



Passport to the Materials World:

Materials Engineering Outreach Activities

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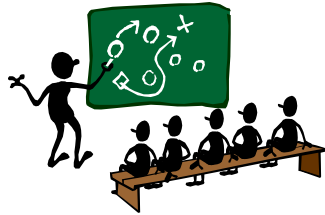


American Society for Engineering Education (ASEE) Annual Conference
Portland OR; June 15, 2005

Why Outreach?!

- Goals:**
- public awareness of Materials
 - science is cool and fun!
 - department recruiting

Strategies

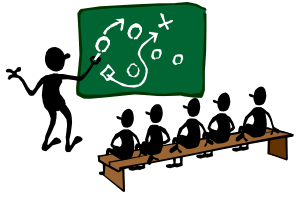


Activities/Demonstrations



**Pedagogy Pointers
and Tips**





Where and To Whom?

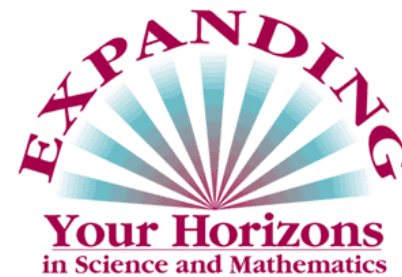
On Campus:

- visits by school groups
- open house
- SWE workshops



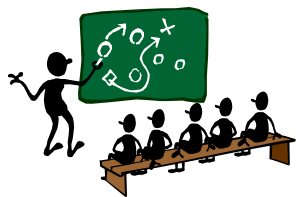
On-site visits:

