

**Technical Education Outreach in Materials Science and Technology Based on
NASA's Materials Research**

Final Educational Activities, Performances and Research Report
Period of
January 1 1999, through December 31, 2002

Submitted by
Dr. James A. Jacobs
BEST Laboratory
Norfolk State University
March 15, 2003

To
Dr. Mark J. Shuart
Director
Structures and Materials Competency
MS 121

Mr. Edwin J. Prior
Deputy Director
Office of Education
MS 400
NASA Langley Research Center
Hampton, Virginia 23681

NASA Langley Research Center Research Grant NAG-1-2125

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Introduction

The grant NAG-1-2125, Technical Education Outreach in Materials Science and Technology, based on NASA's Materials Research, involves collaborative effort among the National Aeronautics and Space Administration's Langley Research Center (NASA-LaRC), Norfolk State University (NSU), national research centers, private industry, technical societies, colleges and universities. The collaboration aims to strengthen math, science and technology education by providing outreach related to materials science and technology (MST). The goal of the project is to transfer new developments from LaRC's Center for Excellence for Structures and Materials and other NASA materials research into technical education across the nation to provide educational outreach and strengthen technical education. To achieve this goal we are employing two main strategies: 1) development of the gateway website <MST-Online.nsu.edu> and 2) using the National Educators' Workshop: Update in Engineering Materials, Science and Technology (NEW:Updates). We have also participated in a number of national projects, presented talks at technical meetings and published articles aimed at improving k-12 technical education.

Through the three years of this project the NSU team developed the successful MST-Online site and continued to upgrade and update it as our limited resources permitted. Three annual NEW:Updates conducted from 2000 through 2002 overcame the challenges presented first by the September 11, 2001 terrorist attacks and the slow U. S. economy and still managed to conduct very effective workshops and expand our outreach efforts. Plans began on NEW:Update 2003 to be hosted by NASA Langley as a part of the celebration of the Centennial of Controlled Flight.

MST Online

MST-Online.nsu.edu, the Internet portal, that springs from NASA LaRC's Center for Excellent in Structures and Materials provides a gateway to math, science and technology based on the interdisciplinary nature of materials science and technology. The MST-Online website design aims at the future of Internet technologies and the future needs of materials science and other technical educators and students. With the support of NASA Langley Research Center, the projects combines materials science and technology content suitable for pre college and college students with links to other sites offering useful MST resources.

In the first year we developed the basic structure of the site. We presented the website and our concepts for further development at national meetings including the 2000 National Educators' Workshop, hosted at the National Composite Center, and 2000 Annual Conference of the American Society for Engineering Education; additionally, the site was highlighted in the popular Prentice-Hall, Inc. textbook, *Engineering Materials Technology*, by Jacobs and Kilduff.

We also distributed several hundred flyers to students at middle school through college levels. Please see attachments #1, which was the front page, used in connection with the National Institute of Standards and Technology's (NIST) Centennial where NEW:Update was invited to help with NIST's Centennial.

We judge the success of MST-Online and make adjustments based on feedback and inquiries which include comments in MST-Online Guest Book, requests for technical information and

comments at technical meetings. Please see Attachment #2. The comments in the MST-Online Guest Book provides a sampling of users, and reveals the site reaches an international audience and has stimulated requests for more materials and means to access NASA resources and expertise. On MST-Online 2nd page we provide several direct links to NASA and especially Langley including featuring the Emmy Awards from Langley's Office of Education at <http://edu.larc.nasa.gov/>.

During the year we added content, new features and linkages to NASA and other appropriate technical sites. An overview of MST content comes from the Jacobs and Kilduff textbook, *Engineering Materials Technology*, revised for a 4th edition in 2001. We established image galleries and continued to add to those galleries and add other galleries such as a sound gallery using music and images related to the metallurgy involved in making steel drums. Please see web page samples in Attachment #3.

We added another feature to MST-Online which provides direct links on the opening screen to NASA Technology Commercialization Network and LaRC's Technology Commercialization program. The new feature resulted from inquiries by MST-Online users related to NASA technology shown on the website. MST-online receives inquiries from students around the world. For example, a design team of students in Australia sought advice on the Life Cycle Analysis of a composite tennis racquet and a mother helping her child with a science fair project requested information on color mixing of polymers. High school teachers interested in more

NASA related resources are directed to the Virginia Air and Space Center and NASA's Office of Education.

Students – Undergraduate students in the School of Science and Technology perform major tasks in development of MST-Online with the supervision of Drs. Wall and Jacobs, and Mr. Armstrong. Students make decisions on the layout of the site, selection of content, links, etc. Students enrolled in courses in the School of Science and Technology use MST-Online on a regular basis to research content related to MST-Online.

Related k-12 Outreach

Due to our close associations with several national education networks we use resources generated from this NASA grant and the many matching and "in-kind" resources we secure to contribute to other outreach project. Attachment #4 provides just a few examples from this outreach. The article, "*Materials science and technology at Hampton Roads High schools*" from ASM International's *Advanced Material & Processes*, December, 2002, provides a historical perspective and current activities involving our long term relationship with NASA Langley and other federal labs and corporations to enhance k-12 technical education . We coupled with a National Science Foundation project and organized a national pre college Materials Science and Technology Institute (Virginia Beach, Norfolk and NASA Langley) and two MST workshops (Wright Patterson Air Force Base and Virginia Beach).

The National Educators' Workshop (NEW:Update)

The National Educators' Workshop:Update (NEW:Update) - Experiments in Engineering Materials, Science and Technology has been the central focus of this project, which aims to transfer technology related to materials science and engineering from NASA LaRC and other federal labs into the public sector through educational institutions. The eighteen years of coordinated work has enhanced materials science and engineering (MSE) education. It has placed emphasis on updating educators and students and provided laboratory experiments on emerging technology for teaching fundamental and newly evolving materials concepts. Our efforts also resulted in a national materials education network to enhance MSE education at the community college and university levels as well as providing support to math, science, and technology education to pre college students. The website on materials education (<http://MST-Online.nsu.edu>) provides a national materials education network, which includes our grant, by connecting with our homepage that features NEW:Update, <http://MST-Online.nsu.edu/new>.

