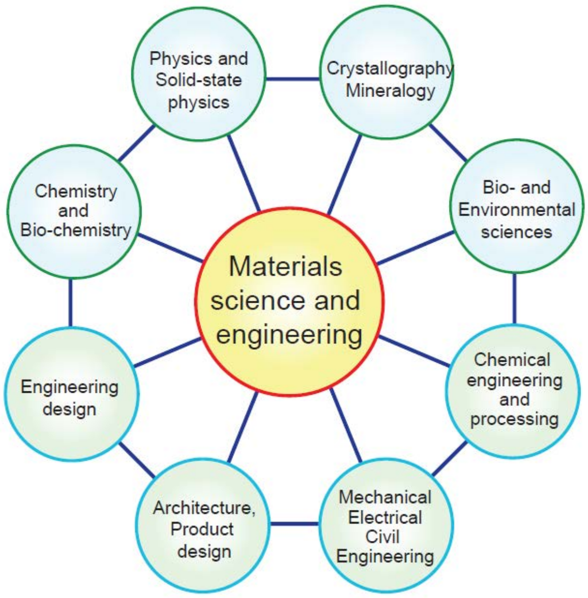
5TH NORTH AMERICAN MATERIALS EDUCATION SYMPOSIUM

The University of Illinois at Urbana-Champaign



March 20-21, 2014

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

The Symposium is coordinated by Granta Design

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MATERIAL INSPIRATION

It is supported by the advisory committee, ASEE Materials Division, ASM International, University of Cambridge, FEMS, SEFI, and the University of Illinois

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SEFI
European Society for Engineering Education
Europäische Gesellschaft für Ingenieur-Ausbildung
Société Européenne pour la Formation des Ingénieurs
UNIVERSITY OF CAMBRIDGE
ILLINOIS
ASM INTERNATIONAL
The Materials Information Society

5th North American Materials Education Symposium

University of Illinois at Urbana-Champaign
Urbana, IL

March 20-21, 2014

Information Booklet

Section 1:

Participants

Attendee list

(Correct on March 13, 2014)

	Name	Institution	Country	Speaker	Poster	Attending
1	Prof Philip White	Arizona State University	USA	Y		Advanced course & Symposium
2	Mr Rob Sawatzky	BCIT	Canada		Y	Symposium
3	Prof Lan Li	Boise State University	USA		Y	Symposium
4	Assoc Prof Mark De Guire	Case Western Reserve University	USA	Y		Symposium
5	Dr Claes Fredriksson	Granta Design	UK		Y	Full Event
6	Miss Elisabeth Kahlmeyer	Granta Design	UK		Y	Full Event
7	Mr Marc Fry	Granta Design	UK			Full Event
8	Mrs Michelle Rushe	Granta Design	USA		Y	Full Event
9	Dr Rebecca Rosenblatt	Illinois State University	USA		Y	Symposium
10	Mrs Ayse Kilic	ITU	Turkey		Y	Symposium
11	Prof Dr Ysmail Yilmaz Taptik	ITU	Turkey			Symposium
12	Dr Kyle Gipson	James Madison University	USA	Y		Symposium
13	Dr Lisa Hix	Keene State College	USA	Y		Full Event
14	Dr Bill Heffner	Lehigh University	USA	Y	Y	Symposium
15	Dr Suzanne Keilson	Loyola University Maryland	USA	Y		Full Event
16	Mr Jacob Gines	Mississippi State University	USA	Y		Symposium
17	Mrs Krista Limmer	Missouri S&T	USA		Y	Symposium
18	Prof Timothy Gutowski	MIT	USA	Y		Symposium
19	Prof Christopher Hutchinson	Monash University	Australia			Symposium
20	Dr Carla Shute	Northwestern University	USA			Symposium
21	Prof Kathleen Stair	Northwestern University	USA	Y		Symposium
22	Mrs Alison Polasik	Ohio State University	USA		Y	Symposium

23	Prof Rudy Buchheit	Ohio State University	USA	Y		Symposium
24	Dr Ron Kander	Philadelphia University	USA	Y		Full Event
25	Dr Tanya Faltens	Purdue University	USA	Y		Symposium
26	Dr Harvey Abramowitz	Purdue University Calumet	USA		Y	Symposium
27	Dr Sivarama Nalluri	Siemens PLM Software	USA			Symposium
28	Dr Linda Cadwell Stancin	Spirit Aerosystems	USA	Y		Symposium
29	Prof Maria Eugenia Noguez de Herrera	Universidad Nacional Autonoma de México	Mexico		Y	Symposium
30	Dr John Nychka	University of Alberta	Canada	Y		Symposium
31	Prof Mike Ashby	University of Cambridge	UK	Y		Full Event
32	Dr Oya Okman	University of Illinois	USA			Symposium
33	Prof John Abelson	University of Illinois	USA	Y		Symposium
34	Prof Bruce Hannon	University of Illinois at Urbana-Champaign	USA			Symposium
35	Prof Eric Weber	University of Nevada Las Vegas	USA	Y		Symposium
36	Dr Surojit Gupta	University of North Dakota	USA		Y	Symposium
37	Dr Paul Eason	University of North Florida	USA	Y		Symposium
38	Dr William Callister	University of Utah	USA			Full Event
39	Prof Mary Wells	University of Waterloo	Canada		Y	Symposium
40	Dr Ashley White	US Green Building Council	USA	Y		Symposium
41	Dr Ben Church	UW-Milwaukee	USA			Symposium
42	Prof Kenneth Wynne	Virginia Commonwealth University	USA			Symposium
43	Prof Jianyu Liang	Worcester Polytechnic Institute	USA		Y	Symposium
44	Prof Rick Sisson	Worcester Polytechnic Institute	USA	Y		Full Event
45	Prof Osamu Umezawa	Yokohama National University	Japan			Full Event

Section 2:

Agenda

At-A-Glance
Agenda & Locations

TIME	*EVENT*	*VENUE*
TUESDAY, MARCH 18: INTRODUCTORY SHORT COURSE		
9:00am	Registration and Refreshments	Illini Union, Illini Room A
10:00am	Introductory Course Opens	
12:00pm	Lunch	
1:00pm – 5:00pm	Introductory Course, continued	
Evening	*Free evening*	
WEDNESDAY, MARCH 19: ADVANCED SHORT COURSE		
8:00am	Registration and Refreshments	Illini Union, Illini Room A
8:15am	Advanced CES EduPack Course Opens	
12:15pm	Lunch	
1:15pm – 3:30pm	Advanced Course, continued	
3:45pm – 5:00pm	CES EduPack Development Meeting	
6:00pm	Presenters Dinner/ *Free evening*	Illini Union, Room 314
THURSDAY, MARCH 20: SYMPOSIUM, DAY ONE		
8:00am	Registration Opens	Illini Union, Illini Room A
8:45am	Symposium Day One	
12:45pm	Lunch and Poster session	
2:15pm – 5:30pm	Symposium Day One, continued	
6:15pm	Symposium Dinner *(open to all delegates)*	Illini Union Ballroom
FRIDAY, MARCH 21: SYMPOSIUM DAY TWO		
8:30am	Registration Opens	Illini Union, Illini Room A
9:00am	Symposium Day Two	
12:30pm	Lunch and Poster Session	
2:00pm – 5:15pm	Symposium Day Two, continued	
6:30pm	Dinner/*Free evening*	Timpone's Italian Restaurant

Please see Section 5 for maps and more details on venues.

Symposium Day One: Thursday, March 20, 2014

LOCATION: ILLINI UNION, UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TIME	SESSION
8.00 am	Registration, Coffee, and Poster setup
8.45 am	Welcome Address, **Prof. John Abelson and Prof. Mike Ashby**
	SESSION 1: Introducing Material Systems and Sustainability Chair: **Prof. Rick Sisson**
9.00 am	Session Introduction
9.05 am	**Dr. Ronald Kander**—Philadelphia University, USA Teaching Systems Thinking: Why, What & How
9.30 am	**Dr. Linda Cadwell Stancin**—Spirit Aerosystems, Inc. The Design, Development, and Selection of Materials for Sustainability in Aviation
9.55 am	**Poster Teasers** Poster Presenters invited to give a one minute presentation about their poster
10.30 am	**Poster Session** Coffee and Introductions
11.15 am	**Dr. Mark De Guire**—Case Western Reserve University, USA. A Revised Materials Science Undergraduate Curriculum, and a New Freshman Course in Materials and Energy
11.40 am	**Dr. Philip White**—Arizona State University, USA Okala Impact Factors 2014 Systemic Modeling of Environmental Impacts
12.05 pm	**Dr. Suzanne Keilson**—Loyola University Maryland, USA The Compatibility of Sustainability Education and Career Focused Education in Materials
12.30 pm	Session discussion led by the session chair
12.45 pm	**Lunch** **Poster Session continued** (starts 1.15 pm)
	SESSION 2: Design and Simulation in Materials Education Chair: **Dr. Mark De Guire**
2.15 pm	Session Introduction
2.20 pm	**Dr. John Nychka**—University of Alberta , Canada Promoting 'Good' Design and Avoiding 'Bad' Design: The Role of History and Human Factors
2.45 pm	**Dr. Lisa Hix**—Keene State College, USA Sustainable Product Design and Innovation
3.10 pm	**Dr. Tanya Faltens**—Purdue University, USA Cloud-based, fully interactive simulations via nanoHUB to enhance student learning of materials engineering concepts
3.35 pm	**Poster Session continued** Coffee/Afternoon Tea
4.15 pm	**Dr. Kyle Gipson**—James Madison University, USA Experiential, Problem-based Learning Opportunity for Undergraduates via Real-world Simulated Engineering Design Project
4.40 pm	**Dr. Paul Eason**—University of North Florida, USA Enhancing Demonstration of ABET Student Outcomes (a-k) Through Hands-On Capstone Design Experience
5.05 pm	**Session and day discussion** led by the session chairs
5.25 pm	Concluding remarks
5.30 pm	Close