- local grade schools
- career fairs
- alumni outreach program



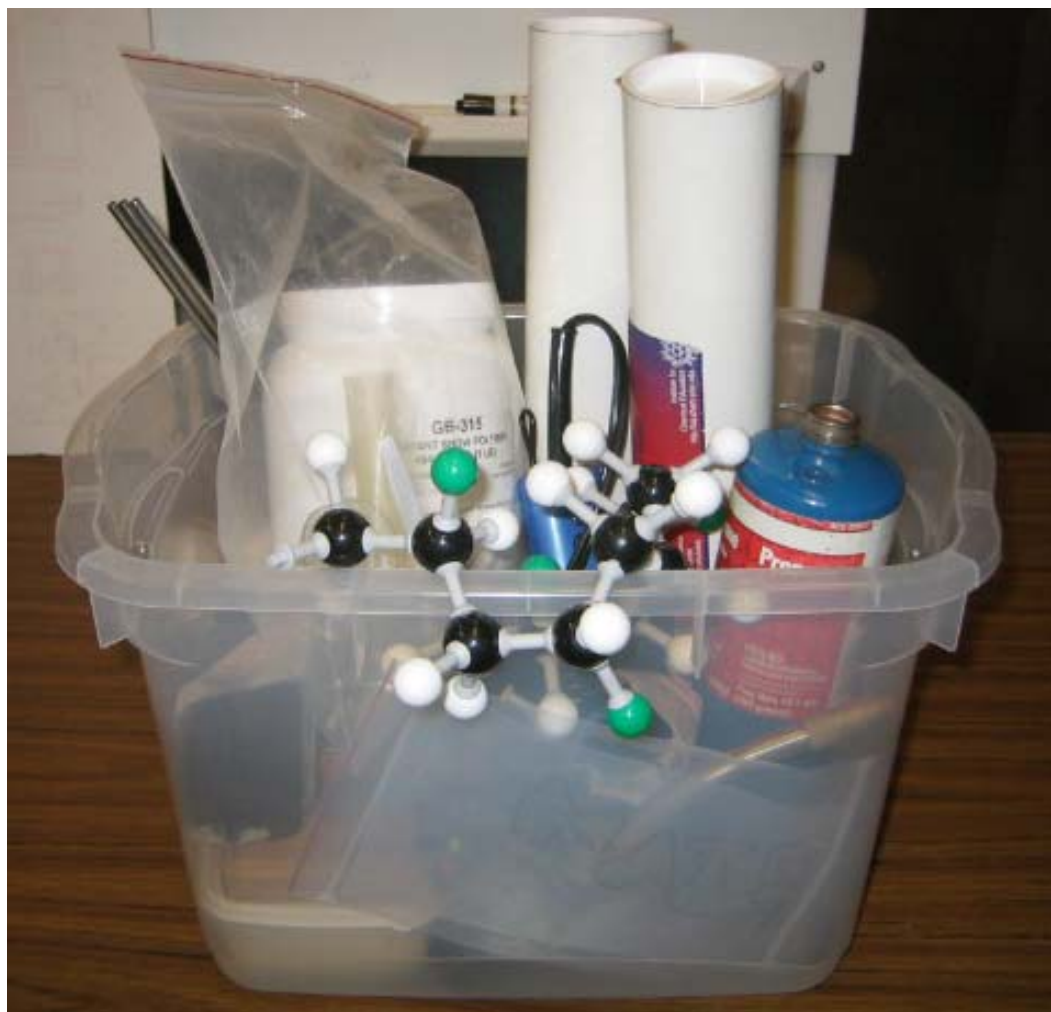
Partners in education

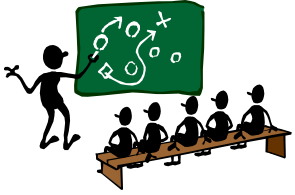




Demo Box

- arsenal of demonstrations, show-n-tell items
- portable,
ready to go
- used by outreach
team of trained
students, others





Powerpoint Presentation

- can be used for class visits, workshops
- steps with demonstrations and activities

➡ use many pictures, few words

➡ promote inquiry

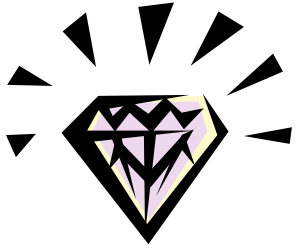
➡ know audience

➡ create with students

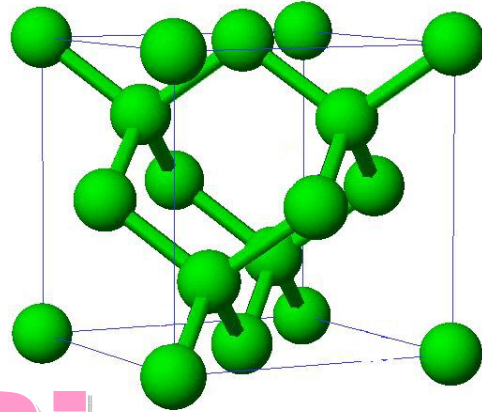
What is Materials Engineering?

- Choose Materials for Applications
 - make **new** materials
 - find new ways to use old materials
- Practical use of Science and Math
 - relate properties, processing, & structure
- What Else Do We Do . . .



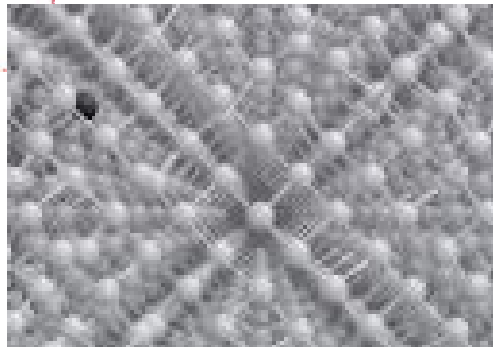


Why are diamonds so hard and sparkly?



Diamonds

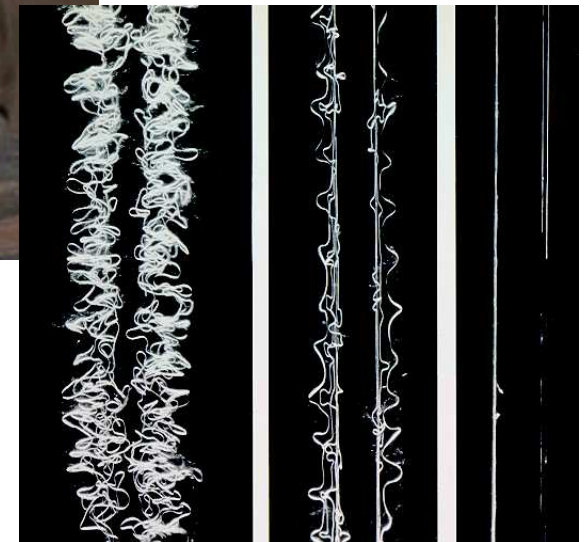
Why are some diamonds colored?

