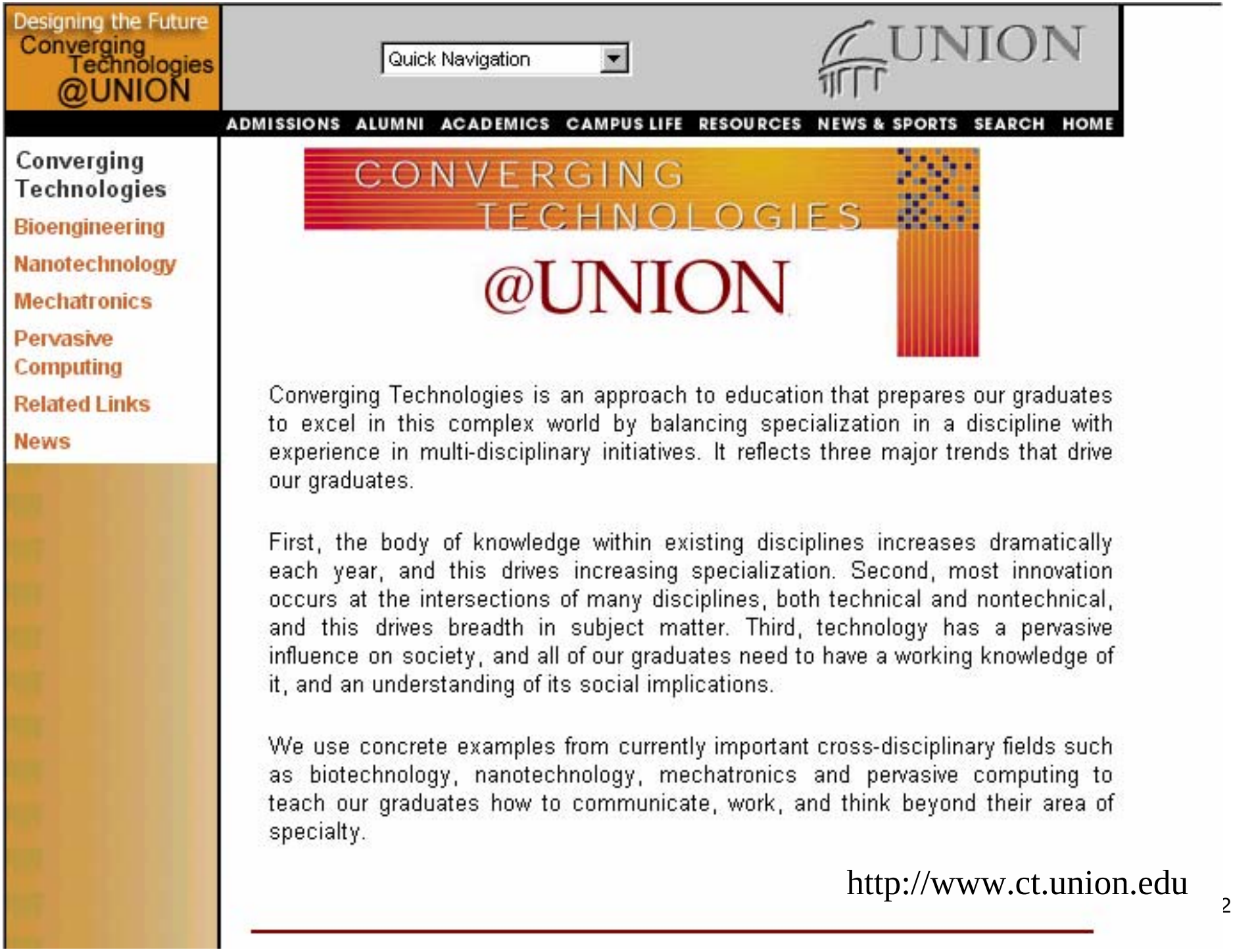
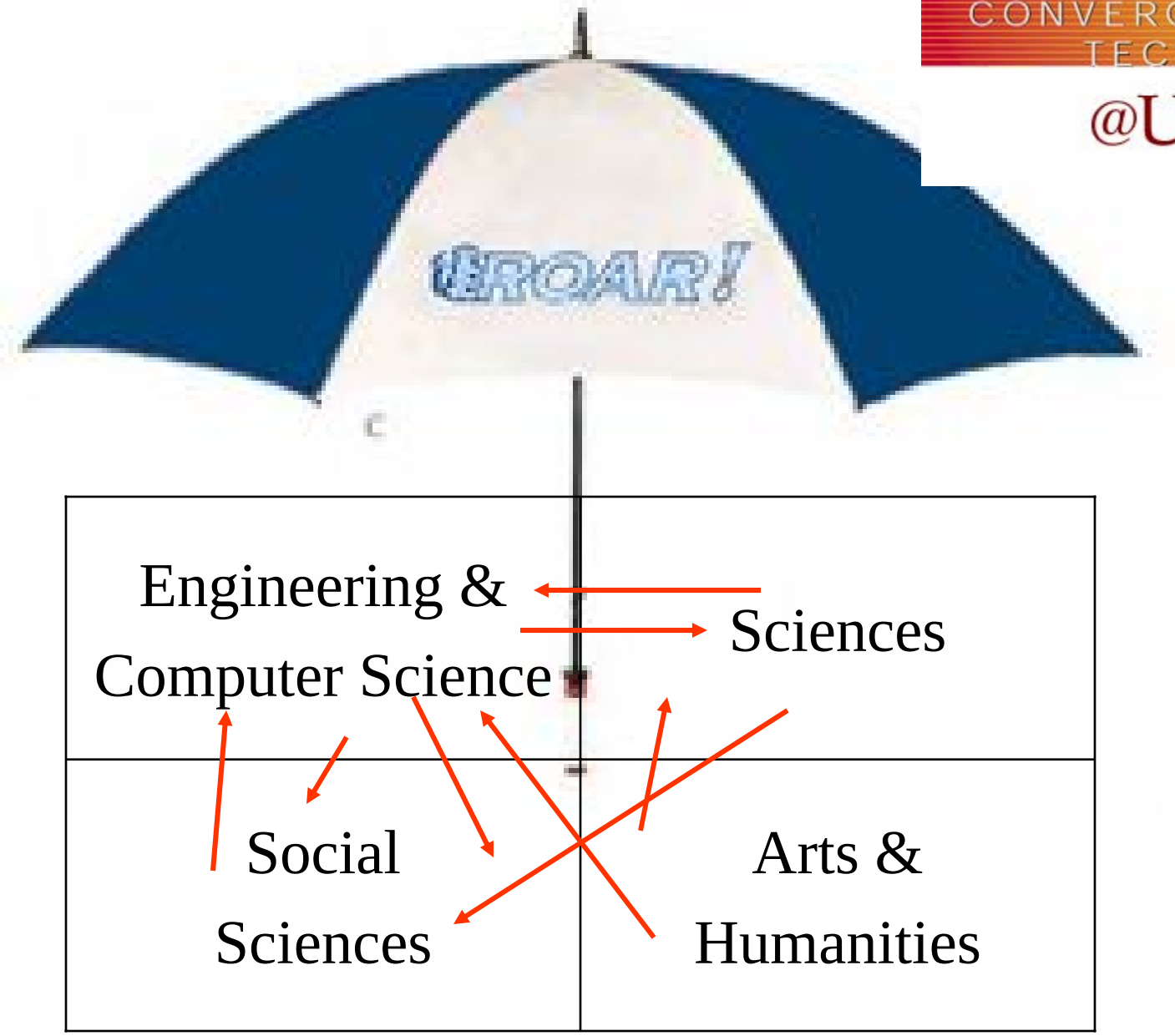
Doug Klein
Director, Center for Converging Technologies (2002 -)
Associate Dean for Information Technology (1999 -)
Professor of Economics (1979 -)
Union College