Evening

Dinner: The Illini Union Ballroom

Note: *There are a limited amount of spaces remaining. If you still wish to attend, but did not already register then the cost is $65.00. Please find a Symposium Organizer to let them know.*

Symposium Day Two: Friday, March 21, 2014

LOCATION: ILLINI UNION, UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

TIME	SESSION
	SESSION 3: Material and Energy-efficient Design Chair: **Prof. John Abelson**
9.00 am	Session Introduction
9.05 am	**Prof. Mike Ashby**—University of Cambridge, UK *Materials in a Systems-dominated, Resource-constrained world*
9.30 am	**Prof. Timothy Gutowski**—Massachusetts Institute of Technology *The Challenge of Teaching about Sustainability in Engineering*
9.55 am	**Poster Session** Coffee and Introductions
10.45 am	**Dr. Ashley White**—U.S. Green Building Council *Integrating Health into the Sustainable Building Materials Conversation: Assessment Tools and Education*
11.10 am	**Dr. Eric Weber**—University of Nevada, USA *Creating the UNLV Solar Decathlon House*
11.35 pm	**Dr. Jacob Gines**—Mississippi State University, USA *The Repository: Developing Continued Stewardship One Board-foot at a Time*
12.00 pm	Session discussion led by the session chair
12.30 pm	Lunch **Poster Session continued** (starts 1.15pm)
	SESSION 4: Hands on: Demos and Projects Chair: **Dr. John Nychka**
2.00 pm	Session Introduction
2.05 pm	**Prof. John Abelson**—University of Illinois at Urbana-Champaign, USA *Materials Selection for the Energy-Efficient Home: The Time Value of Investment*
2.30 pm	**Prof. Rick Sisson**—WPI, USA *Teaching and Learning the Fundamentals of Environmental Degradation of Engineered Structures.*
2.55 pm	**Dr. Bill Heffner**—Lehigh University, USA *Low-cost, cross-disciplinary experiments in materials science using candy glass and home-built apparatus*
3.20 pm	Coffee/Afternoon Tea **Poster Session continuted**
4.00 pm	**Dr. Kathleen Stair**—Northwestern University, USA *Discovering ultracapacitors in a sophomore-level lab*
4.25 pm	**Prof. Rudolph Buchheit**—The Ohio State University, USA *Integrating Databases, Visualization, Simulation and Computation into the Materials Science and Engineering Curricula*
4.50 pm	**Introduction to the 2015 North American Materials Education Symposium**
4.55 pm	**Session and day discussion** led by the session chairs
5.10 pm	Concluding remarks
5.15 pm	Close

Evening

Dinner: Timpone's Italian Restaurant, 710 S. Goodwin Ave., Urbana, IL 61801

Note: *There are a limited amount of spaces remaining. If you still wish to attend, but did not already register then the cost is $65.00. Please find a Symposium Organizer to let them know.*

Section 3:

Presentation Abstracts

Day One: Thursday March 20, 2014

Day One, 9:05am

Teaching Systems Thinking: Why, What & How

R. Kander
Executive Dean, Kanbar College of Design, Engineering and Commerce, Philadelphia University, PA, USA

A **system** is an *interconnected* set of *elements* that is coherently organized in a way that achieves a specific *function* or *purpose*. Examples of systems all around us range from complex man-made systems like our automobiles and computers, to biological ecosystems like our bodies and our planet, to complex service systems like universities, hospitals, and governments.

In today's world, it is important to teach systems thinking because the challenges we face are becoming more and more complex with time, and more difficult to understand and predict using traditional tools and techniques.

There are two prevailing theories on why humans have so much trouble dealing with complex, highly interconnected systems. One theory is that people are idiots. (This may indeed be true, but it is not a very useful theory and not one I will address in this presentation!). The second. Is that we don't have very good tools to **visualize**, **model**, and **simulate** the behavior of complex, highly interdependent systems. More importantly, we also don't have good ways to **communicate** understandings and insights about complex systems to one another and to key decision-makers.

The second theory is the one addressed by a new course at Philadelphia University that is designed to impart "systems thinking" skills to students from a wide range of professional majors from design, engineering, and business disciplines. Students who successfully complete this course are able to explain the major attributes of a system, define the spatial and temporal boundaries of a system, map the interrelationships between variables within dynamic systems, and apply systems thinking tools to recommend solutions to complex real-world problems.

The course is taught using VensimPLE, a systems dynamics software package from Ventana Systems (**http://www.vensim.com**). This is freeware that can be downloaded from the web for educational use, so no student purchase is required. The course also uses a book authored by Donella H Meadows entitled "*Thinking In Systems: A Primer*" (Chelsea Green Publishing, 2008).

Day One, 9:30am

The Design, Development, and Selection of Materials for Sustainability in Aviation

L. Cadwell Stancin
Director of Core Structures Engineering and Technology, Spirit Aerosystems, Inc.

Commercial aviation demand continues to increase worldwide. Materials development has been and will continue to be a key factor in supporting the environmental sustainability of the industry. Opportunities for improvement include higher performance materials which reduce aircraft weight, aerodynamic designs and surface treatments, reduced manufacturing waste, lower energy and water consumption, tailored materials, and material reuse or recycling. This talk will discuss the fundamental considerations in the design, development and implementation of new materials and processes for aviation, while highlighting the relationships of these attributes to sustainability. In designing materials for airplanes, one must consider: performance requirements, product timing, manufacturing capabilities, customer preference, non-recurring development and test costs, impact of the material on surrounding structure, and durability. Aviation industry examples in advanced metals deposition and joining, thermoplastics processing, and composite and aluminum materials development will be illustrated to serve as teaching aids.

Day One, 11:15am

A Revised Materials Science Undergraduate Curriculum, and a New Freshman Course in Materials and Energy

M. R. De Guire
Department of Materials Science and Engineering, Case Western Reserve University, OH, USA

The Department of Materials Science and Engineering at Case Western Reserve University has completed a major revision of its undergraduate curriculum. The aims of the changes were to:

- Show students that a degree in materials science and engineering prepares them for rewarding careers that provide creative, effective solutions to societal needs.
- Provide a curriculum built on scientific fundamentals that also covers current manufacturing, design, and applications of engineering materials.

New features of the revised curriculum include:

- Incorporation of Integrated Computational Materials Engineering (ICME) across the curriculum, starting in year 2.
- Four required courses emphasizing technology and applications: "Materials for …
    - Structural applications
    - Electronics and photonics
    - Biological and medical technology
    - Energy and sustainability
- Design content across all four years
- Materials manufacturing across the curriculum
- Student-selected concentrations in either biomaterials, electronic materials, polymers, or structural materials and mechanical behavior; or a design-your-own concentration

The revision implemented recommendations from the department's external advisory committee and from ABET. Student response has been strongly positive, with enrollments more than doubling in just under two years since being approved.

The talk will also discuss a new first-year course, "Materials and Energy," now in its second year. This course, open to all first-year students but limited to an enrollment of 17, is essentially a writing and research seminar course. It uses the subject of manufactured materials—as vehicles of energy and resource consumption, but also as enablers of more sustainable practices—as the platform for exposing new college students to academic inquiry, research, and debate. In addition, the course introduces historical, societal, and economic dimensions of society's use of engineered materials.

Day One, 11:40am

Okala Impact Factors 2014: Systemic Modeling of Environmental Impacts

P. White
School of Sustainability, Arizona State University, USA

Okala Impact Factors 2014 were developed to be a designer-friendly form of LCA developed with robust North American science. This method enables students of design engineering, product design, architecture, and all design disciplines to understand the life cycle implications of material decisions. It allows rapid "back of an envelope" decision-making through single-figure LCA, for estimating systemic ecological impacts in the design concept phase.

The Factors have been calculated for more than 500 materials and processes used in hard products, architecture, soft goods and electronic systems. They include common manufacturing, transportation, energy use, incineration and landfill processes, which allow modeling of environmental performance over the entire life cycle. Climate Change impacts for all materials and processes are also provided if separate calculations for that impact category are needed.

Okala Impact Factors 2014 each combines these impacts categories [1,2]

Acidification	Ecotoxicity
Fossil Fuel Depletion	Climate Change
Human Cancer	Human Respiratory Health
Human Toxicity	Ozone Layer Depletion
Photochemical Smog	Water Eutrophication

They also employ weighing values specified by NIST[3,4,5] and Inventory Dataset Normalization, a process that eliminates the bias that often results from systemic disparities among the layers of requisite LCAdata.[6]

The factors are part of the Okala Practitioner[7] guide, which is organized for students in all design disciplines. Okala has been taught since 2004, in over fifty design schools in North America and internationally. It teaches the fundamental concepts of applied life cycle thinking essential to sustainable development.

