This helps the students realize that they are already familiar with volume, since they are likely to know units such as gallons, liters, cubic centimeters, teaspoons, etc. The students are then taught some basic shapes by introducing them as objects they have seen before, such as a basketball (object) acting as a sphere (shape).

The lesson continued with a discussion of how engineers and scientists might use volume calculations. Example situations included calculating the volume of various components of an engine or machine, calculating the volume of a water tower design, etc.

The students were very excited to see their individual lung capacities by inflating a balloon with a single breath. They were then able to determine their lung capacity by calculating the volume of the nearly spherical balloon. The first of the following pictures is the worksheet that accompanies the activity, which could also be used in other classes as a tool for reviewing volume calculations, or as a fun summer camp project.




# Ice Cream

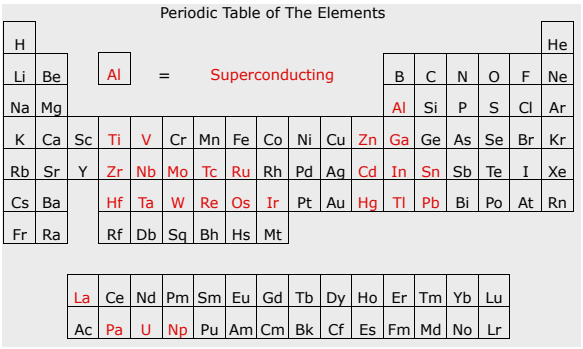
Several members of our chapter travelled to a local elementary school for its annual Science Night. The Material Advantage members hosted an activity that taught the elementary students about phase changes, specifically freezing and melting. This was accomplished by allowing the children to mix their own batch of ice cream, which were then frozen with liquid nitrogen. The chapter volunteers explained that as materials are cooled they eventually freeze.

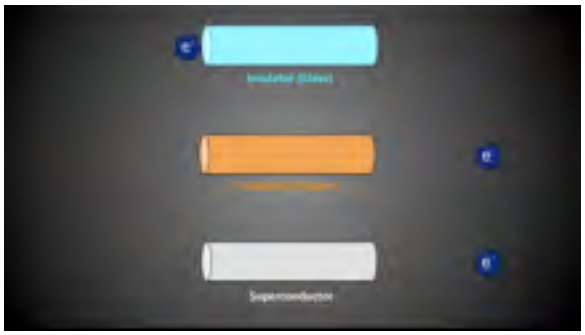
The incredible 'creaminess' of this treat was related to the fact that the mixture of milk and sugar was cooled so rapidly that it did not have time to crystallize. The mixture formed small, nearly spherical particles, which provide a more pleasant sensation to one's taste buds.

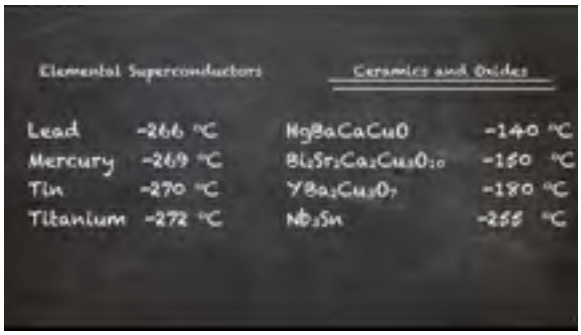
Temperature scales and the uses for liquid nitrogen as a cryogenic fluid in science and medicine were also discussed. Examples of such applications for liquid nitrogen include acting as: a source of nitrogen gas, a tool for cryosurgery, a cooling agent for superconductors, etc.