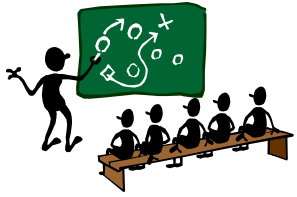




Spider Silk

- 2X stronger than Kevlar
- very lightweight
- can stretch 30%
- possible uses:
 - bullet proof vests
 - sporting goods
 - wound closure
 - synthetic ligaments





Welcome to MATEland!

Building an Engineer
SWE Workshop



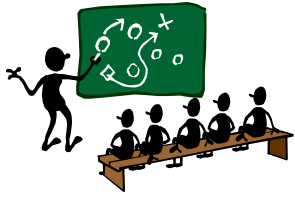
Welcome and introduction
by Mayor of MATEland

Discover Materials World!

- passports of attractions issued

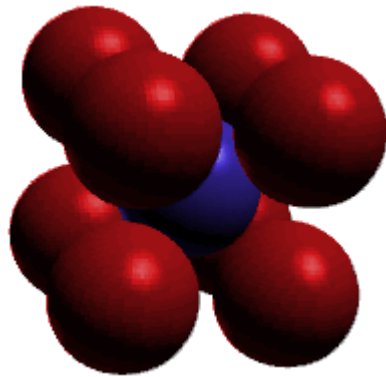
- guest book for
comments





MATEland Attractions and Passport

Welcome to MATEland



Materials Passport
Building an Engineer 2004
Materials Engineering Department

stamp please!



Planet of the
Shapes



Shape Memory Alloys are an amazing group of metals that have the ability to "remember" their original shape after being deformed or changed. The most popular Shape Memory Alloy is nickel titanium, NiTi.



Atlantis



The space shuttle tile is very porous and thus has very good insulating properties. These tiles protect the shuttle from the high temperatures experienced during reentry from space. The insulating properties allow the tile to be handled on one side while being heated with a blow-torch on the other.



Insta-Snow



Insta-Snow is a special superabsorbent polymer powder that expands to 100 times its original size when water is added. The polymer chains of the dry powder are tightly packed around each other. Water causes the polymer chains to unravel making the powder grow into snow!



Bounce
House



In this experiment, you use white glue and borax to make a polymer! The glue has many vinyl monomers that are not connected in long chains. Borate ions from the borax cause the monomers to link together forming long polymer chains. The properties of the glue change from sticky to stretchy when monomers link together.



Charpy Town



The Charpy Impact test shows how much energy a material absorbs during fracture. The surfaces of the broken parts can be viewed as brittle or ductile. Testing the same type of material at high, low, and room temperatures shows how a material changes from brittle to ductile at a transition temperature.



Hi-Tech
Creamery Country



This experiment shows the rapid solidification of a milk and sugar mixture. The liquid nitrogen uses energy from the milk and sugar to change from a liquid to a gas. The absorption of heat by the liquid nitrogen solidifies the milk and sugar into yummy ice cream!



Metropoglass



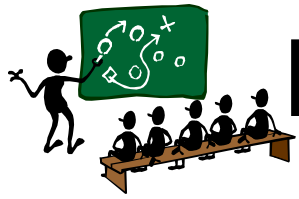
Metals that are processed to be noncrystalline are known as "Metallic Glass". This material allows the steel ball to "bounce" elastically because of the random orientation of the atoms. Golf clubs made of Metallic Glass drive the ball farther than those made of ordinary materials.



The Land of
Levitation



Superconductors used in this experiment are made from YBa₂Cu₃O₇. When they are cooled under a critical temperature a small magnet will float above them. The future of fast monorail transportation may lie in superconductors.



Map of MATEland



- individual attractions/lab stations around room (stamp for passport)
- trained students at each station
- hands-on, inquiry based, interactive

Polymers

- lightweight
- flexible
- versatile
- easy to manufacture





Bounce House



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Flubber: polymer processing



hands-on, interactive



discovery based





Insta-Snow



Polymer structure: add H₂O

Insta-Snow is a special superabsorbent polymer powder that expands to 100 times its original size when water is added. The polymer chains of the dry powder are tightly packed around each other. Water causes the polymer chains to unravel making the powder grow into snow!