1. Bare, J., Norris, G., Pennington, D., McKone, T. The Tool for the Reduction and Assessment of Chemical and other Environmental Impacts. Journal of Industrial Ecology, 2003, 6:3–4
2. Bare, J. TRACI 2.2 US EPA, 2012, available at: www.epa.gov/ ORD/NRMRL/std/sab/traci/, accessed Feb 2013
3. Lippiatt, B. BEES®4.0: Building for Environmental and Economic Sustainability, Technical Manual and User Guide, National Institute of Standards and Technology, Technology Administration, U.S. Department of Commerce, 2007
4. Gloria T., Lippiatt B., Cooper J. Life Cycle Impact Assessment Weights to Support Environmentally Preferable Purchasing in the United States. Environmental Science and Technology, 2000, 41(21):7551–7557
5. United States Environmental Protection Agency, Science Advisory Board. Toward Integrated Environmental Decision-Making, EPA-SAB-EC-00-011, Washington, D.C., 2000
6. White, P., Carty, M. Reducing Bias through Process Inventory Dataset Normalization, International Journal of Life Cycle Assessment, Langsborg, Germany, 2009
7. White, P., St. Pierre, L., Belletire, S., Okala Practitioner, Phoenix, AZ, 2013, available at: www.amazon.com

Day One, 12:05pm

The Compatibility of Sustainability Education and Career Focused Education in Materials

S. Keilson
Loyola College, Loyola University Maryland, USA

Higher education in the United States is facing a number of challenges. As costs and student debt have escalated, questions of the value-added outcomes for a college degree have intensified. This is not isolated to liberal arts degrees, but has raised questions about the utility of engineering degree curricula as currently designed and delivered. Adding additional elements to the curriculum, such as sustainability, undergo this additional scrutiny about making students "marketable". Sustainability is somehow seen to be "nice" but not "necessary", a fringe benefit that can't be squeezed into the degree and disconnected from a career focus. Even if one brings up the market sector of renewables, that is often seen as only a niche focus and that sustainability does not have broader applicability.

I present a case study of how materials in the context of sustainability can be a pragmatic addition for students in Electrical Engineering. Electrical Engineering students are typically not taught and don't think much about where the metals and rare earth elements necessary for current component manufacture come from. Although there was some public spotlight on "conflict minerals", especially in 2010, there is still a tremendous disconnect among students and the public about the importance of mining, and the numerous non-technical constraints that the supply chain for materials imposes on manufacture.

The exploration for new materials to improve the performance of electronics is strong and vibrant and the decline of the silicon-based age has been forecasted for a number of years. But much of this discussion does not include a careful analysis of where the resources are coming from and what impact that may have. In contrast, the petroleum industry is used to an analysis of the social, cultural, economic, political, legal and other nontechnical factors around the raw materials they need. An engineer coming into that industry with a mindset that takes account of such factors is more valuable, with a broader and deeper skillset. This is not to say that there is not much that is troubling about the current practices of that industry. Electrical engineers need to learn the analytic skills to look at questions of sustainable and ethical sources for their raw materials. Examples will be drawn from battery, solar panel, and integrated circuit manufacture and the sources for key materials in those products. Educational resources will also be presented.

Day One, 2:15pm

Promoting 'Good' Design and Avoiding 'Bad' Design: The Role of History and Human Factors

J. A. Nychka, G. M. Nelson, M. Nouri
Chemical and Materials Engineering Department, University of Alberta, Canada

Have you ever seen or used a terribly designed object? Are you curious if they did any research at all on previous solutions to the problem? Have you wondered if the designer ever used the object themself? We presume that most of us have answered 'yes' to the above questions and had better solutions than what was produced. But, how are we to be sure that we don't fall into the same pitfall of bad design?

In this presentation the incorporation of 1) history and 2) human factors engineering into materials education will be discussed in the context of an introductory materials science course, and in a materials design capstone project course.

We have developed historical design case studies about to showcase the evolution of best practices of designing with materials, and reinforcing fundamentals. Such background places learning in context in order to engage students in a laboratory setting and to deepen their learning. Our thoughts on the impact of such case studies will be shared.

Human factors are those which account for many levels of interaction between a design and its users such as those ranging from the physical aspects up to the political implications of a design—such a construct is a systems thinking approach. In many instances of bad design forethought is absent and can be tracked back to a lack of understanding or disregard of Human factors; often engineering students tend and want to focus on the details rather than the system level design, or in how people interact with technology. In contrast, incorporating an assessment of Human factors from the initial design stages often results in better, and even good design. We will discuss how a Human factor audit has been developed and incorporated in our senior materials design project course, and the history surrounding its evolution.

Day One, 2:45pm

Materials—A Life Cycle View: Ecology in the industrial economy

L. C. Hix
Sustainable Product Design and Innovation Technology, Design and Safety Department, Keene State College, USA

The sphere of influence of product designers and engineers places them squarely in the middle of the materials and processing decision-making process. To create a strong foundation for launching efforts in designing for sustainability, the connections between the economic and biophysical worlds need to come to life for the student. Drawing on learning styles and technical capabilities of current undergraduate students, the author created, implemented and assessed the illustrated Material Life Cycle (iMLC) educational tool to build a framework and a background of environmental, human health, resource and social issues related to material selection during the product design and engineering processes. As a result of their research, students create a visual whole of a material's life cycle including its properties and impacts from extraction to the end-of-useful-life in the context of a product's major material group. For the last 6 years, student teams have been successfully creating 5 different iMLC per semester in an undergraduate course in industrial materials.

This talk will review the research into materials, Life Cycle Assessment and curriculum design leading to the development of the iMLC educational tool and include the preparation lessons, research techniques, project description, worksheets, examples and assessment mechanisms involved in the course delivery. Pre-tests, post-tests and end-of-semester reflective summaries provide evidence of students grasping the sustainability framework for assessing a material's viability and impacts. During subsequent product design projects and in their careers, students have demonstrated their ability to successfully apply this framework in their decision making.

As future knowledge workers involved in new product design and development, students are able to formulate the appropriate questions and research solutions to improve the sustainability and ecological performance of products. A framework for understanding the complexities of sustainability issues is nurtured while building competency with the methods, tools and skills needed to implement change.

Day One, 3:10pm

Cloud-based, fully interactive simulations via nanoHUB to enhance student learning of materials engineering concepts

T. Faltens, N. Onofrio, and A. Strachan
Discovery and Learning Research (DLR), Purdue University, West Lafayette, IN, USA

Interactive simulations and visualizations enable students to explore abstract concepts in a hands-on, concrete way. Students can gain familiarity with trends in materials behavior and develop a more intuitive understanding of complex mechanisms or concepts by proactively exploring the effects of varying materials parameters or testing conditions. The NSF-funded nanoHUB, a premier engineering cyber-environment for learning and research in nanotechnology and related areas, hosts over 300 cloud-based simulation tools. Users access these tools, free of charge, using a standard web-browser, without the need to download or install any software.

This talk introduces three complete materials science educational packages, with clearly labeled learning objectives, that are available on nanoHUB. These packages employ simulations and contain everything that a student needs to learn. Video lectures introduce the concepts to be explored, step-by-step tutorials explain how to run the online simulations, and assignments are included.

Two of these packages are short learning modules designed for sophomore materials engineering students and have been regularly used at Purdue for several years. In the first learning module, students use molecular dynamics simulation to deform a metallic nanowire to understand the atomic-level mechanisms responsible for plastic deformation and compare the response of the nanoscale object with that of macroscopic polycrystalline tensile bars. The second learning module uses density functional theory for students to explore bonding and the development of the energy band structure in silicon.

In addition to these short learning modules, we will describe a complete 5-week graduate-level course, entitled “From Atoms to Materials”. This nanoHUB-U course starts from atomic level physics and builds up to macroscopic properties of materials. Simulations reinforce and develop the concepts taught in the lectures.

All materials for these courses are available in nanoHUB, and instructors are welcome to incorporate individual components or full sections in their own courses.

Day One, 4:15pm

Experiential, Problem-based Learning Opportunity for Undergraduates via Real-world Simulated Engineering Design Project

K. Gipson
College of Integrated Science & Engineering, James Madison University, VA, USA

Materials & Mechanics is integrated subject course within Engineering at James Madison University, generally taken in the junior year. As part of the Madison Engineering curriculum, the emphasis of the course is to provide a working foundation for exploring the governing principles of materials science and the mechanics of materials. The course fuses science-led and design-led approaches in order to develop a plan for materials selection. To underscore the interconnectedness of structure, properties, processing, and performance of materials in products, a semester long team-based project has been developed where the team is assigned a material family to select a material candidate for use as a container of a new carbonated beverage to be sold in five-liter units.

The focus of the talk will be the semester long team-based, experiential, open-ended, and non-directed project that was motivated by providing Madison Engineering students with an "industrial new hire" type of experience. There are modules that focus on aspects of the project but the entire project encompasses the translation of customer desires into functional attributes for the purpose of selecting materials that will yield a valued and sustainable final product. A qualitative investigation including a life-cycle analysis using Granta's CES EduPack by Granta is conducted as well as a quantitative analysis incorporating physical property testing spanning mechanical, electrical, chemical, optical, magnetic, and thermal properties. Included within the project are evaluations of the economical, technical, environmental and social impacts from the production of the container if the product is commercialized.

Day One, 4:40pm

Enhancing Demonstration of ABET Student Outcomes (a-k) Through Hands-On Capstone Design Experience

P. Eason
Mechanical Engineering, College of Computing, Engineering & Construction, University of North Florida, FL, USA

The University of North Florida (UNF) maintains a commitment to the design-build-assess approach to the engineering capstone design experience. During the two course sequence in the final fall/spring academic year, students are required to self-select teams, identify problems and perform an open-ended design approach which resulting in the physical production and validation of the design. In the first semester, students are required to produce physical prototypes if possible, and, if not, significant modeling efforts are required to demonstrate proof of concept. CES EduPack is one of the software tools students are encouraged to use, in addition to FEA and CFD where appropriate. Students are required to design using predictive software to accelerate the iteration process in the embodiment phase of the design process. Proposals turned in at the end of the first semester lay out specific performance criteria that the built project will be assessed against in the second semester. In the second semester, the final design report includes documentation of the manufacturing process, as well as testing and validation of performance, and commentary on the eco-friendliness of the project through the Eco Audit Tool in CES EduPack.