The National Composite Center (NCC) hosted the 15th Annual National Educators' Workshop (NEW:Update 2000) in Kettering, Ohio, with support of the Air Force Research Laboratory's Materials and Manufacturing Directorate at Wright Patterson Air Force Base, Research Institute at University of Dayton, Air Force Institute of Technology and Advanced Integrated Manufacturing Center at Sinclair Community College, on October 31 - November 3, 2000.

Please see the attached NASA Conference Publication. The workshop was co-directed by Jim Jacobs of Norfolk State University and Louis A. Luedtke, President and CEO of NCC.

Approximately 150 people were involved with the workshop and the program. They represented the broad spectrum of folks interested in materials education K through college. Professors and

teachers, from across the nation, who are keen on teaching, attended the workshop as seen in the attached NASA CP Participants. Sessions at NCC, coupled with half-day workshops mini workshops at the Materials and Manufacturing Directorate, University of Dayton, and Advanced Integrated Manufacturing Center, provided an excellent environment for technical updates on composites. The technical sessions and a full day of five mini workshops provided a balanced perspective on aerospace, infrastructure and automotive applications of composite materials as evidenced in Attachment 5, NASA Conference Publication.

A total of 41 education MSE methods, talks, experiments and demonstrations were made and nine technical update plenary sessions were conducted. The workshop resulted in valuable interaction among the participants, sharing ideas and concerns on improving mathematics, science and technology education coming from the wide range of perspectives represented.

We offered a session on the MST-Online website, using real-time online demonstration of the site. Interaction during this session provided useful feedback for the website project team to make improvements to the site.

EMSET2 – This project team also conducted a session on of the just completed 2nd edition on the CD ROM, *Experiments in Materials Science, Engineering and Technology*. This CD ROM resulted from the 13 years of the National Educators' Workshops. The NEW:Updates enabled educators to participate in seminars of peer-reviewed experiments and demonstrations in materials science, engineering and technology. Following each workshop, these papers were published in an annual compendium, with the generous support of NASA.

With the assistance from NASA and other governmental, educational and industrial organizations, we have been able to publish thirteen yearly volumes of these papers in an easily used format, the *EMSET2 (Experiments in Materials Science and Engineering 2)* CD ROM. This is an expanded and updated version of the original *EMSET* CD ROM, *EMSET1 (ISBN 0-13-648486-7)* contains 213 peer-reviewed demonstrations and experiments presented during the first decade of NEW:Updates 1986 through 1995. *EMSET2 (ISBN 0-13-030534-0)* contains more than 400 peer reviewed experiments and demonstrations that were presented at NEW:Updates 86 through 98.

This CD ROM runs on all platforms and uses the universally accepted Adobe Acrobat format for retrieval, display and printing.

To help the user, about 400 experiments and demonstrations are indexed and available as PDF files and presented as seen in the contents on the following page.

Table of Contents of *EMSET2 CD ROM*

Introduction to EMSET2

Experiments & Demonstrations

Thirteen Years of Experiments and Demonstrations from the National Educators' Workshops

Experiments & Demonstrations –

1. Structure, Testing & Evaluation
2. Metals
3. Polymers
4. Ceramics
5. Composites
6. Electronic & Optical Materials
7. Materials Curriculum

Additional Resources

A Short Course on Microscopy of Fiber-Reinforced Polymer Composite

Image Gallery

Workshop Groups
Applications
Photos, Photomicrographs and
Models
Web Sites

Prentice-Hall Books

How We Made the EMSET2 PDFs

With *EMSET2*, the educator can find the material he or she wants by:

- Browsing the tables of contents, or
- Searching, using the full text search, for Author, Title, Institution, Key Word.

The papers which are located can then be reviewed and used by:

- Displaying an exact image of the paper(s), including text, graphs, pictures and formulae, or
- Printing the paper as written, or
- Copying the text and/or graphics into a word processor for editing.

For the 3rd edition, we would like to use more photos, photomicrographs, and other resources that represent the range of materials at LaRC.

A report on NEW:Update 2000 was delivered on November 26, 2000, to the annual meeting of the International Council for Materials Education (ICME) held in conjunction with the Fall 2000

Materials Research Society meeting in Boston. ICME, supporter of NEW:Updates since its beginning, provides for peer review of papers presented for NEW:Updates. It also publishes selected papers from NEW:Updates in the *Journal of Materials Education*. The organization also aids in dissemination of NEW:Update results through meetings and Internet distribution.

As a part of the Centennial celebration of the establishment of NIST (formerly National Bureau of Standards), Dr. Leslie Smith, Director of the Materials Science and Engineering Laboratories (MSEL) offered to host NEW:Update 2001. After two years of planning for their workshop, and just two weeks prior to the workshop, national security personnel closed NIST to conferences which seemed to doom NEW:Update 2001. However, due to the untiring efforts of University of Maryland's Professor Isabel Lloyd, a member of the Organizing Committee, with assistance from NEW: Update 2001 Co Director and MSEL research Dr. Said Jahanmir and others on the committee, we were able to move NEW:Update 2001 to the University of Maryland. As seen the NASA CP the NEW:Update 2001 workshop went of well with good participation.

NEW:Update 2002 (hosted in Silicon Valley by San Jose State University, Seagate Technologies, IBM Almaden Research Laboratory, NASA Ames, SEMI, and Lockheed Martin), faced the challenges of a weak economy and required considerable effort of the Organizing Committee to garner the required resources to cobble together NEW:Update 2002. After two years of diligent work and with support from various technical societies, NSF coalitions, corporations, NIST and other colleges and universities (please see list in NEW:Update 2002 notebook) a fine workshop agenda was developed. While the 120 participants were not as many as the committee projected, NEW:Update 2002 had excellent participation considering the poor

economy and difficulties faculty encountered in obtaining travel support. Many used their own funds to attend this workshop that provided so many instructional materials and opportunities to visit world class research labs and interface with the researchers. A highlight of the high caliber presentations was the first plenary by Dr. Meyya Meyyapan, of NASA Ames, entitled "*Nanotechnology: Opportunities and Challenges*". Dr. Meyyapan supplied his PowerPoint presentation on CD ROM to Dr Jacobs who distributed them to those who made requests including Mr. Edwin Prior who added it to the Langley resources.