http://www.ct.union.edu

CONVERGING TECHNOLOGIES @UNION



CONVERGING TECHNOLOGIES @UNION

Bioengineering

Mechatronics

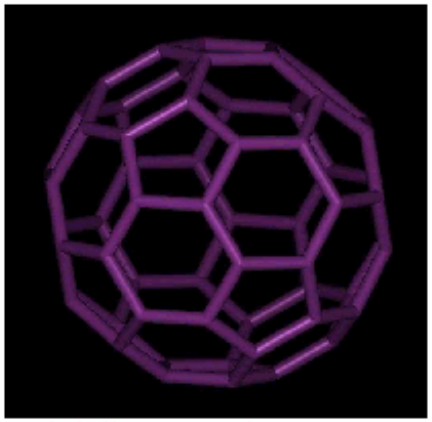
Nanoscience & technology

Pervasive Computing

Neuroscience

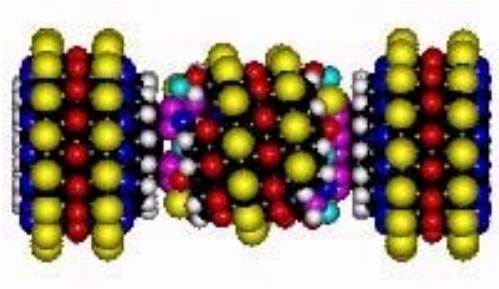
Environmental Studies

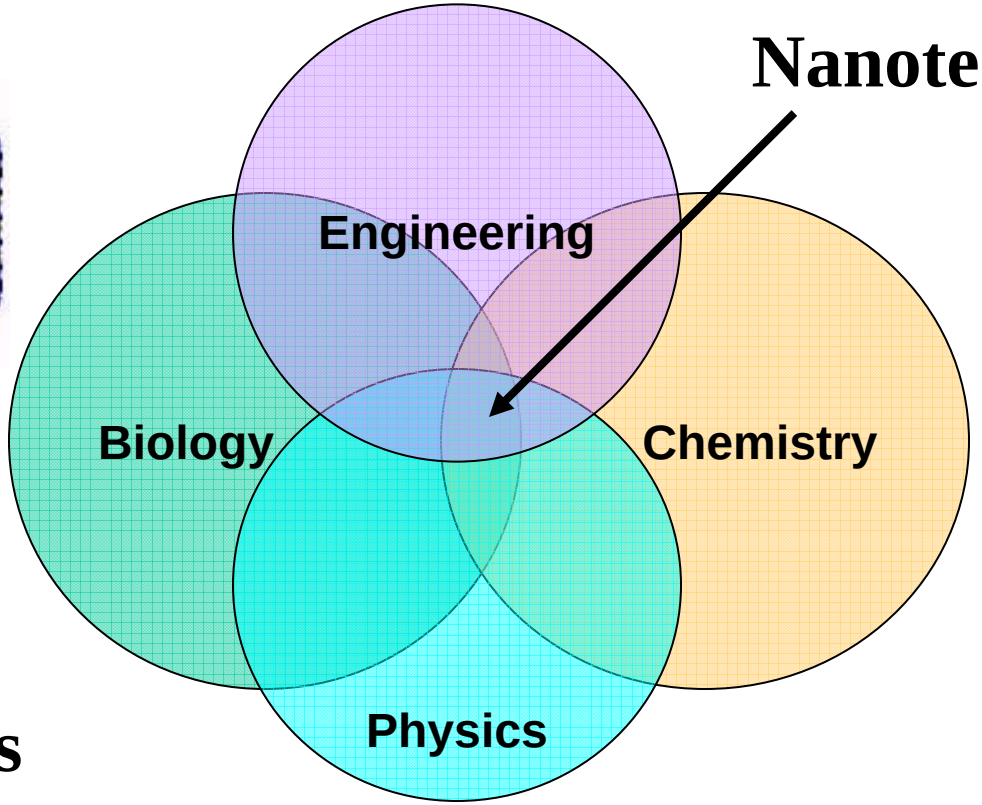
Arts and Technology



Buckyball representation.
Courtesy of Daniel T. Colbert, Center for Nanoscale Science and Technology, Rice University