Insta-Snow



Surprise!



⇒ sensory: visual, touch

⇒ applications: Hollywood movies, others...

What happens if H_2O evaporates?





Materials Girl Workshop



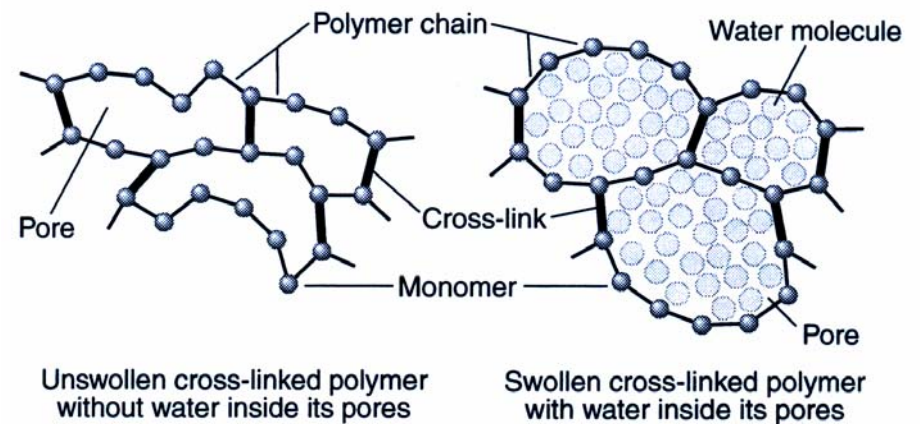
Soil Moist: water adsorbed by polymer



hands-on lab experiments



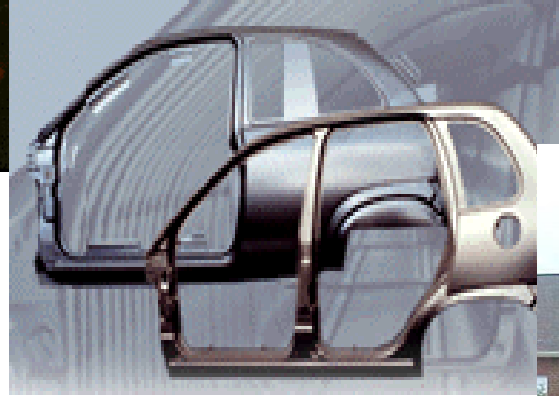
science inquiry and engineering design



Metals

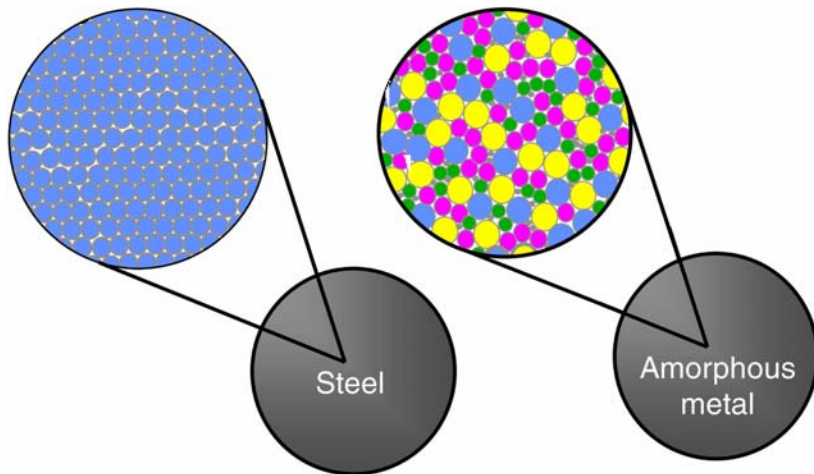
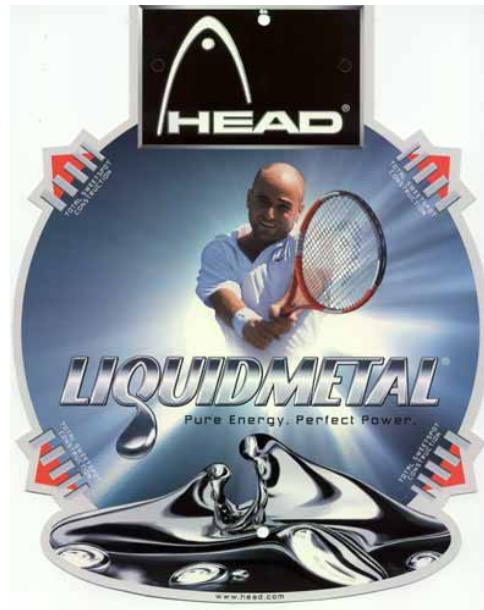