As with all past NEW:Updates, 2002 was attended by authors of textbooks who use the technical updates to add to their textbook revisions. For example Jim Jacobs and Tom Kilduff made use of Dr. Meyyapan's CD ROM and other materials from NEW:Updates 2000 through 2002 for input into their 5th edition of *Engineering Materials Technology*.

Funding of NEW:Update Workshops and Assistance to MST Online – The activities funded by this grant, as with many if not most, presents an on-going challenge. NASA LaRC's involvement has been crucial to this effort. Earlier NEW:Updates also gained support from the Office of Energy Efficiency and Renewable Energy, Department of Energy, National Composite Center, including contributions from its corporate board members, and Materials Science and Engineering Laboratories at NIST. We also had assistance from United States Automotive Materials Partnership's Center for Lightweight Materials and Processing at the University of Michigan-Dearborn, and the Gateway Engineering Coalition. Much of the support came with "in-kind" assistance. As an example, NCC provided their center to host most of the workshop and the Air Force Research Laboratory's Materials and Manufacturing Directorate at Wright-

Patterson AFB provided buses to transport participants and supplied mini workshop attendees samples of composites for them to take back to show their students. NCC also developed a CD ROM, which contained the group photo and Power Point presentations of technical update presentations. Participation by technical societies also provided valuable instructional materials allowing the professors in attendance to update their course materials.

Registration fees, to help defray the cost of the workshop, have been held at the same level for over a decade. Keeping the workshop affordable to faculty, most of whom are on ever-decreasing travel budgets, will continue to be a priority of the Organizing Committee. Assistance from sponsors/supporters was again a key factor in good faculty participation.

In addition to those listed above, many individual, agencies and groups make the annual NEW:Update and associated educational outreach possible. They are recognized in the NASA CPs for the annual NEW:Updates.

MST-Online, NEW:Updates and Associated Outreach Briefing

On December 12, 2000, this project team provided a briefing to Dr. Mark Shuart, Mr. Ed Prior, Langley program directors and members of the Office of Education at LaRC on the accomplishments related to MST-Online, NEW:Updates and our many other outreach successes including the widely adopted textbook, *Engineering Materials Technology*, that sprung from NASA research and has become a comprehensive materials science and technology textbook used in classrooms worldwide. At the briefing we supplied copies of the participants' notebook for NEW:Update 2000 and *NASA/CP-2000-210325 for the National Educators' Workshop*:

Update 99 Standard Experiments in Engineering, Materials Science, and Technology.

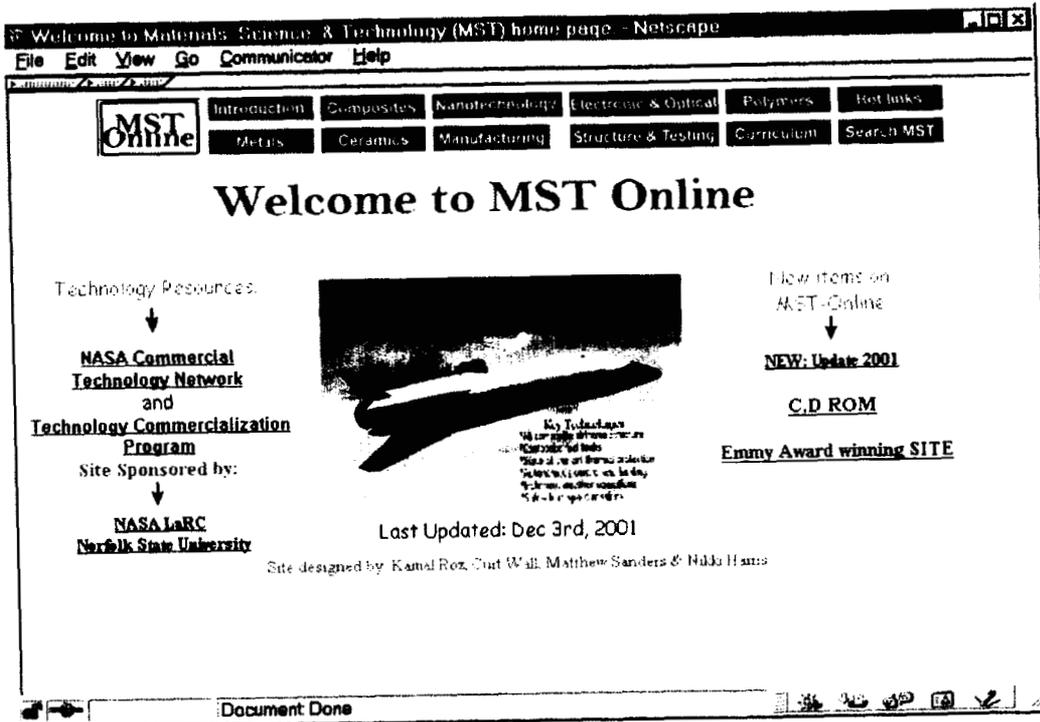
With continued funding at about \$50,000 per year (\$25k Langley + \$25k USAF-OSR) and the other funds and “in-kind” support we should be able to ensure a maximum effort to build on the current platform for the MST-online site, NEW:Updates, and related educational outreach. Less funding will limit our ability, but we are committed to enhancing the web site as resources permit. We hope to continue adding to the photo and sound galleries and adding a major component on nanotechnology to MST-Online. We will continue to conduct research into other evolving materials science and technology, especially that which generates from LaRC’s Center for Excellence in Structures and Materials, as well as those enhancing methods for educational outreach.