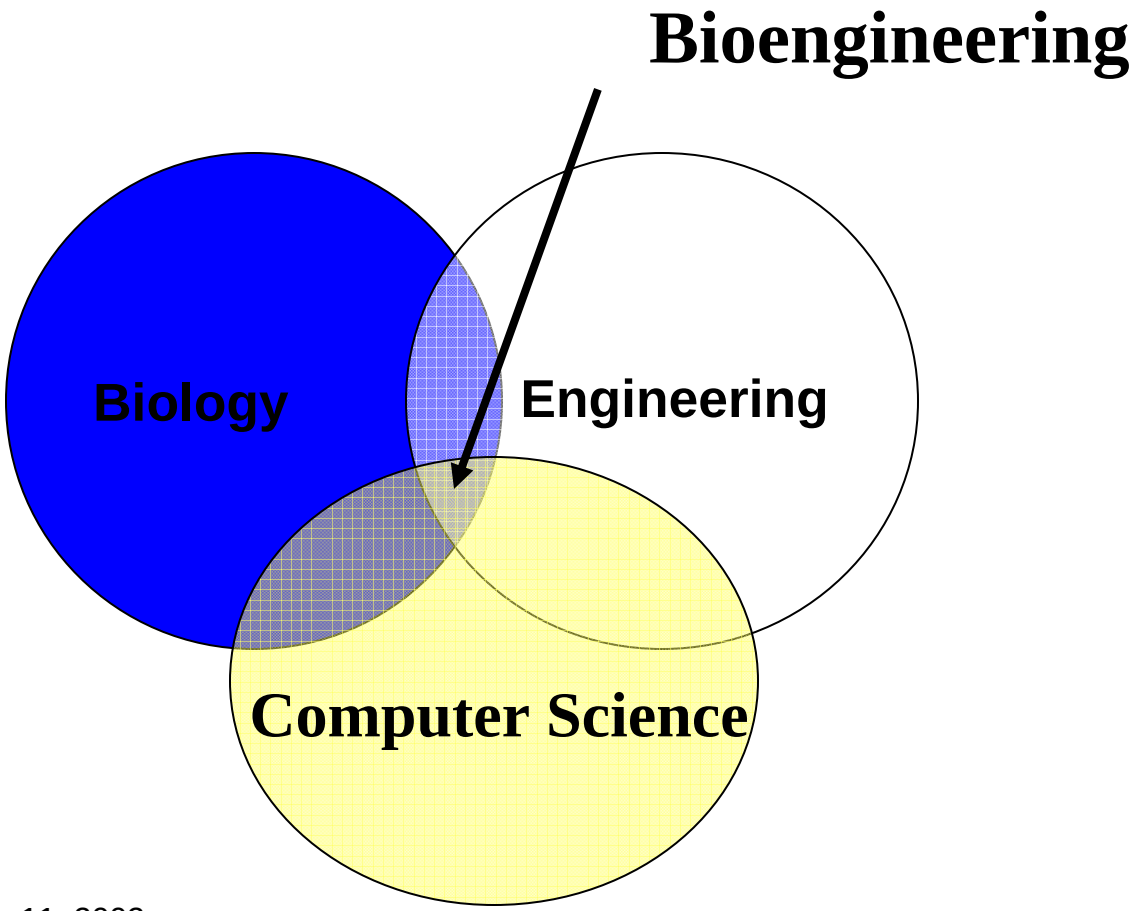
… a future in NANOTECHNOLOGY





Liberal Arts & Engineering

… a future in BIOENGINEERING



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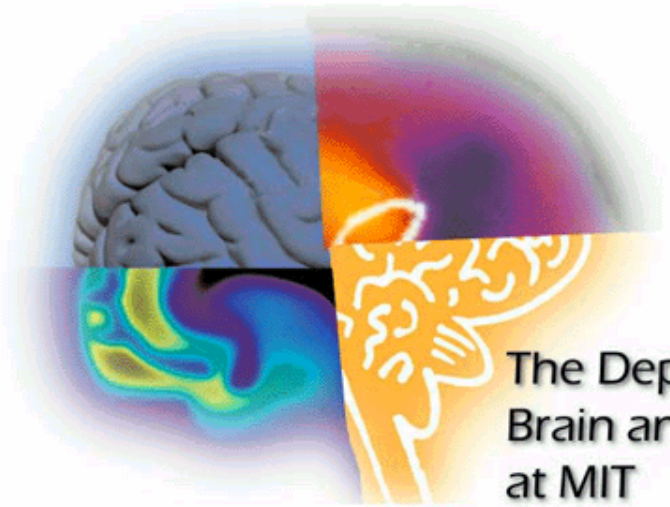


The Department of Brain and Cognitive Sciences at MIT

In the Department of Brain and Cognitive Sciences at MIT we study the brain and mind as a coherent theme, working to understand cognition - its processes, and its mechanisms at the level of molecules, neurons, networks of neurons, and brain modules. We span a very large range of inquiry into problems of brain and mind, and our work bridges