- conductive
- formable
- recyclable
- strong
- shiny



Sports Equipment

Which material for your golf club or tennis racquet?



new materials developed
for unique applications!



Metropoglass



interactive – make prediction



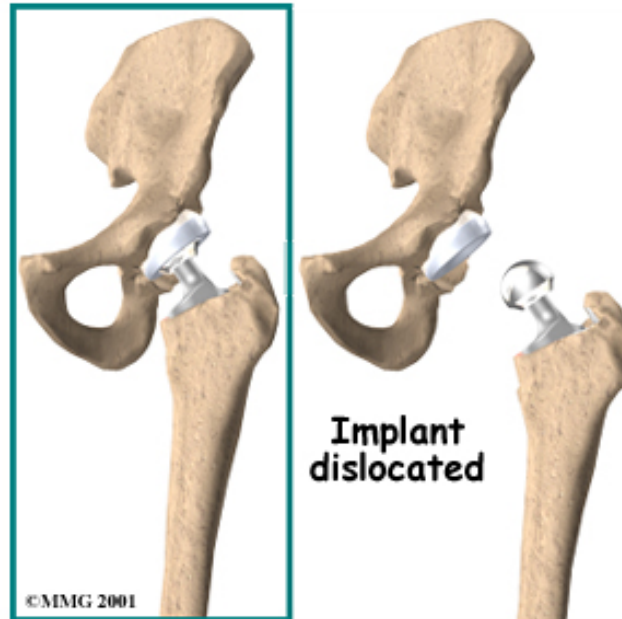
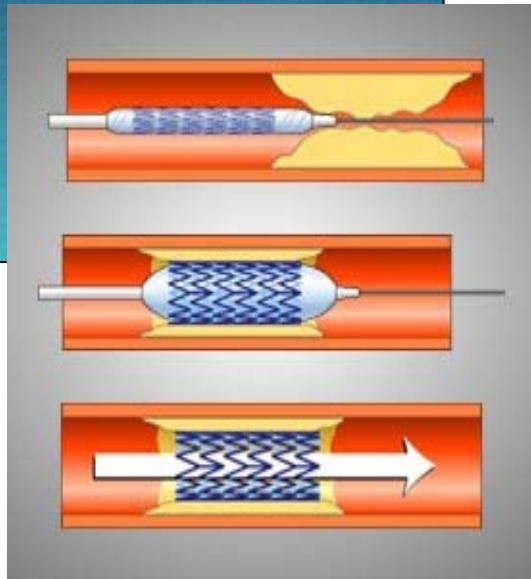
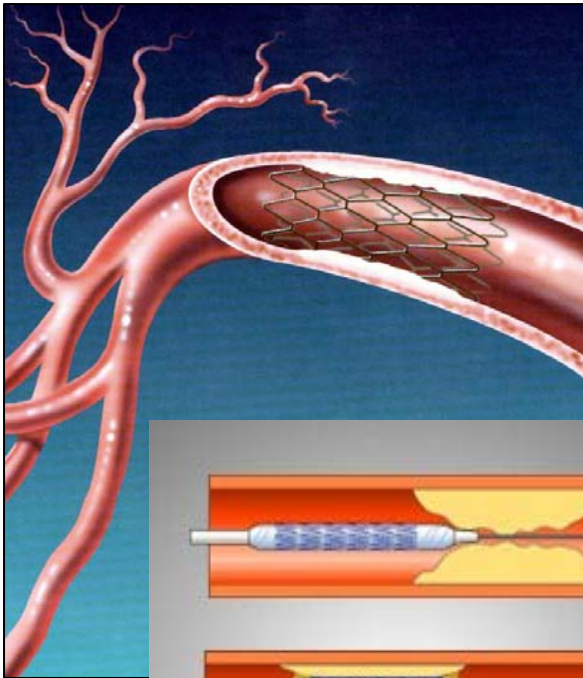
cool sports applications