As ABET focuses strongly on the major design experience in the accreditation process, UNF has decided to demonstrate all common engineering student outcomes (a-k) in the capstone experience, with special emphasis on outcomes h-k, as these outcomes are often difficult to demonstrate in traditionally delivered technical courses. In addition, interdisciplinary projects are encouraged, which requires all engineering majors to share a common platform in the capstone courses. Evidence will be presented from a recent ABET audit which illustrates the power in requiring an iterative design process, resulting in the production and assessment of the project, including commentary on societal and global implications. Case studies from selected student projects will be shown.

Day Two: Friday March 21, 2014

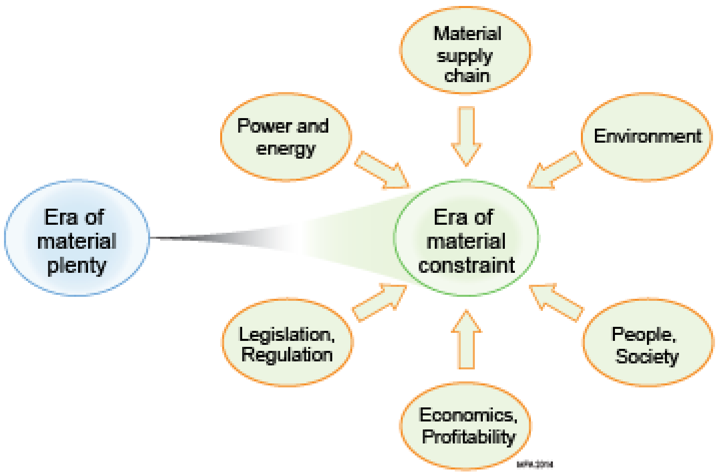
Day Two, 9:05am

Materials in a Systems-dominated, Resource-constrained World

M. Ashby
Engineering, University of Cambridge, UK

What will our students be doing 10 years from now? Teaching and research, like us? A few. Far more will be employed in materials-dependent industries; many of these will assume managerial roles charged with managing materials-related risk.

Over much of the last century material supply was not (with occasional exceptions) a major issue. Trade tended to be national rather than global. Material prices, in real terms, were static or falling. There was relatively little control over the way materials were used or what happened to them at the end of product life. Corporate priorities focussed on profitability and financial returns to shareholders.



Today the picture looks rather different. The increasing complexity of products creates a dependence on a larger number of elements, some comparatively rare. These are sourced globally and used to make products that are traded on a global scale. Manufacturing nations increasingly compete for exclusive rights to minerals resources world-wide in order to safeguard their industrial capacity. New and expanding legislation controls many aspects of manufacturer responsibility, product design, material usage and material disposal. The public, stakeholders and government increasingly judge corporate success not just in financial terms but in terms of stewardship of the environment and welfare of its workforce and that of the local economy of the communities in which it operates. Corporations respond by issuing Sustainability Reports detailing their attention to Corporate Social Responsibility (CSR).

Thus a significant role of the Materials Engineer is now likely to be dominated by issues such as:

- Adapting to, and complying with environmental and other material-related legislation
- Managing the material supply chain, particularly where "critical" materials are involved
- Contingency planning to cope with material constraints and price volatility
- Helping the company to adapt to a circular materials economy

In short, it is probable that many of our students will be involved with materials risk-management.

To what extent should our materials teaching respond to these changes? This talk explores some of the issues and provides some ideas and schematics to help explain them to students. My hope that this will stimulate a discussion and sharing of views on how to adapt our teaching to include these global issues.

Day Two, 9:30am

The Challenge of Teaching about Sustainability in Engineering

T. Gutowski
Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA, USA

The teaching of sustainability is an important problem that faces society. It is also a new and important area of research. Students are excited to be engaged and bring enthusiasm to class. But the area is new, as yet poorly defined. Furthermore, current tools do not bring the same accuracy nor assurance of success that conventional engineering tools do. So what should you do? My approach is given below in bullet form.

1. Set the framework and establish the focus
2. Review the basics
3. Teach basic tools including thermodynamics
4. Discuss accounting issues
5. Do examples to illustrate the use of these tools
6. Engage students in a useful experiment

I will provide examples and additional details on each of these points during my talk.

Day Two, 10:45am

Integrating Health into the Sustainable Building Materials Conversation: Assessment Tools and Education

A. White
Materials Research Program Manager, U.S. Green Building Council

Health has long been a tenet of green building practice, although a lesser-recognized attribute compared with energy efficiency and environmental stewardship. The U.S. Green Building Council has been at the forefront of prioritizing the health aspects of buildings, incorporating them into its LEED (Leadership in Energy and Environmental Design) rating system. A new credit in version 4 of the LEED rating system rewards the use of materials with a disclosed list of ingredients and those containing no hazardous substances.

Much of the onus currently would seem to lie with building designers to specify “safe” materials. However, an architect’s education contains little to no training on identifying material and chemical hazards. Materials science and chemistry curricula also contain little in the way of hazard assessment, and little in the way of considering the health implications of ingredient choices when designing materials and products. As an additional burden, product manufacturers are rarely willing to disclose the ingredients in their products, making the potential health effects even more difficult to discern.

These education and information gaps present manifold opportunities for improvement. A few tools and frameworks (e.g., Green Screen, Health Product Declaration, alternatives assessment frameworks) have been developed in recent years to help gather, distill, and evaluate material ingredient and hazard information. However, we must also consider questions such as:

- To what extent should architects be trained in the health aspects of materials? To what extent should materials scientists be trained to be familiar with the building industry? In whose “educational territory” do these topics lie?
- How can we best train materials scientists and engineers to understand the health implications of their ingredient choices and prioritize these aspects when designing materials and products?
- How can we make health considerations and toxic ingredient substitution more widely recognized attributes of sustainability?

Day Two, 11:10am

Creating the UNLV Solar Decathlon House

E. Weber
School of Architecture, University of Nevada, USA

In Fall 2011, the University of Nevada—Las Vegas School of Architecture's David G. Howryla Design—Build Studio began development of UNLV's entry into the U.S. Department of Energy Solar Decathlon 2013, an international, university-based competition to design solar-powered housing prototypes. In the closest finish in the history of the competition, Team Las Vegas placed second overall, the only U.S. team in the top three. The design team's primary goal was not the creation of a workable engineering model; instead, the team explored how technology can be a tool that assists people to reconnect with materiality, texture, light, and time, creating opportunities for memorable experiences.

Many students who have participated in design-build programs across the United States have cited them as critical formative experiences in their development as design professionals. Additionally, as a competition that requires collaboration between engineering, architecture, interior design, marketing, and communications, the Solar Decathlon is an effective tool for simulating teamwork on real projects.

As the only university located in the Mojave Desert, one of the most extreme environments in North America, UNLV's inclusion in this competition offers a unique opportunity to demonstrate leadership in developing innovative responses to arid climates. As many parts of the world are experiencing significant climate change-related droughts, our responses to these issues can have impacts beyond the Las Vegas region.

Day Two, 11:35pm

The Repository: Developing Continued Stewardship One Board-foot at a Time

J. A. Gines
School of Architecture, Mississippi State University, MS, USA

In the spring of 2013, the School of Architecture at Mississippi State University began the development of a materials library, "The Repository"; which is used to enhance the School's teaching curriculum, pedagogy of making, ecological agenda, and provides students with increased exposure and knowledge of sustainable building materials. This undertaking has three main operations including: the design and construction of a storage/shelving/display system that will house the materials, the development of a revolutionary comparative database that utilizes artificial intelligence software, and the acquisition of the collection of sustainable building materials. The Repository is one of only a handful of material libraries housed in architecture schools throughout the nation and perhaps the only one solely dedicated to sustainable building materials.

This investigation utilizes the design and development of The Repository, to critique the value of tacit understanding and haptic engagement as tools for increased material stewardship. "Materials have three basic conditions… the visual phenomena of the surface, its workability (cutting, bending, shaping, etc.) and finally, its tactility."[1]

Partnering with the only Forest Stewardship Council (FSC) lumber mill in the state of Mississippi, Anderson-Tulley Lumber Co., the project team employed 11 different species and over 1,500 board-feet of rough-sawn FSC lumber to create the primary framework and shelving of The Repository. Through a multi-layered process of cutting, planning, joining, laminating, sanding, finishing, and assembling, students became intimately acquainted with the physical properties of the materials in question and developed a broader understanding of their stewardship responsibilities as they engage the material world.

Day Two, 2:05pm

Materials Selection for the Energy-Efficient Home: The Time Value of Investment

J. R. Abelson
Professor of Materials Science and Engineering, University of Illinois at Urbana-Champaign, USA

The *Materials Selection for Sustainability* course attracts senior and graduate students from diverse engineering backgrounds at the University of Illinois to learn the selection and optimization methods in the *Materials and the Environment* textbook and in the CES EduPack. One of our engineering colleagues, Prof. Ty Newell, has developed a software that simulates home performance as a function of its design features (http://buildequinox.com). With both tools at hand, our students evaluate the tradeoffs between materials selection choices and performance in small homes located in any part of the US. Optimization involves significant adjustments in the use of materials for insulation, daylighting, heat pumps and solar PV power. However, important issues emerge: (i) in what ways are health and comfort more important than energy savings? And (ii) from what financial perspectives do extra investments afford net gains?