many different levels of analysis, including molecular and cellular neuroscience, systems neuroscience, computational neuroscience, cognitive science and cognitive neuroscience. We have a tradition of outstanding education, research and scholarship, and a clear vision for our future.

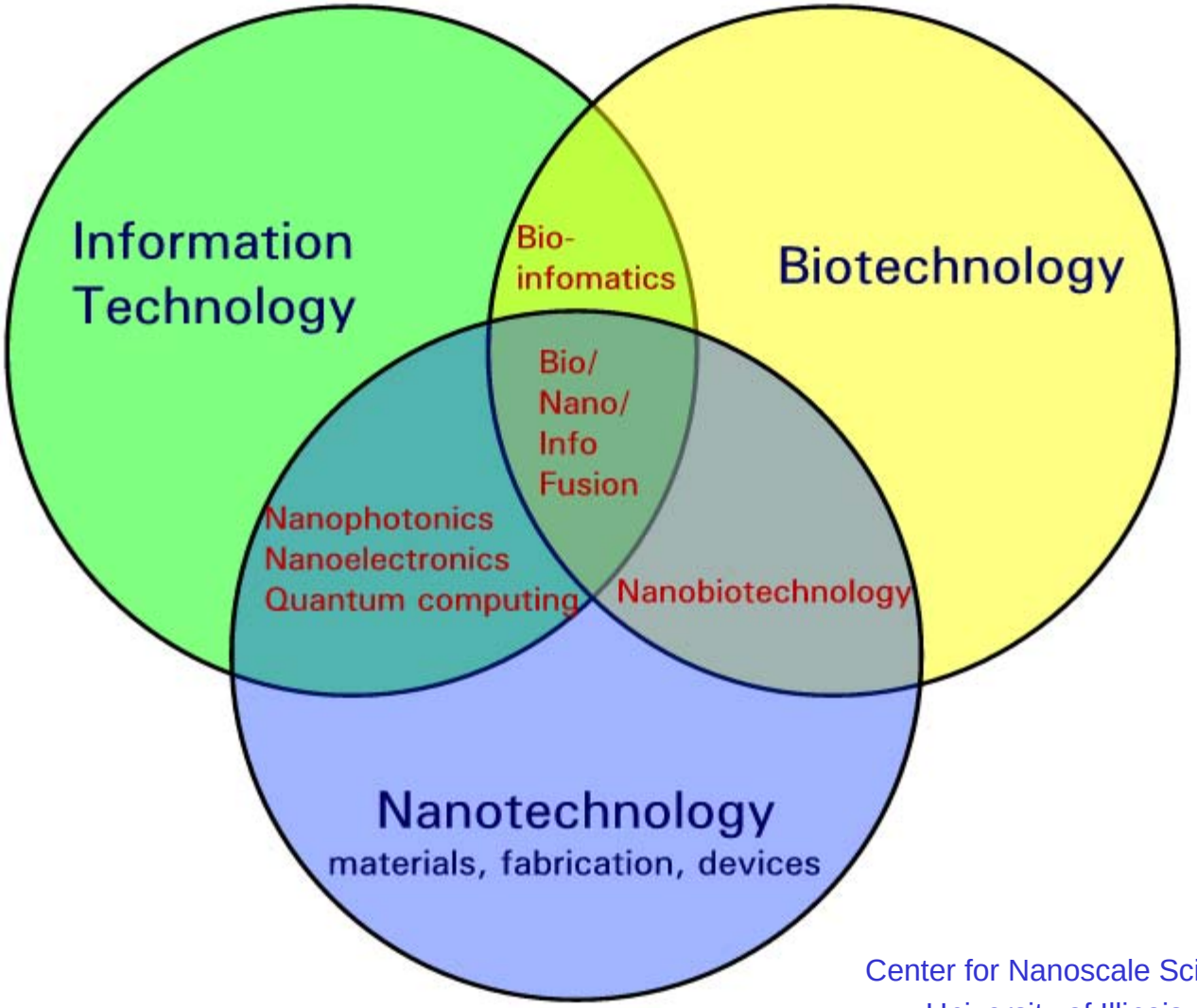
It is widely recognized that neuroscience and cognitive science are going to be the most exciting scientific fields throughout the next several decades and important areas of growth for MIT in the next 10 to 20 years. We believe our Department is uniquely positioned to be the leader in these fields.