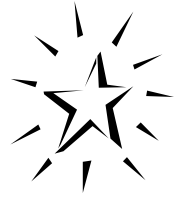


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Bio-Materials

materials developed
to help people

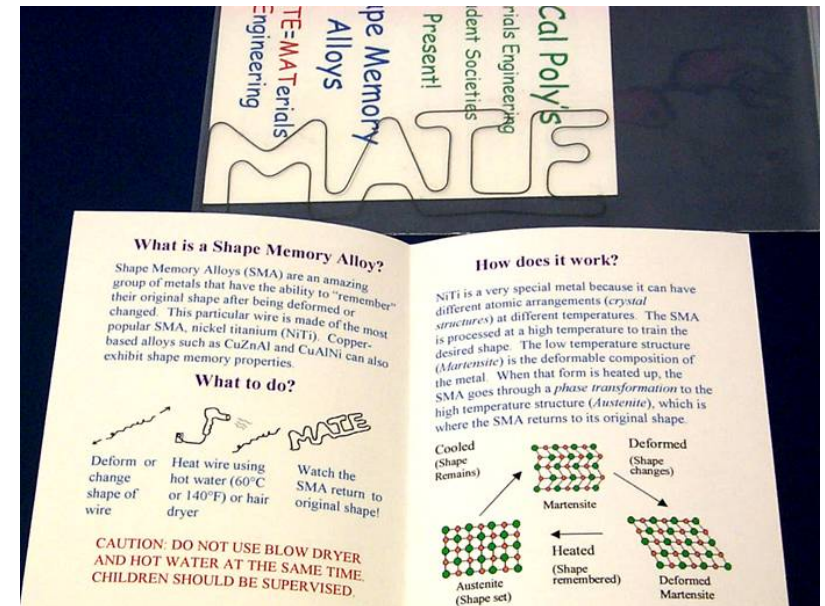




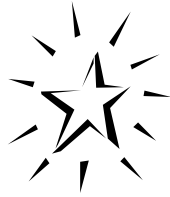
Planet of the Shapes



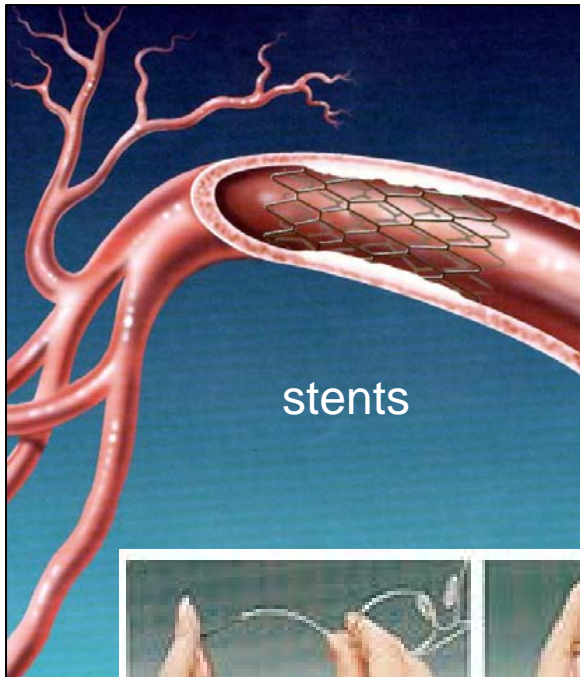
Shape Memory NiTi Alloys: shape remembered when heated



Shape Memory Alloys are an amazing group of metals that have the ability to "remember" their original shape after being deformed or changed. The most popular Shape Memory Alloy is nickel titanium, NiTi.



Planet of the Shapes



eyeglass frames!