NEW:Update 2003 will be hosted by NASA Langley and the Thomas Jefferson National Laboratory, October 19 through October 22, 2003.. The Organizing Committee has made excellent progress and we have made a good beginning in getting wide spread involvement of the technical community. Please see attachment #6 which reflects the enthusiasm for NEW:Update 2003 already generated as a result of Mr. Prior’s overview given at NEW:Update 2002 and by celebration Centennial of Controlled Flight at NASA Langley.

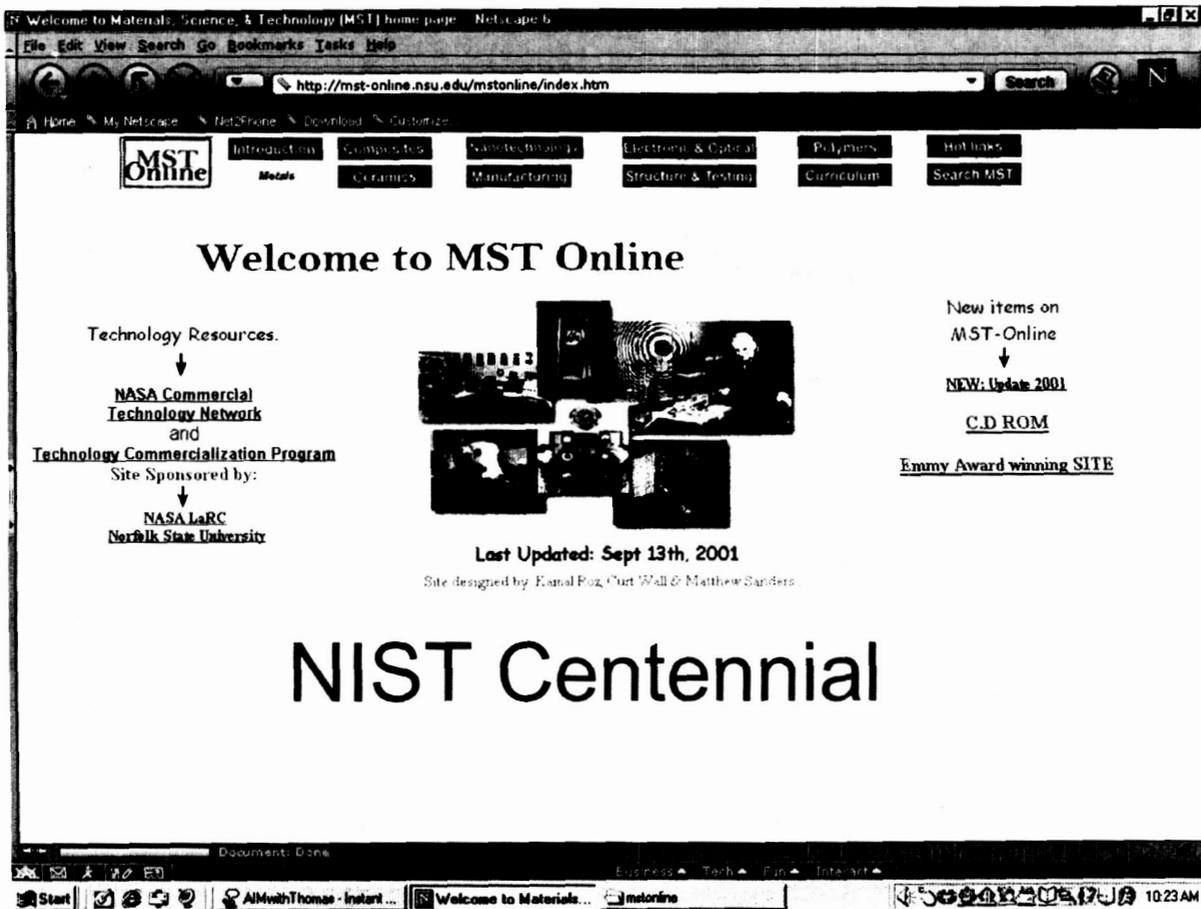
NEW:Update 2004 planning is also underway. Arizona State University and industries in the Phoenix region have offered to host the workshop. An initial NEW:Update 2004 Organizing Committee meeting was hosted by the Tech Group in Phoenix in February, 2003, and the second committee meeting is being planned for early April.

ATTACHMENT 1

MST-Online Information Sheet for Students



Click on, [Http://MST-Online.nsu.edu](http://MST-Online.nsu.edu) and
 Link to the cool
 World of Materials,
 Science, & Technology



Click On, [Http://MST-Online.nsu.edu](http://MST-Online.nsu.edu) and
Link To the cool
World of Materials,
Science, & Technology

ATTACHMENT 2
MST-Online Guest Book Comments



Welcome to MST Online

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[Sign this Guestbook](#) | [Manage your Guestbook](#)

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Thursday 02/27/2003 4:42:17am

Name: Rebecca Finmore

Homepage:

E-Mail: rebeccafinmore30@msn.com

Referred By: Friend

City/Country: ENGLAND

Comments: this website has been ~VERY~ useful in helping with my college work ;)
thanks alot! :o) TALOOLA xxx

Thursday 02/27/2003 4:39:46am

Name: sarah carter

Homepage:

E-Mail: [n/a](#)

Referred By: Friend

City/Country:

Comments: thanks this helped with my course work ;)

Thursday 02/27/2003 4:31:03am

Name: Rebecca Finmore

Homepage:

E-Mail: [n/a](#)

Referred By: Search Engine

City/Country: England UK

Comments: thanks alot! this has really helped with ma college work hehe! :o)

Thursday 12/12/2002 9:13:14am

Name: Stuart Brooks

Homepage:

E-Mail: stuart_brooks@hotmail.com

Referred By: Just Surfed In

City/Country: Farmville

Comments: I enjoyed the ceramics part it explain the meaning of the word ceramic and how its used for materials today. I also liked the home page when i original reviewed the page. i did not have a chance to visit all the sections of this website. Once reading about the materials and observe how they use the ceramics to create useful supplies, I felt this was an great web site. I also thought it was very prepared and well put together it made all the web links very helpful. I enjoyed the site!!