Day Two, 2:30pm

Teaching and Learning the Fundamentals of Environmental Degradation of Engineered Structures

R.D. Sisson, Jr.[1], T.EL-Korchi[2]
[1]Materials Science and Engineering [2]Civil and Environmental Engineering
Worcester Polytechnic Institute, USA

The degradation of the infrastructure is a major expensive problem in every country around the word. Unfortunately, the engineers who work on these problems received little education in this wide topic. At WPI we have developed a multidisciplinary graduate course with civil and environmental engineering and materials science and engineering faculty and students participating. During the spring semester of 2014 we have 20 students (10 CEEs and 10 MSEs) and 7 seven faculty members (5 CEE and 2MTEs) working together to learn the important topics: metallic corrosion, stress corrosion and corrosion fatigue, degradation of concrete, degradation of asphalt, degradation of polymers and composites and wood. There are weekly lectures, discussions and homework. Five student teams were formed to address the problem of the degradation of; tunnels, bridges, structures, power plants and roadways. Every other week the team gives a PowerPoint presentation on a selected issue; defining the scope of the problem, the degradation mechanisms, inspection techniques, life prediction, repair methods and new construction. This course will end with a ½ day symposium consisting of the team presentations. Students, faculty and local engineers will be invited. In this presentation the results of this active, participatory learning experience will be discussed for both students and faculty.

Day Two, 2:55pm

Low-cost, cross-disciplinary experiments in materials science using candy glass and home-built apparatus

W. Heffner, H. Jain
Lehigh University, Bethlehem, PA, USA

Much social and political dialog has centered on the need to improve student achievement and interest in science, engineering and technology education in the US. Recently, more attention has been brought to the significance of both hands-on learning and the informal educational experience to the total educational experience of both student and adult learners [1]. In response to this challenge, we have developed a collection of low-cost experiments for exploring the science of glassy materials through hands-on activities with sucrose based glass (a.k.a. hard candy). This innocuous and easy to synthesize model glass system provides a vehicle for quantitative exploration of the materials properties and compositional trends exhibited by both commercial oxide and polymeric glasses, but at much more accessible temperatures. This mini-curriculum of glass science consists of inter-related experiments and home built apparatuses. It provides an environment to develop an understanding of materials and measurement through active, prolonged engagement. Some of our earlier reported experiments [2] included the synthesis of sugar glass, phase diagrams, refractive index measurement, a fiber drawing tower, crystallization kinetics and a rudimentary version of a DTA. Since that report we have made substantial improvements and added new topics, including electrical and thermal conductivity, an improved DTA apparatus, and measurement of fluorescence in caramelized sugars. All of our experiments are designed to be low-cost (typically <$100) and the apparatuses are designed for assembly by students or teachers. These resources are all available at no cost on our website (http://www.lehigh.edu/imi/), which also includes interesting and informative video lectures on glass and materials science to complement the learning experience.

This work is supported by the International Materials Institute for New Functionality in Glass through the NSF Grant (DMR-0844014).

1. Philip Bell, Bruce Lewenstein, Andrew W. Shouse, and Michael A. Feder, Editors, Learning Science in Informal Environments: People, Places, and Pursuits (National Academies Press, Washington, DC, 2009).
2. W. Heffner and H. Jain, Mat. Res. Symposium Proc., Vol. 1233, Fall 2009.

Day Two, 4:00pm

Discovering ultracapacitors in a sophomore-level lab

K. A. Stair, J. Huang
Department of Materials Science and Engineering, Northwestern University, USA

A hands-on lab serves to introduce new energy-storage technologies in a sophomore-level class. The experiment begins with simple materials—carbon soot electrodes and an aqueous KOH electrolyte made into "ultracapacitors" in the form of a coin cell. The device performance is measured with a battery analyzer. Students are asked to compare electrochemical double layer ultracapacitors with batteries and conventional dielectric capacitors and consider materials parameters that might improve device performance. Completed in two 80-minute sessions, the students have time to learn how to make and test batteries and then implement a few ideas and test improved performance. This is offered as one of several mid-term "Discovery Labs" from which students can choose in an introductory materials class with weekly labs. Materials concepts are first introduced in a series of "Foundational labs," and the "Discovery labs" that follow are designed to be open-ended and foster creativity. Students present their experiments and findings to classmates in a final, third session.

Day Two, 4:25pm

Integrating Databases, Visualization, Simulation and Computation in to the Materials Science and Engineering Curricula

R.G. Buchheit, P.M. Anderson, A.P. Polasik, W.E. Windl
Materials Science and Engineering, The Ohio State University, USA

Ohio State University moved from a quarters-based academic calendar to a semesters-based calendar beginning with the 2012 academic year. As part of this change, we elected to revise degree program curricula in a significant manner. A key objective in our revision was to respond to elements of the Integrated Computational Materials Engineering (ICME) and Materials Genome Initiative (MGI) grand challenges pertaining to education of materials scientists and engineers. In responding to these challenges, we have developed a curriculum that attempts to integrate database use, visualization, simulation and computation approaches in materials science with other core educational content. At the undergraduate level, our goal is produce graduates who are cognizant of the broad range of computational tools available to materials engineers and what they can do to solve engineering problems, and who are able to use a number of those tools proficiently to solve problems of practical importance themselves. The MSE core curriculum includes 9 credit hours (four courses), or 20% devoted to these topics. Students may take an additional 4 credit hours (two courses) in elective content on computational methods in materials science. In this presentation, details will be presented on the specific course offerings, course content, exercises, and software packages used. How the courses are postured in the curriculum will also be addressed. Hurdles we have discovered will also be discussed including readiness of the students to learn and readiness of the faculty to teach this new content, software support and expense, and controls needed to prevent unnecessary proliferation of software packages in the teaching of this new content.

Day Two, 4:50pm

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Section 4:

Poster Abstracts

Poster Abstracts

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3	Dr. Ayse Kilic	Chemical and Metallurgical Engineering Faculty, İstanbul Technical University, Turkey	Problem Solving and Design Based Approach of Material Selection in Materials Engineering Education
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Poster 1

A New Three-Year Computational MSE Lab Sequence at The Ohio State University

Alison K. Polasik, Ji-Cheng Zhao, Wolfgang E. Windl, Steven R. Niezgoda, and Peter M. Anderson
The Ohio State University, USA

In 2013, The Ohio State University converted from a 10-week quarter to a 14-week semester calendar. This prompted a dramatic overhaul of the MSE undergraduate curriculum, including the addition of a three-year modeling and simulation lab sequence. At the undergraduate level, our goal was to produce graduates who are cognizant of the broad range of computational tools available to materials engineers and what they can do to solve engineering problems, and who are able to use a number of those tools proficiently to solve problems of practical importance themselves. The computational labs align with the lecture courses taught within the same academic year. Moreover, they demonstrate the visualization of materials phenomena and the implementation of various theories and physics into numerical schemes. This includes a focus on structure and materials selection in the sophomore year using Crystal Maker and CES EduPack and a focus on thermodynamics/kinetics and mechanical and electrical properties in the junior year using MATLAB. Projects in the senior year build on this foundation and introduce finite element modeling using ABAQUS. Group-based learning and aggregation of class-wide data are used to reveal trends and insight beyond the scope of an individual student approach. The broad exposure to various computational techniques and data analysis equips seniors with relevant skills to impact their capstone and design projects. Overall, modeling and simulation are an increasingly vital component to undergraduate education and an essential thrust within the Materials Genome Initiative. This lab sequence allows our instructors to incorporate these critical skills into the core curriculum, and ultimately to better prepare the students for their careers. Despite the challenges, student feedback on the sequence has been positive and the results rewarding.

Poster 2

Resources to Support Bio-Engineering Teaching and Research

Ana Pereira-Medrano, Jorge Sobral, Sarah Egan
Granta Design, UK

The field of bio engineering, biomedical engineering and similar biomaterials courses are of great academic interest, especially in the USA and Europe. Already holding advanced databases currently used in the biomedical sector, such as the human biological materials and materials for medical devices, we have compiled a complete set of resources to support bio engineering teaching and research at Universities.

Starting with CES EduPack for undergraduate teaching, the new Bio Engineering edition provides a set of teaching resources has been updated and developed: a completely overhauled database as the foundation, and supportive medical and non-medical case studies. This new editions comprises of two levels:

1) Level 2 for introductory-level courses for biomaterials, which has data on relevant biomaterials for bio engineering applications. This level will help to develop the understanding of natural and naturally-derived materials versus man-made engineering materials. Starts to explore factors important in medical device design. biomimicry, and use of biomaterials as sustainable alternative.

2) Level 3, for advanced-level courses, which comes with an advanced materials database enabling material selection for medical devices. Providing nearly 4,000 materials, this level provides a comprehensive database for advanced teaching and projects in the field of bioengineering.

The poster also provides an overview of our research resources, currently used in the medical devices industry. These include CES Medical Selector™, which is built on the same principles as the software in CES EduPack™. Instead of the extensive teaching resources available in CES EduPack, this provides specialist tools, extensive materials property data, and advanced graphical analysis for industry and research centers. Additionally, there are 2 online libraries of information: the Human Biological Materials Database and ASM Medical Materials Database. Both are ideally suited for in-depth research of biomechanical properties of tissues, in the case of the first one, and screen, analyze, and source candidate materials and coatings for device applications and associated compatible drugs, in the latter one.