Superelastic NiTi rods:
heat generated when deformed



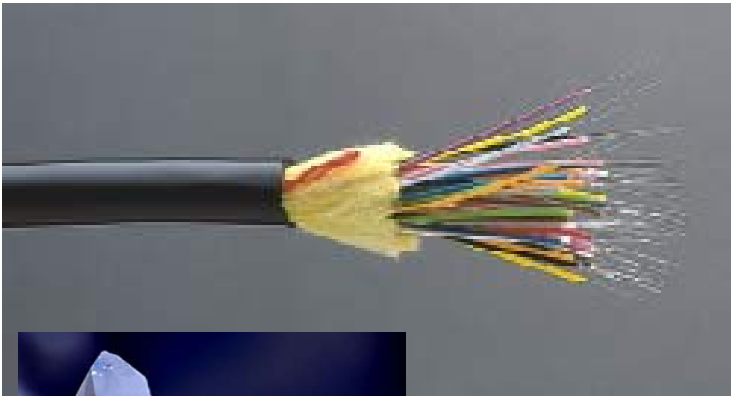
sensory: touch



applications help people

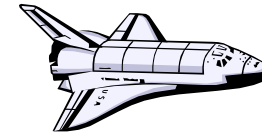
Ceramics

- high strength
- brittle
- insulating





Atlantis



Space shuttle tile:
thermal insulator

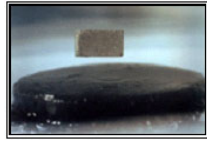


relate to news events

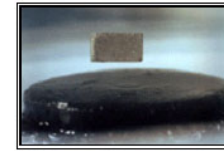


fire is exciting!

The space shuttle tile is very porous and thus has very good insulating properties. These tiles protect the shuttle from the high temperatures experienced during reentry from space. The insulating properties allow the tile to be handled on one side while being heated with a blow-torch on the other.



The Land of Levitation



Superconductor: levitate magnet

Superconductors used in this experiment are made from $\text{YBa}_2\text{Cu}_3\text{O}_7$. When they are cooled under a critical temperature a small magnet will float above them. The future of fast monorail transportation may lie in superconductors.



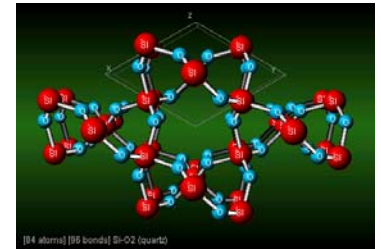
Analyze Stuff!

Crystalline Structures

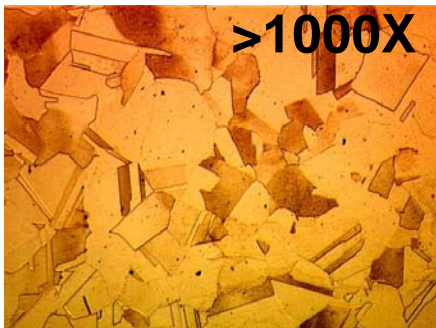
1X



Bulk



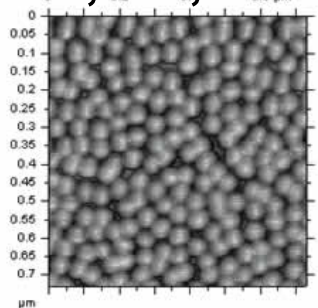
>1000X



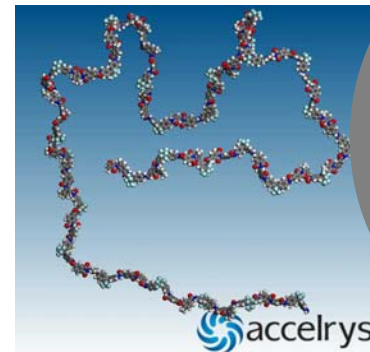
Micro

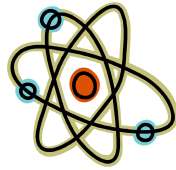
Non-Crystalline Structures

>1,000,000X

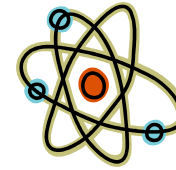


Nano





Nano Fabric



Nanotechnology: clothing

Billions of tiny whiskers create a thin cushion of air above the cotton fabric, allowing liquids to bead up and roll off without a trace.



COOLEST INVENTIONS



Clothing

Time coolest inventions 2002

new materials for
spill-proof and
stain-free clothing



Nano-Tex



Break Stuff!

Mechanical Properties

- Strength
- Fatigue Life
- Fracture Mode

Why?