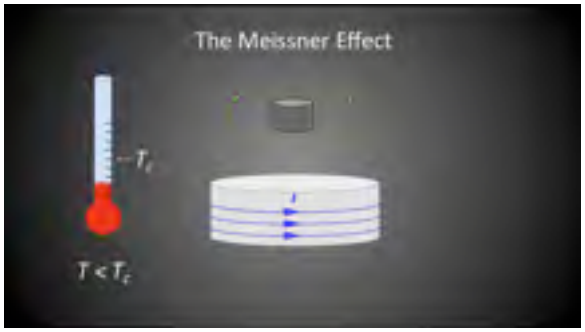
ASM Podcast

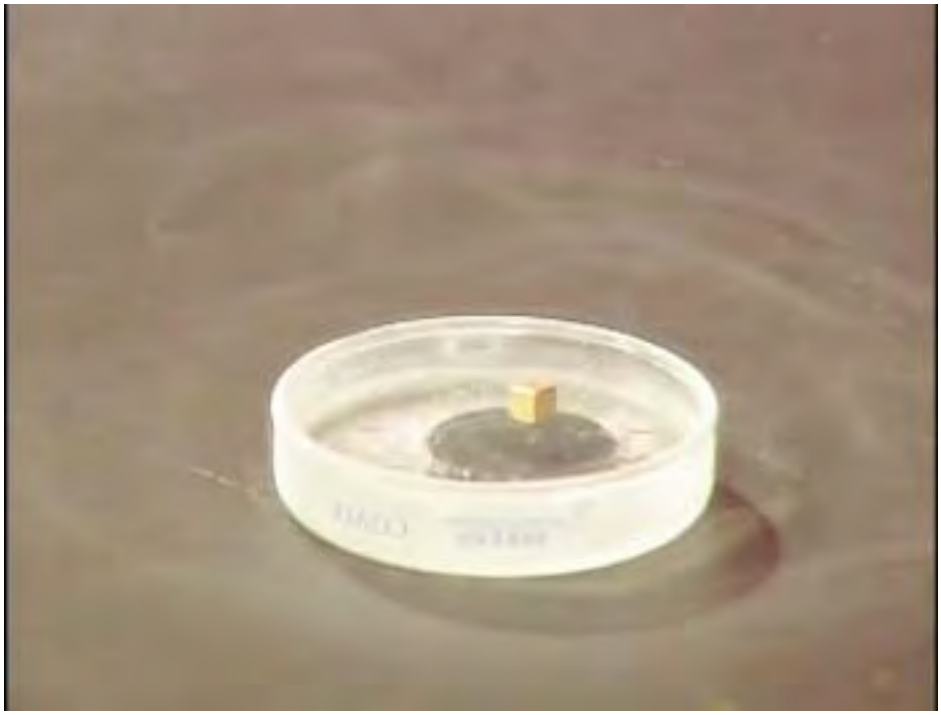
Earlier this spring, a video podcast submitted by the Iowa State University Chapter of Material Advantage was accepted by the Materials Radio program of ASM International. The three minute video discusses the theory, materials, and applications of superconductors and will be featured on the ASM website in the near future, making it available to students across the globe. The podcast is currently available at http://www.mse.iastate.edu/ma/photos.html





# Concluding Remarks

There are several great challenges that face our planet, such as reducing global warming, finding alternatives for diminishing fossil fuels, and improving inefficient electrical transmission systems. Each of these challenges will require the best minds and most creative thinkers of our generation. We feel that our outreach efforts contribute to solving these problems, since they motivate, engage, excite, and inspire students to better themselves.

The key to our chapter's success is simple. We simply have a very enthusiastic and involved department. Our students enjoy the benefits of great camaraderie, such as forming helpful study groups, fun athletic teams, and life-long friendships. Whether we are shopping for necessities for a family need, playing a competitive game of broomball, serving ice cream to local elementary students, or any number of other activities, our chapter maintains an inviting and exciting environment so that all of our members feel welcome and part of our group.

The inclusive nature of our organization is reflected by the large number of freshman and sophomore students who serve on the executive board alongside junior and senior students, allowing them to develop leadership skills early during their undergraduate study. Another benefit of a cohesive student body is the large volunteer base it provides. As a result, our outreach and volunteer events are far from being understaffed.

As evidenced by this report, the Iowa State University Chapter of Material Advantage enjoys a very successful outreach program. We are dedicated to promoting Materials Science and Engineering and instilling an interest of science and engineering within students of all ages.

In closing, we thank you for considering our chapter as a candidate for the 2010 World Materials Day Award.

Sincerely,
**The Iowa State University Chapter of Material Advantage**