Tuesday 12/03/2002 12:08:08am

Name: Knohia Wilson

Homepage:

E-Mail:

Referred By: Just Surfed In

City/Country: Norfolk, VA

Comments: I liked the mst online website. It had quick links and a lot of imformation about different types of metals and about NASA. I also liked each time you but the cursor on a item it changed to a different types of airplanes. The reading was informatize but long and boring to read. In conclusion, I liked the new mst-online but it can be greater in the future.

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Welcome to MST Online

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Tuesday 12/03/2002 11:50:49am

Name: patrick jones

Homepage:

E-Mail: pj_757@hotmail.com

Referred By: Just Surfed In

City/Country: Norfolk Virginia

Comments: The graphics on this web page could be better, but then again this is not done on Microsoft Xp for better graphics who ever designed this web page shouldnt use Microsoft Pro. However the usage of the hyperlinks are very helpful in getting what appears to be good information on Nanotechnology.

Tuesday 09/24/2002 10:58:03am

Name: Benjamin Bond

Homepage:

E-Mail: myicebling@aol.com

Referred By: Friend

City/Country: NSU

Comments: I think their should be more text hyper links rather the picture links so you will be able to quickly go to where you want to be on the site

Friday 09/13/2002 9:10:15pm

Name: Marquita Jeffress

Homepage: <http://mst-online>

E-Mail: quitaboo@hotmail.com

Referred By: Just Surfed In

City/Country: Norfolk, Virginia

Comments: The X-3; stilleto is my personal favorite of all the planes. Even though it is not very reliable, it is the most appealing. Hopefully in the future, designers will be able to make the X-3 up to its expectations.

CIT-150-01

Thursday 09/12/2002 10:14:37am

Name: Jessica Major

Homepage:

E-Mail:

Referred By: Friend

City/Country: norfolk,USA

Comments: i liked the engineering materials section it described the everyday household items we use and made me think of how important they are. i also liked the welcome when i first opened the page. i didn't get to visit all the sections of this website, but from what i saw it was very informative and i will come back to finish viewing it. after reading about the materials and seeing how they use the simple plastics and glass to construct useful materials it made me further interested in computers and their daily functions. i also thought it was very organized and well put together it made access very easy.

Thursday 09/12/2002 10:10:55am

Name: Corey T. Brown

Homepage:

E-Mail:

Referred By: Just Surfed In

City/Country: Chesapeake, usa

Comments: I enjoyed the types of planes that were on the home page to grab the peoples attention who were entering. I specifically went into the manufacturing section were they ran radiografic inspections. The lab looked pretty cool from what I saw. I just would like to know what test do they run and how are they so successful.

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Tuesday 09/03/2002 6:52:49pm

Name: Aaron Blicblau

Homepage: <http://www.ses.swin.edu.au/~ablicblau/>

E-Mail: ablicblau@swin.edu.au

Referred By: Just Surfed In

City/Country: Australia

Comments:

Tuesday 09/03/2002 12:21:31am

Name: Patrick

Homepage:

E-Mail: pj_757@hotmail.com

Referred By: Just Surfed In

City/Country: Norfolk/VA

Comments: I think that the clip art is used wisley. Or the maker of the page used the multimedia program, power point perhaps. The hyperlinks use on the web page are good for the t1 line.

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T
A

F

-----Original Message-----

From: Daniel B. Armstrong [mailto:dbarmstrong@nsu.edu]

Sent: Thursday, March 06, 2003 5:20 PM

To: KitnsMeow29@aol.com

Cc: James Jacobs

Subject: RE: Questions about polymers

I'm sorry, I'm not an expert on color dispersion. Some materials freely disperse, smoke or perfume in air, while others require mechanical mixing. oil in water. two si[Jim Jacobs] tes that may be helpful are www.howstuffworks.com and www.askjeeves.com

Good luck

Dan

-----Original Message-----

From: KitnsMeow29@aol.com [mailto:KitnsMeow29@aol.com]