Poster 3

Problem Solving and Design Based Approach of Material Selection in Materials Engineering Education

Ayse Kilic, Yılmaz Taptik
Istanbul Technical University, Turkey

Considering the fact that material selection plays a significant role during the industrial developments under today's competitive conditions, the concept of material selection is becoming more important in undergraduate curriculum of materials engineering education, especially with the aim of training the future engineers efficiently. ITU Materials Engineering education changed its focus point and teaching techniques in parallel with the recent developments and as a result of this, design and problem based approach came into prominence. Materials selection is introduced to the students after basic science and engineering courses and Ashby diagrams are used during search of the suitable material and process for the given circumstances. Design principles are also emphasized within the scope of course and there are case studies which give an opportunity to the students to work as team both for seeking solutions and effective parameters also for learning material/proses selection and design stages. At the end of the course, it is achieved that students are able to make a connection between engineering materials and design-process-property relation, evaluate the knowledge gained during the courses as a whole, understand the importance of the design and use the quality tools. In this study, it is emphasized that necessary conditions should be ready for initiating the case studies for team works from the earlier semester of the materials engineering education and in this regard, there is a need for certain courses should be structured with project and design home works. It is also intended to determine the factors effecting teams with both collecting the data from different perspectives such as, the way of making a team with the students' own choices or with a random selection, and with the analysis of teaching techniques.

Poster 4

Computer-based Support for Product Development Teaching

Dr. Claes Fredriksson[1], Mats Eriksson[2]
[1]Granta Design, UK, [2]University West, Sweden

Product Development is a prime topic for many engineering courses and educational programs. The Product Development Process is implemented by companies in many different ways, depending on e.g., costumer requirements. However, a number of common elements exist and are covered by teaching at Universities. In our poster, we point out several key elements of a Product Development process that can be facilitated and taught using, for example, a standard edition of the widely used CES EduPack software. These are:

- **Specification of product function and requirements**, using the limit stage parameters as guidelines for properties to consider.
- **Screening and scoring (ranking) of concepts**, where material properties, such as strength or cost for concepts can be estimated using the software.
- **Optimization of properties for the final design**, including process selection and costing, e.g., finding the best metal alloy or grade of polymer using links between materials and process data, in combination with built-in cost models.
- **Evaluation of properties of the final product to be used by marketing**, e.g., declaring the carbon footprint using an Eco Audit, or finding strengths and weaknesses for strategic market positioning.

The methodology has been tested among third year undergraduate students of mechanical engineering at University West, Sweden in a sustainability design project. A small group was followed during the product development of a combined liquid container and construction element for use in developing countries or in disaster areas. Examples of the use of EduPack as a project tool, are shown. The findings can be useful for different directions within product development, for example *Design for X* (DfX) used to represent different design focuses. In particular, X could stand for Manufacturability, Value or Environment in our approach.

Poster 5

Visualization of Materials Knowledge and Concepts

Elisabeth Kahlmeyer, Hannah Melia, Magda Figuerola
Granta Design, UK

We are surrounded by thousands of inputs in our daily life, from adverts on the street to millions of internet entries. It has become more important to stand out and use visualization tools, not just to advertise but to create and support an understanding of a subject.

Most people agree that:

- a picture says a thousand words
- students learn in different ways
- students learn best when they are engaged with the subject.

Therefore, images and charts that illustrate materials knowledge and concepts are a useful tool for materials educators. This approach aims to transfer knowledge in an efficient way and to promote materials knowledge to the next generation and catch their attention.

In this poster we want to show examples and possible applications of presenting materials knowledge and concepts in a visual way.

Poster 6

Visualization of Ternary Phase Diagrams in 3D

Harvey Abramowitz, Erik Johnsen, Michael Alden Roller, Weizhuo Zhao, Xuantong Liu, Lingjun Zhang, Xuan Zhang
Purdue University Calumet, USA

To help students, researchers and operators better visualize and understand ternary phase diagrams, a web-based application is being developed at Purdue University Calumet that includes the use of 3D. The application is comprised of various sections: General binary systems; General ternary systems; Ternary systems for ironmaking; Ternary systems for BOF steelmaking; and Ternary systems for ladle metallurgy. The application will be available for demonstration.

Poster 7

ICME Education at Missouri S&T

Krista Limmer and M. Asle Zaeem
Missouri University of Science and Technology, USA

According to the "Materials Genome Initiative (MGI) for Global Competiveness" issued by the office of the President in 2011 and backed by the National Academy of Science, computational materials engineering is one of the main tools for the future success of US industries, and preparing and educating future engineers with sufficient computational skills is essential.

Along this direction, a new course entitled "Introduction to Integrated Computational Materials Engineering (ICME) has been developed in the MSE department at Missouri S&T. This course is designed to attract undergraduate and graduate students from all STEM disciplines. Through the face-to-face lectures, computer labs, and individual and team projects, students are exposed to five different scales of computational materials science tools and their applications. Computational methods covered in this course include density functional theory (electronic scale), molecular dynamics (atomistic scale), dislocation dynamics (microscale), phase field modeling (macroscale), and finite element modeling (macroscale). Integrating these modeling tools towards the path of material and process design is the goal of this new course.

Poster 8

Computational Training in Materials Science and Engineering (MSE) Curriculum

Lan Li[1]*, Eric Nelson*[1] *and Laura Bartolo*[2]
[1] *Boise State University, USA,* [2] *Kent State University, USA*

In tomorrow's MSE workplace, computational modeling tools will be integral to optimize outcomes. Universities, national labs and industry already integrate such tools, with increasing use across scientific and engineering disciplines. However, undergraduates and graduate students new to modeling methods can find them unrelated to their education and training. Computational materials case studies target advancing students' understanding of concepts of computational modeling methods and enhancing their abilities to use the methods to solve real materials problems. Different assessment approaches are applied to measure student learning improvement. The case studies are transferable to other disciplines as well as disseminated through MatDL (Materials Digital Library) repository and script library.

We have developed five case study prototypes, based on actual research. These cases demonstrate how to implement computational tools to optimize material process, how material structures lead to properties, and how to select materials for desired applications. They have been successfully used in an undergraduate and graduate joint course in computational materials science, offered every fall semester at BSU. In the class, the instructor demonstrated each case, explained the reasons to select and apply a specific modeling method to the case, and introduced the basic concepts associated with the method. In order to enhance their hands-on experience, individual students were required to modify each case-study computational model to solve a similar problem for other types of materials, as graded assignments. A number of assessments were applied, including student surveys, weekly quizzes, individual small projects, and oral exam. Through student performance comparison before and after case studies, the outcomes indicated significant student learning and hands-on skill improvements. These teaching materials and instructional strategies are applicable to other materials-related courses. The scripts used in the case studies are posted on the MatDL script library. The cases and assignments are also assessable from MatDL.

Poster 9

Lectures on the Social and Political Life of the Native Country in a Course on Materials and Sustainable Development Course

M E Noguez, G Salas, J Ramírez, D. González
Universidad Nacional Autónoma de México, Mexico

Planning for teaching a Materials and Sustainable Development course for metallurgical engineering undergraduates in a *developing* country, implies to motivate students into a paradigm change in order to take account of the real barriers and incentives faced when acting in their engineering professional life regarding this point. There must be a close view of the own environment, a realistic view of the own country, its significances and consequences.

It is thought that at least two 1.5 hr. / week lectures and a workshop have to be dedicated to present and work with the students with facts and goals on sustainability in the native country.

In this work, initial data collected for these course lectures and workshop regarding the situation in Mexico, are presented. The selection of data and facts was made to reflect the lights and the shadows of the sustainable work in the country and its industry. The data are: accomplishment of the Kyoto protocol, citizen and government implemented initiatives (energy sources, fuel consumption, etc.) ecology education, poverty index, corruption index, political positions, etc. and how they are related. Some of the health impacts caused by actual industrial policies and attitudes on a population in a city as Mexico City are presented too. The goal is to help students construct a positive, realistic and aggressive attitude when facing the difficulty of transforming the working and living environment towards a sustainable one.

These lectures and workshop have not been tested yet. They are presented with the conviction that touching these social issues is a necessity when teaching a Materials and Sustainable Development course .

Poster 10

New Granta's Teaching Resources Website 2.0

Michelle Rushe, Hannah Melia, Magda Figuerola
Granta Design, UK

Today the number of resources that circulate over the internet is huge. It is important to select resources that are **high quality** with **trustworthy data**. Working closely with many **respected universities** puts us in a good position to monitor **innovations** and **research** in the Materials Education field.

Our **Teaching Resources** compile powerful data and present it in an easy and accessible way across **different specialist fields.**

We manage **250+ teaching resources** for Materials Educators in **different languages, formats and specialties.** All the resources have been improved over the last year and put into a completely new **platform.**

In the new Teaching Resources Website it is easier to:

- Find resources
- Favorite resources
- Create your own memorable password
- Log in once and download everything
- Find out what the Teaching Resources team are up to
- Get inspiration from Granta's blog
- Communicate with other educators about materials education topics.

Granta's Teaching Resources Website also **supports academics** in **Teaching** and **works as a link** between the different communities and special interests via the **Forum** and the **Blog.**

This poster will showcase some of the improvements and request your feedback on ideas for future development.