...so things don't break



Brittle Fracture



Ductile Fracture



Charpy Town



Charpy Impact Test: break, fracture metals

The Charpy Impact test shows how much energy a material absorbs during fracture. The surfaces of the broken parts can be viewed as brittle or ductile. Testing the same type of material at high, low, and room temperatures shows how a material changes from brittle to ductile at a transition temperature.



Hi-Tech Creamery Country



Liquid Nitrogen Ice Cream: rapid solidification processing



sensory: visual, taste

This experiment shows the rapid solidification of a milk and sugar mixture. The liquid nitrogen uses energy from the milk and sugar to change from a liquid to a gas. The absorption of heat by the liquid nitrogen solidifies the milk and sugar into yummy ice cream!



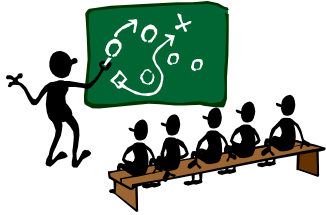


Open House Booth



- interactive demos
- fun, friendly students





Impact

Visitors: thank you letters, surveys, guest book for comments
future work

College students: communication skills, deeper learning,
deeper association with materials department and field

Professors: demos for the classroom, laboratory development,
better teaching, connection to the community



I really enjoyed the part about the liquid metals and steel especially when the balls came in the jars, it was really amazing. That was a really cool presentation and everything you talked about like atoms, marbles, and the science.

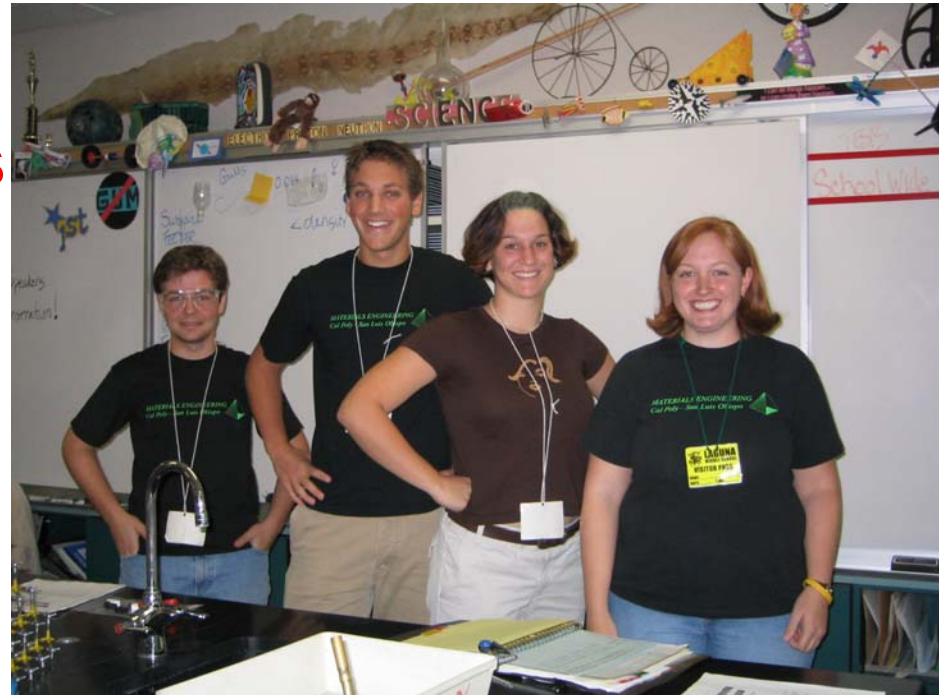
I liked the part when you guys put liquid in something white then when I touch it it felt very soft then you guys said that it was snow. When I grow I want to be in science like you guys you guys are very cool at science. Thank you for coming in



General Tips

- develop standard set of **adaptable** demonstrations
interactive, sensory, inquiry or discovery-based
- relate to audience: young children vs. high school
connect to real world, applications
- use appropriate language: no technical lingo!
build upon existing knowledge
- create core group of **students**
rehearse, rehearse, rehearse
- partner with others

Have Fun!





ASM/AIST/TMS World Materials Day Student Competition:

Promotion of the wider knowledge of materials and their importance in every day life to the benefit of young people.



TMS Annual Meeting Awards Banquet, February 2005, San Francisco