Sent: Tuesday, March 04, 2003 5:59 PM

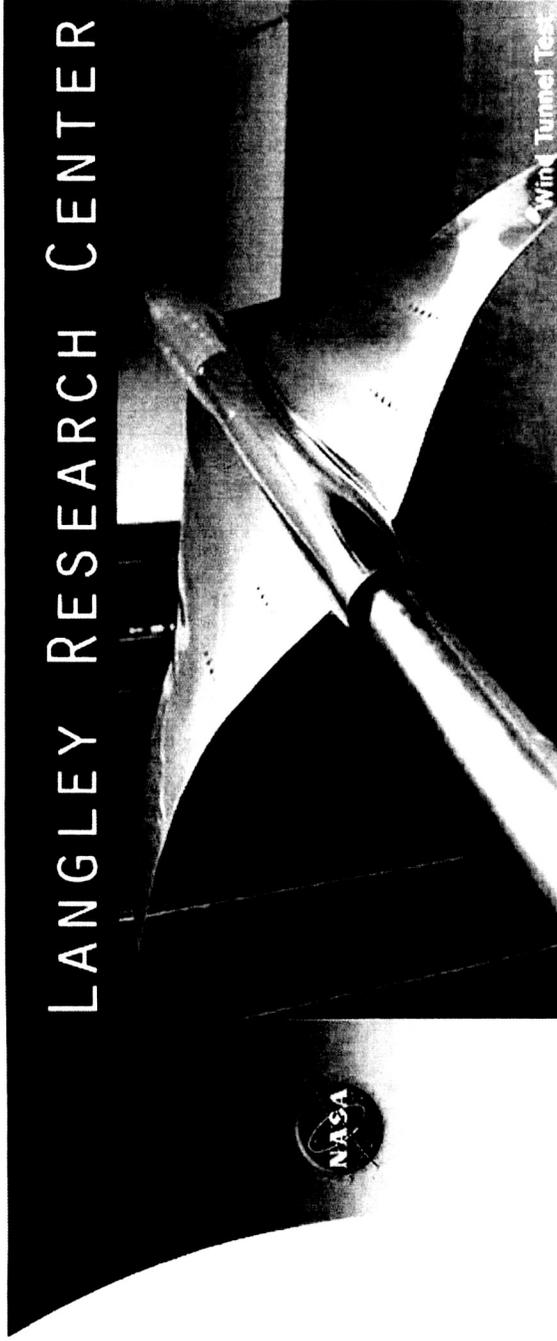
To: dbarmstrong@nsu.edu

Subject: Questions about polymers

Dear Dr. Jacobs,

My 10 year old daughter is doing her 4th grade science fair project on polymers. We made a linear polymer slime from cornstarch, water and different food colors. When she mixed 1 tablespoon of yellow slime with 1 tablespoon of blue slime the colors did not blend on their own to make green but made yellow and blue swirls, 4 hours later they had blended somewhat so that the swirls had green edges but never totally. She used the same mix and stirred this time the slimes blended together. I have looked and looked online to find the reason the slime never completely blended to make green without being stirred but cannot find the explanation. I feel like I should be able to explain it but I'm stumped and we only have 2 days left before her abstract is due. Can you help? Thank you for your time.

ATTACHMENT 3
MST-Online Opening Pages



[ABOUT US](#) •
 [NEWS AND EVENTS](#) •
 [EDUCATION](#) •
 [IMAGES](#) •
 [BUSINESS WITH US](#) •
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SPACE SHUTTLE COLUMBIA:

On February 1, 2003, the Space Shuttle Columbia was lost during its re-entry into Earth's atmosphere. As we mourn the loss of seven family members, NASA has created a web site to collect and distribute information about the crew, the mission and the ongoing investigation.

[search](#) [Help](#) [Advanced](#)

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NASA Responsible Official: C. W. Cleghorn • Page Curator: R. D. Allen • Last Updated: 02/28/2003

RESEARCH	
Aeronautics	Earth Science
Space Technology	Structures & Materials

MST

Materials Science & Technology

**Nanotechnology
Polymers
Structures & Testing
Curriculum
Hot Links**

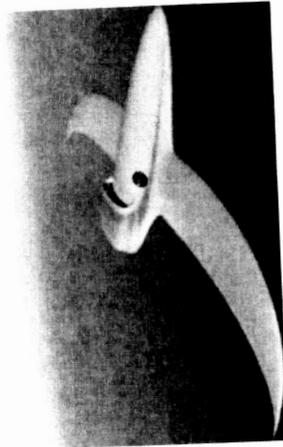
NEW Items on MST-Online:

NEW: Update 2003

C.D. ROM

Emmy Award Winning Site

Site designed by: Nikki Harris, Kamal Roz,
Matthew Sanders, & Curt Wall.



Site Sponsored by:

NASA LARC

Air Force Research Lab

Norfolk State University



**Introduction
Ceramics
Composites
Electronic & Optics
Metals**

Technology Resources:

NASA Commercial Technology Network

&

Technology Commercialization Program



View My Guestbook

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ATTACHMENT 4

ASM International

Advanced Materials & Processes

article

Materials science and technology at Hampton

By James A. Jacobs
 School of Science & Technology
 Norfolk State University

"My favorite project was when we made our own rings through the process of lost wax casting...I think this program offers a lot of knowledge that could be used in many different fields of science and engineering."

Alex Sbrana, 11th grade

To build the future of our profession, materials science and technology (MST) is being offered at a growing number of high schools throughout the United States, as well as in other countries. This new program provides an approach for students to learn about science, math, engineering and technology (SMET).

Due to the multidisciplinary nature of materials science and engineering, MST provides integrated SMET content as found in the real world. This article examines two high schools in the Hampton Roads, Virginia area: Maury, a historic inner city school in Norfolk, and Landstown, in its second year of operation in suburban Virginia Beach.

How did materials science and technology become pre-college subjects?

On the east coast, with support from NASA Langley Research Center in the early 1970s, I began to integrate content from materials science, engineering and technology into high school science and technology courses.

"My favorite project was when we made glass by mixing chemicals and then burning the substance into a liquid, which then cooled into glass...I like material science because all you do is hands-on, so you're never really bored in the class."

Kenneth O'Dell, 10th grade

About the same time, on the west coast, Dr. Tom Stoebe, FASM, was using funding from the National Science Foundation to develop MST activities to help improve precollege math and science education. Similar projects developed in Florida and California.

In the mid 1980s, Stoebe and I linked up with a project involving Richland High School in Richland, Wash., and teacher Steve Piippo. Piippo had sought assistance from the Pacific Northwest National Laboratory (PNNL) to upgrade his technology education program. Roy Bunnell, a PNNL senior scientist, was one of a number from PNNL who assisted Steve. Later, Roy retired and started a new career as a MST teacher in Kennewick, Wash.

With funding from a variety of agencies and with the involvement of many individuals at PNNL and the Richland area, a program evolved to pull together a coherent MST curriculum. The resulting PNNL curriculum guide, *Materials Science and Technology Teachers' Handbook*, incorporated activities and content from projects from around the nation such as the Commonwealth of Virginia Technology Education's, *Materials & Processes Technology Curriculum Guide* and Stoebe's *Materials Activity Cards*, a textbook that



James A. Jacobs demonstrates thermal properties of a silicon shuttle tile to Roger Crider's class. The tile is a part of a kit of specimens from the American Ceramics Society.

Tom Kilduff and I wrote. Plus, it also contained many ideas from PNNL researchers, technicians and a local artisan.

"We used two different types of wire to make glass beads and compared them. The ingredients we used were borax and a hot flame...I like courses with a lot of experiments, and would recommend this course to future scientists and engineers."