Poster 11

Developing Inquiry-based Interdisciplinary Nanobiotechnology Laboratory Experience for Undergraduate Students in Materials Science and Chemical Engineering Majors

Jianyu Liang[1], Terri Camesano[1], and Jeanne Hubelbank[2]
[1]Worcester Polytechnic Institute, USA, [2]Program evaluation and assessment consultant, USA

Nanobiotechnology is a new field that probes the intersection of nanomaterials with biological molecules and cells. While undergraduate students have no doubt heard of the importance of nanotechnology and nanoscience, relatively few can appreciate how the scale of matter affects the fundamental science or behavior of a system. Most learning on this topic tends to occur in upper-level electives or in senior thesis projects or REU programs. Further, our undergraduate curricula do not include enough exploration-based laboratory courses, in which students work towards solving a problem in collaborative teams. In addition, by emphasizing the way that society can benefit from improvements in nanomaterials research and applications, we can capture the interest of more students, especially those from underrepresented minority groups.

This presentation discusses the creation at Worcester Polytechnic Institute (WPI) of an inquiry-based series of laboratory modules that are designed to expose students to nanomaterials and nanobiotechnology, increase specific skills in nanomaterial synthesis and characterization, augment their interest and confidence in pursuing the subject matter, and encourage them to pursue higher level nano-courses as well as research projects.

In this presentation, the challenges and experience on offering such an interdisciplinary undergraduate laboratory course will be summarized. The evaluation results and students' feedbacks strongly demonstrated that the open-ended and cutting-edge nature of the course was a plus for most students and a reason for enrolling in the course. It was also found that students' exposure to and work with research methodology, experimental skills, and preparation and presentation of oral and written reports prepared them for the changing job market and future studies.

Poster 12

Integrating knowledge and concepts of sustainability in a mechanical engineering curriculum via an engineering clinic concept

Mary A. Wells, David C. Weckman and Roydon Fraser
University of Waterloo, USA

The mechanical engineering program at the University of Waterloo consists of a series of academic terms interspersed with mandatory co-op experiences over a five year period. The core academic mechanical engineering curriculum is made up of courses that are derived from the five research groups in the department, including: 1) thermal engineering, 2) fluid mechanics, 3) materials engineering and processing, 4) automation and controls and 5) solid mechanics and machine design.

Although the mechanical engineering curriculum is crafted to provide an integrated program of academic learning and experiential learning through a mandatory series of co-operative industrial work terms, the students tend to experience the program by necessity, in discrete and separate courses as well as co-op experiences. In an effort to integrate knowledge both across discrete courses in a term and along knowledge threads in the program, the idea of an engineering clinic as a mechanism to integrate courses was formulated.

In this talk, we describe the motivations for the engineering clinic and how clinic activities (life cycle analysis and dissection of an engine) has been used in both the 1st year as well as 3rd year of our mechanical engineering program to help integrate knowledge learned in courses such as solid body mechanics and machine design, materials science and engineering, and manufacturing processes by presenting students with a real world problem as well as motivation and strategies to investigate and integrate energy and sustainability considerations into the design, materials selection and manufacturing processes required to produce a real world, commercial product.

Poster 13

Student Difficulties Using Graphs Required for a Materials Science Course

Rebecca Rosenblatt
Illinois State University, USA

We report on difficulties students have with the standard graphs and diagrams used in a university level materials science course which includes atomic bonding potential energy graphs, material concentration and diffusion graphs, stress-stain plots, creep/fatigue material lifetimes, phase diagrams, TTT plots, and log plots. Many of these difficulties overlap with general areas in science education where students have difficulties with graphs. Such as, students confounding slope with height and students failing to attend to the axis which are being graphed. However, many other graphical difficulties are specific to the type of chart or diagram used. For example, many students have difficulties both using the boundaries of a phase diagram to derive information about the microstructure of the alloy and understanding the physical meaning of the boundaries between phases. In addition, we report on the effectiveness of some graph activities implemented in recitation.

Poster 14

Usefulness of small reading-based intervention for teaching non-engineers mechanical properties.

Rebecca Rosenblatt
Illinois State University, USA

We report on a small study assessing student learning from a 10 minute reading-based intervention. The reading intervention was created by an introductory research student creating notes from a standard undergraduate text book on the most important basics of yield strength, Young's Modulus, and plastic vs. elastic deformation. The overall style was bullet point notes about the important facts or instances that go with the basics of mechanical properties and a basic stress strain diagram illustrating the ties with some of these properties. Modeling previous cognitive studies, students were randomly assigned to one of two groups. A group who read for the entire 10 minutes and a group who read for 5 minutes and then used the last 5 minutes to reflect on their reading. After, students completed a 12 item quiz and a week later were given the same quiz. Some main findings were as follows. Students in the read/reflect group showed less forgetting over the course of the week (consistent with previous studies). Students showed much larger variations from item to item in abilities than engineering students, these variations illustrate inherent difficulties for certain items which were not visible when looking only at engineering students. Lastly, this study was also done with a group of pre-service physics and earth-and-space science teachers. The physics teachers did significantly better on the posttest showing much greater ability to learn this new materials science topic than the earth-and-space science teachers.

Poster 15

Sustainable Trades Training in Institutes of Technology

Rob Sawatzky
British Columbia Institute of Technology, CA

The National Occupational Analysis (NOA) outlines curriculum requirements for all Canadian trades programs. The topic of sustainable materials and practices is not currently included in the Joinery NOA. British Columbia Institute of Technology's (BCIT's) Joinery department has addressed this shortfall by implementing a recycling program, purchasing sustainably harvested solid wood (FSC), purchasing panel products that contain No Added Urea Formaldehyde (NAUF), using water-base adhesives, installing a variable frequency drive (VFD) dust extraction system and requesting the purchase of a wood waste-to-energy biomass energy system.

Annual targets we have met:

- 345 cubic yards of waste diverted from the landfill by recyling.
- 67% of our 7,220 BM of solid wood purchases are FSC certified.
- 78% of our 840 sheets of panel product purchases have NAUF.
- 100% water-base adhesives.
- 85% electrical savings from VFD dust extractor.

Collectively, the Joinery and Carpentry departments generate approximately 250,000 kg of wood waste on an annual basis. By purchasing a 200 kW waste-to-energy biomass boiler this waste could be converted into 4000 GJ of energy, supply hot water to our campus district heating line and reduce our carbon emissions by 200 tonnes (Project approved by BCIT's Board of Governors, listed in five-year capital plan, feasibility study, fuel study, ash report and schematic design report completed).

Our progress has:

- Motivated other BCIT departments to implement similar strategies.
- Influenced sustainable practices of the local Architectural Woodworking Industry.
- Garnered financial support from the British Columbia Bioenergy Network
- Resulted in support from the Ministry of Environment and Metro Vancouver's Regional District.

Poster 16

Novel Senior Design Projects for Developing Better Understanding of Sustainable Materials Manufacturing

Surojit Gupta[1], D. Bose[2], M. N. Cavalli[1]
[1]University of North Dakota, USA, [2]Boise State University, USA

This abstract will report an innovative approach for creating senior design projects for better understanding of sustainable materials manufacturing for both online and campus based students. The authors will present a test case where online engineering students are from different parts of the country, for example, CA, NY, MN etc. Some of the major challenges during the design of online senior design projects are, (a) establishing online communication between students, (b) teaching online students in real time, and (c) creating a project where different online students can participate and contribute synchronously as well as asynchronously. The authors propose an approach for solving the above mentioned problems. Problems (a)-(b) may be solved by using currently available Learning Management System (LMS) and cloud-based storage and sharing technologies like Blackboard (BB), Google share and mobile applications, among others. During this presentation, the authors will present their experiences of using various technologies. There are several ways of solving problem (c). The authors will present an approach where online and on-campus senior design projects were integrated to provide an enriching experience for students. During this presentation, the authors will present their experience of using an integrated approach for building senior design projects.