Christopher Amo-Quarm, 11th grade

Eventually, the ECI Corp. developed a full turnkey MST curriculum complete with equipment, supplies, curriculum guides and workbooks. The PNNL Guide and the ECI Program are complemented by numerous modules and guides, as well as teachers' institutes, to help school systems get started with MST offerings.

Another recent project developed resources, which provide valuable input to pre-college MST. With support from the National Science Federation grant, Northwestern University developed the Material World Modules, and field tested them across the nation. In addition to these resources, teachers can prepare to teach MST through institutes and workshops.

Annually, the NSF-funded project, Enhancement of Materials Technology for Manufacturing (EMTECH) under the direction of John Rusin and Stoebe, provides short workshops and week-long institutes. The ASM International Foundation also offers a range of support ranging from teacher grants to student and teacher camps, including the award-winning "Materials Camp" program.

"The stained glass project was cool because it was fun, and you had to be really patient while cutting, scoring and soldering the stained glass together...What I liked most was that we have fun doing labs and projects and we still learn!"

Kenny Deiss, 10th grade

Across the U.S. and in other countries, one can find a variety of MST teaching arrangements. MST is offered by technology education and sci-

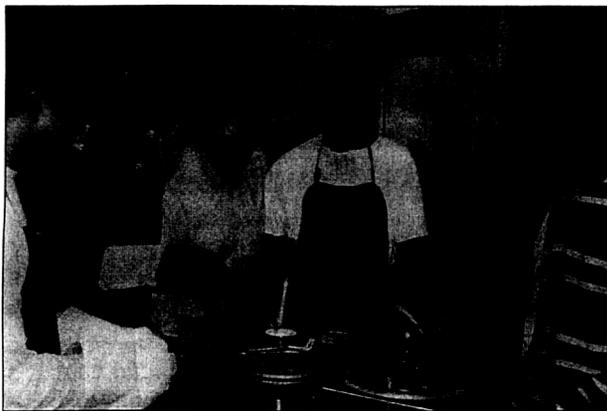
New member benefit: Capital For Knowledge Education Loan Program

The Capital for Knowledge Education Loan Program sets itself apart by extending its loan programs to an ASM member's entire family. ASM members or any of their relatives - children, spouse, grandchildren, parents, siblings, aunts, uncles and even cousins - can apply.

A variety of affordable borrowing options are available to fit almost any budget. There are no application fees and no pre-payment penalties. For maximum flexibility, you may even apply with a co-borrower. To take advantage of this valuable member benefit, visit their web site at www.capital4u.net.

You can also request information or apply over the phone by calling (888) 651-LOAN or e-mail info@capital4u.net. (Be sure to tell the representative that you're affiliated with ASM International).

Roads High Schools



Dwayne Bushey and students of Maury High School melt sterling silver for investment casting of a ring.

ence departments, as well as taught by teams comprised of technology education and science teachers.

Virginia has offered various forms of materials technology in high schools for over 20 years. Maury High School under the leadership of Dwayne Bushey, a NSU alumnus, is one of three Norfolk high schools that purchased the ECI MST to upgrade existing technology education/science laboratories.

Virginia Beach has both designed new schools and upgraded older schools with labs for MST. These labs used equipment, supplies and curriculum materials from various sources. Landstown High School was the first school in this region to incorporate ECI's turnkey approach to MST in design of that school. Designers included specifications for ECI's complete lab including lab tables, benches and storage. Technology education teacher Roger Crider opened the new program.

Both Crider and Bushey, like a score of Virginia technology education and science teachers, attended the MST summer institute. The institute is held at the Materials Science Teacher Center, a part of the EMTECH's project coordinated by Rusin at Edmonds Community College.

Units of study for the one-year MST courses include solids, metals, ceramics, polymers and composites. Students read, discuss, complete workbooks exercises and take tests over concepts. Lab work involves various experiments such as crystal growing, alloying and tensile testing. Lab projects vary from making rings with the lost wax casting process to constructing stained glass windows and composite aircraft gliders. Students keep journals to record their observations, make hypotheses, sketch design ideas and write conclusions.

"We've used all kinds of materials, including metals, polymers, ceramics and composites...I like working on all kinds of things that we work on in this class, and I love doing experiments."

William Brian Taylor, 11th grade

Materials As a Gateway to Science, Technology Engineering and Mathematics (MAGSTEM), is a national coalition to support technical ed-

ucation using materials science and technology as a base. MAGSTEM recently pulled together many individuals and groups involved in materials education. This coalition has gained start-up funding and sought large grants to infuse materials education from kindergarten to college level education as a means to make technical education understandable to all youth.

Don Evans and Rustum Roy from Arizona State University's CRESMET center have spearheaded the effort to bring individuals and groups together including technical, federal agencies, universities, community colleges and public education to provide a broad based curriculum effort.

Several of the groups and classroom teachers mentioned in this article have aligned MST courses with national and state standards for mathematics, science and technology. Benchmarks and guidelines from organizations including the American Association for the Advancement of Science's Project 2061 and the International Technology Educational Association's Technology for All American's Project, as well as state standards for learning, have been applied.

For more information, please e-mail me at jajacobs@nsu.edu.

"The stained glass project was my favorite. It's the kind of project that brings out the creativity in an individual, and also exemplifies patience and hard work...There are things you can't get from a regular class."

Mary Joy Que, 12th grade

ASM Education seminar update

For complete details about these upcoming 2003 courses, as well as to register, visit www.asminternational.org/training today. All courses will be held at Materials Park.

Metallurgy for the Non-Metallurgist, Jan. 27-31

ASM's most popular course is for those who need a working understanding of metals and their applications, but have no previous training in metallurgy. It's the perfect course for technical, lab and sales personnel, engineers from other disciplines, managers and administrative staff.

Elements of Metallurgy, Feb. 10-14

An intensive introduction to the principles of metallurgy, this course will give you an understanding of practical applications in various fields of metals and alloy production, testing and manufacturing processes. A sound understanding of both chemistry and physics is required.

Aluminum & its Alloys, Feb. 10-14

This introductory course covers the history of aluminum extraction, physical properties, classification, wrought and casting alloys. It's an ideal overview seminar for individuals who are involved with any facet of aluminum and its alloys including metallurgists, technicians, quality control personnel and purchasers.

Principles of Failure Analysis, Feb. 24-28

This course bridges the gap between theory and practice, providing a practical approach for the non-metallurgist as well as those new to failure analysis. It covers procedures for analysis, failure mechanisms and failure in product forms and components. Numerous case histories will illustrate key points.

ATTACHMENT 5

NASA CPs and Notebooks

NEW:Updates 2000, 2001, and 2002

ATTACHMENT 6

NEW:Update 2003

Webpages and Faculty e-mail

▲ Jim Jacobs

From: Pete Thomas [p.d.thomas@larc.nasa.gov]
Sent: Tuesday, February 25, 2003 8:36 AM
To: bunnro@ksd.org
Cc: jajacobs@nsu.edu; e.j.prior@larc.nasa.gov; w.b.williams@larc.nasa.gov
Subject: Fwd: High school teacher with model airplanes for NEW:Update 2003

>Roy:

I am a retired Naval Aviator, and have been on the staff here at NASA Langley Research Center for the last 12 years. I work extensively in the Precollege Programs area. I am the aeronautics rep when any issue comes up that needs both a pilot and an educator to manage. I will be helping to work the NEW 2003 program here at NASA Langley. Could you provide me any additional information on your project, so that that I could be of help?

Pete

>From: "Jim Jacobs" <jajacobs@nsu.edu>
>To: "Pete Thomas" <p.d.thomas@larc.nasa.gov>
>Cc: "Roy Bunnell" <bunnro@ksd.org>, "Ed Prior"
><e.j.prior@larc.nasa.gov>
>Subject: High school teacher with model airplanes for NEW:Update 2003
>Date: Mon, 24 Feb 2003 13:54:42 -0500
>X-Priority: 3 (Normal)
>Importance: Normal

>
>Dear Pete,

>
>Roy Bunnell, a high school teacher at Southridge High School, in
>Kennewick, Washington, has a project with his students involving
>constructing model airplanes of very old aircraft using new composite
>technology. Roy will be presenting at NEW:Update 2003 and is trying to
>coordinate the best place to demonstrate these planes. Would you
>please e-mail Roy <bunnro@ksd.org> to serve as a point of contact? I
>think there will be enough room in the Reid auditorium, but you may
>have some other ideas after communicating with Roy.

>
>I was at the Peninsula Engineering Council dinner this past Saturday
>and saw your name as one of the officers of the PEC. I looked for you,
>but didn't see you. Bob Ash invited me over on Wednesday to the
>full-scale wind tunnel at Langley to see the testing of the 03 flyer.
>He said Thursday and Friday will be very hectic as they will have the
>media covering the wind tunnel test. I plan on being there around 1:00
>just in case you are in the area. Bob also said that he definitely
>wants to keep ODU involved in the planning for NEW:Update 2003.

>
>Jim Jacobs
>School of Science & Technology
>Norfolk State University
>700 Park Avenue
>Norfolk, VA 23504-8060
>
>757-823-8109
>FAX 823-8215
>
>MST-Online.nsu.edu
>MST-Online.nsu.edu/new

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Peter D. Thomas, ViGYAN, Inc. p.d.thomas@larc.nasa.gov
NASA Langley Research Center <http://edu.larc.nasa.gov/>
MS 400

Jim Jacobs

From: Steve Piippo [Steve.Piippo@rsd.edu]
Sent: Tuesday, February 25, 2003 3:18 PM
To: jajacobs@nsu.edu
Subject: RE: Aim & Intent

The Spa is open to you anytime you are in Richland. Bring a grandkid too if you'd like.

>>> "James Jacobs" <jajacobs@nsu.edu> 02/25/03 12:17PM >>>
Thank you for the copy of the article; it was well done. Thanks for your kind words.

I was in Richland for a very brief stay last week. sorry I didn't have time to come by a get in you spa. Did speak to Roy Bunnell; he's planning on making NEW:Update 2003 at NASA. Hope you can join him.

Jim

Jim Jacobs
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Norfolk State University
700 Park Avenue
Norfolk, VA 23504-8060

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FAX 823-8215

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-----Original Message-----

From: Steve Piippo [mailto:Steve.Piippo@rsd.edu]
Sent: Wednesday, February 19, 2003 4:12 PM
To: jajacobs@nsu.edu
Subject: RE: Aim & Intent

Sending you an article about Shuttle Tiles inspired from your text. We have a SPA for hydrotherapy. 7'X7'X36" with 27 jets. 5 seats, total body massage lounge, recycled materials, composites, foam insulated, special alloy heaters, computer programmed, easy off cover and maintenance free. Good for the old joints and muscles.

Spaaaaa

>>> "James Jacobs" <jajacobs@nsu.edu> 02/11/03 09:32AM >>>
Thanks for that piece of info. I'm putting in another 60 hours a week on top of my real job, working on the 5th edition. We have more on the Columbia in this edition. We'll be at NASA Langley for NEW:Update 2003 for the 100 Years of Flight Celebration. Hope you can make it.

Jim

Jim Jacobs
School of Science & Technology
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700 Park Avenue
Norfolk, VA 23504-8060

757-823-8109

Fax 823-8215

MST-Online.nsu.edu

MST-Online.nsu.edu new

-----Original Message-----

From: Steve Piippo [mailto:Steve.Piippo@rsd.edu]

Sent: Friday, December 20, 2002 6:12 PM

To: jajacobs@nsu.edu

Subject: Aim & Intent

I read your article in the December issue of Advanced Materials & Processes. You did a wonderful job with the history, vision, successes, importance of MST and the future benefitting kids. You have been the constant in my mind or as Paul Howard would say, "the aim & intent has always been to benefit kids." Merry Christmas and Happy Holidays!