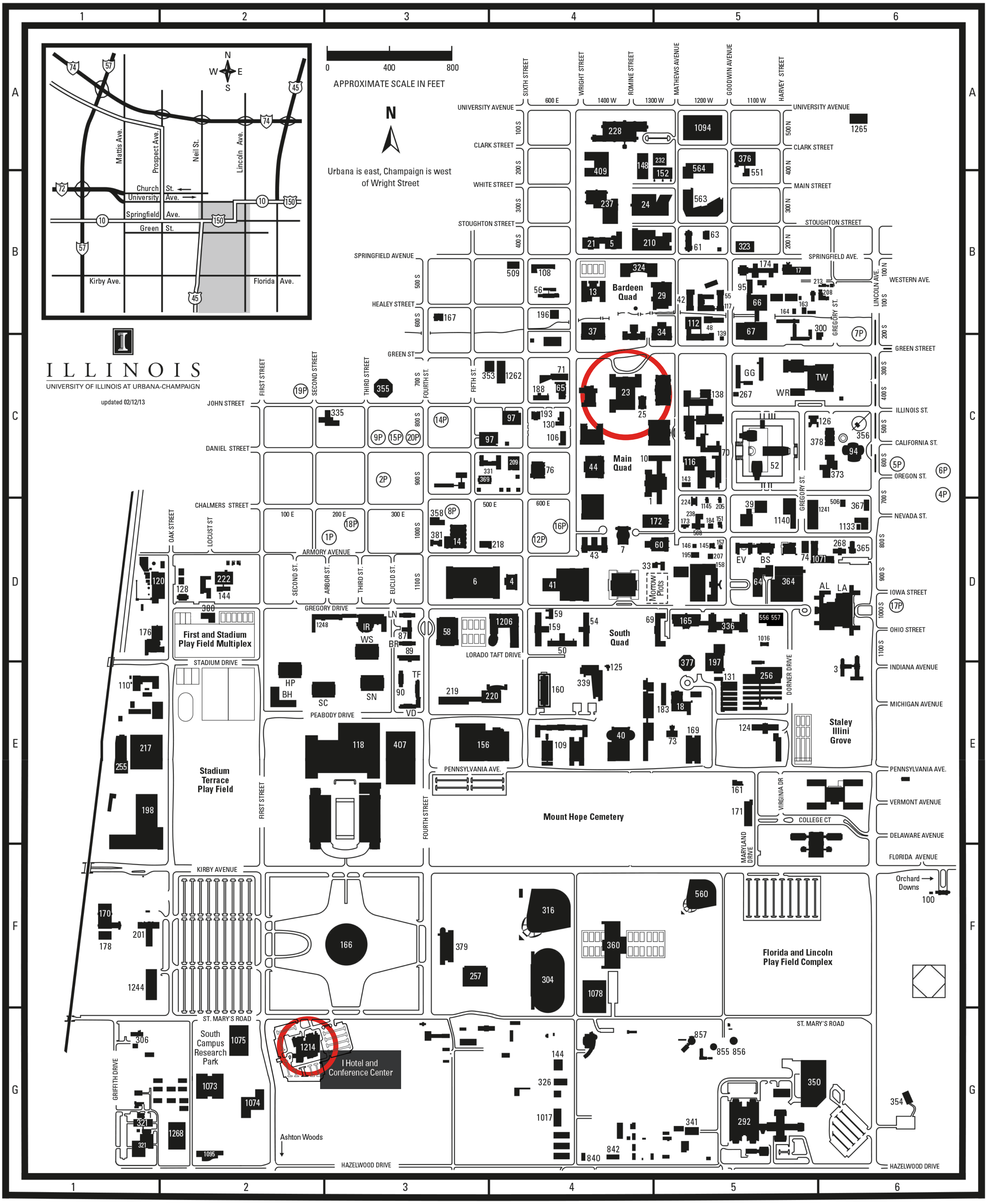
Poster 17

Low-cost experimental program in glass science using candy glass

William Heffner & Himanshu Jain
Lehigh University, USA

We have developed a collection of low-cost experiments and apparatus for exploring glass science through hands-on activities with sucrose based glass (a.k.a. hard candy). This very accessible material exhibits many aspects of glassy materials, from synthesis to properties, characterization and engineering applications. Some of the activities described in this poster include: synthesis, phase diagram, refractive index measurement, crystallization phenomena, and a fiber drawing tower, as well as differential thermal analysis and electrical conductivity apparatus. Our priority is to keep all experiments within the resources of a typical high school student, while incorporating quantitative science content. Most of the experiments can be assembled in a high school lab with minimal cost, and yet would also be appropriate for inclusion in an undergraduate materials lab. The scientific content of these experiments progresses systematically, providing an environment to develop an understanding of glassy materials within a framework of active prolonged engagement.

Section 5:Maps, Contact Details, and Venue Information


ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
updated 02/12/13
APPROXIMATE SCALE IN FEET
0
400
800
N
Urbana is east, Champaign is west of Wright Street
Mattis Ave.
Prospect Ave.
Neil St.
Lincoln Ave.
Church St.
University Ave.
Springfield Ave.
Green St.
Kirby Ave.
Florida Ave.
UNIVERSITY AVENUE
CLARK STREET
WHITE STREET
STOUGHTON STREET
SPRINGFIELD AVENUE
HEALEY STREET
GREEN ST
JOHN STREET
DANIEL STREET
CHALMERS STREET
ARMORY AVENUE
GREGORY DRIVE
STADIUM DRIVE
PEABODY DRIVE
LORADO TAFT DRIVE
PENNSYLVANIA AVE.
KIRBY AVENUE
ST. MARY'S ROAD
HAZELWOOD DRIVE
SIXTH STREET
WRIGHT STREET
ROMINE STREET
MATHEWS AVENUE
GOODWIN AVENUE
HARVEY STREET
LINCOLN AVE.
GREGORY ST.
WESTERN AVE.
MAIN STREET
GREEN STREET
ILLINOIS ST.
CALIFORNIA ST.
OREGON ST.
NEVADA ST.
IOWA STREET
OHIO STREET
INDIANA AVENUE
MICHIGAN AVENUE
PENNSYLVANIA AVE.
VERMONT AVENUE
DELAWARE AVENUE
FLORIDA AVENUE
COLLEGE CT
VIRGINIA DR
MARYLAND DRIVE
DORNER DRIVE
FIRST STREET
SECOND STREET
THIRD STREET
FOURTH ST.
FIFTH ST.
OAK STREET
LOCUST ST
GRIFFITH DRIVE
Bardeen Quad
Main Quad
South Quad
Morrow Plots
Staley Illini Grove
Mount Hope Cemetery
First and Stadium Play Field Multiplex
Stadium Terrace Play Field
Florida and Lincoln Play Field Complex
South Campus Research Park
I Hotel and Conference Center
Ashton Woods
Orchard Downs

University of Illinois at Urbana-Champaign

Contact Details

Address:
1401 West Green Street Urbana, Illinois 61801

Phone:
(217) 333-1545

Main campus switchboard:
217-333-1000

Event cell phone (in case of emergency only):
949-237-8052

Maps and Directions are available at the Philadelphia University website:
www.illinois.edu/resourcesfor/visitors/directions.html

Rooms

The Main venue of both Short Courses and Symposium is the Illini Union.

Tuesday & Wednesday (Short Courses): Illini A

Thursday & Friday (Symposium): Illini ABC

Map

The map on the facing page shows the Illini Union (main venue) – building #23, C4

Dinner Venues

Presenters' Dinner
Wednesday, March 19
Illini Union, University of Illinois at Urbana-Champaign

The dinner will follow straight from the course.

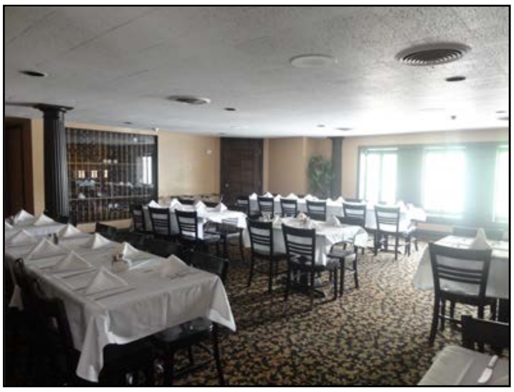
Symposium Dinner
Thursday, March 20
Illini Union Ballroom, University of Illinois at Urbana Champaign

The dinner will follow straight from the Symposium.

Dinner
Friday, March 21
Timpone's Restaurant, Urbana

Timpone's Restaurant is locally recognized as the finest table in the Central Illinois region.

More information on:
www.timpones-urbana.com



Local Information

This year's North American Materials Education Symposium and Short Courses are taking place at the University of Illinois at Urbana-Champaign . Additional information on travel, housing, and dinner venues is online: **www.materials-education.com/2014/na/local.htm**

University of Illinois at Urbana-Champaign

The University began when a minister from Champaign decided to build training school for ministers. Subsequently, the people of Champaign-Urbana learned that the state of Illinois was looking for a place to build the downstate branch of a college to teach agriculture, and convinced the committee to choose Champaign-Urbana.

The new college was called Illinois Industrial University, and it opened in 1868 with 77 students. They lived in and took classes in the Elephant building, which the University named Old Main Hall. The University added many subjects to those it taught. It would later change its name to the University of Illinois and would grow to become the world renowned institute it is today.

University of Illinois Website: http: www.illinois.edu/

Section 6:

Symposium Organization

Organization

The International and North American Materials Education Symposia are coordinated by Granta Design with support from the advisory committee and the following organizations:

- **American Society for Engineering Education (ASEE), Materials Division**
- **ASM International**
- **Department of Materials Science and Metallurgy, University of Cambridge**
- **Department of Engineering, University of Cambridge**
- **European Society for Engineering Education (SEFI)**
- **The Federation of European Materials Societies (FEMS)**
- **Granta Design**
- **The University of Illinois at Urbana-Champaign**

The program for these events was guided bythe following Advisory Committee:

COMMITTEE MEMBER	AFFILIATION(S)
Prof Mike Ashby (Committee Chair)	University of Cambridge, UK & Chairman, Granta Design
Prof John Abelson	University of Illinois at Urbana-Champaign, USA
Prof Diran Apelian	Worcester Polytechnic Institute, US
Prof Yves Brechet	INP, Grenoble, France
Prof Rudolph Buchheit	Ohio State University, US
Dr Tim Bullough	University of Liverpool, UK
Prof Seh Chun Lim	Deputy Dean, Faculty of Engineering, National University of Singapore
Prof Bill Clyne	University of Cambridge, UK
Prof David Embury	McMaster University, Canada
Prof Peter Goodhew	University of Liverpool, UK
Prof Trevor Harding	Cal Poly San Luis Obispo, US
Dr Ronald Kander	Philadelphia University, US
Prof Suk Joong L. Lang	KAIST, Korea
Prof Ke Lu	National Laboratory for Materials Science, China
Prof Kiyoshi Okada	Tokyo Institute of Technology, Japan
Prof Christine Ortiz	Massachusetts Institute of Technology, US
Dr Noel Rutter	University of Cambridge, UK
Prof S. Ranganathan	Indian Institute of Science, Bangalore, India
Dr Hugh Shercliff	Department of Engineering, University of Cambridge, UK
Prof Richard Sisson	Dean of Graduate Studies, Worcester Polytechnic Institute, US
Prof John Wang	National University of Singapore
Prof Alexander Wanner	Karlsruhe Institute of Technology, Germany
Prof Sybrand van der Zwaag	TU Delft, Netherlands