Massachusetts Institute of Technology
Department of Brain and Cognitive Sciences
77 Massachusetts Avenue

Internet

Start 8:34 PM

Advances at the Confluences of Technologies



Dr. Ilesanmi Adesida
Center for Nanoscale Science and Technology
University of Illinois at Urbana-Champaign

Implementing CT

Four (plus) working groups; developing courses & programs

(ESC – 016)

External support

(Mellon, NSFx3, IBM, GE, Albany Molecular, SUNYA, AMC)

CT Alumni advisory board

Retreats – S.W.O.T.

Center for Converging Technologies

Strengths

CONVERGING TECHNOLOGIES @UNION

Goodwill and positive thinking; high level support

Plan for Union; new LA faculty positions; facilities (some)

Strong Gen Ed program; experience with ID programs (some)

Open campus culture for faculty and students

Good campus resources for student and faculty research

Good geographic location

Disciplinary strength (S or W?)

Strong students, especially in science and engineering

Weaknesses

CONVERGING TECHNOLOGIES @UNION

Conflict between traditional disciplines and ID work (FRB)

Ensuring sufficient buy-in from students, faculty (communication)

Funding and support:

- number of faculty
- space and equipment

Ensuring program quality – both curricular & research

- spreading too thin? Sacrifice fundamentals?

Opportunities

CONVERGING TECHNOLOGIES @UNION

Alumni base (specific and general)

Funding opportunities – government, private, foundation

Strong external support for ID programs (Newsweek; Chronicle)

Geography (IBM, SUNYA, GE, AMC)

Unique nature of program

- "Glory for Union"
- Exportable
- External collaboration opportunities
- Opportunity to teach entrepreneurial skills

Threats

Is CT a fad/intellectually viable?

Expense – programmatic, capital needs

Liberal Arts in the college market

- Union's image to world
- Liberal Arts colleges in general
- size of Union College

Summary

CONVERGING TECHNOLOGIES @UNION

Biggest opportunity:

- Combination of extraordinary internal and external inducements to develop ID-CT programs

Biggest hurdles:

- Developing the administrative structure to support interdisciplinary teaching and research, while maintaining core disciplinary fundamentals
- Securing adequate resources (grants, partnerships)
- Actively involving more people from Hum. & Soc Sci.

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Next Frontiers

F. Scott Schafer for Newsweek

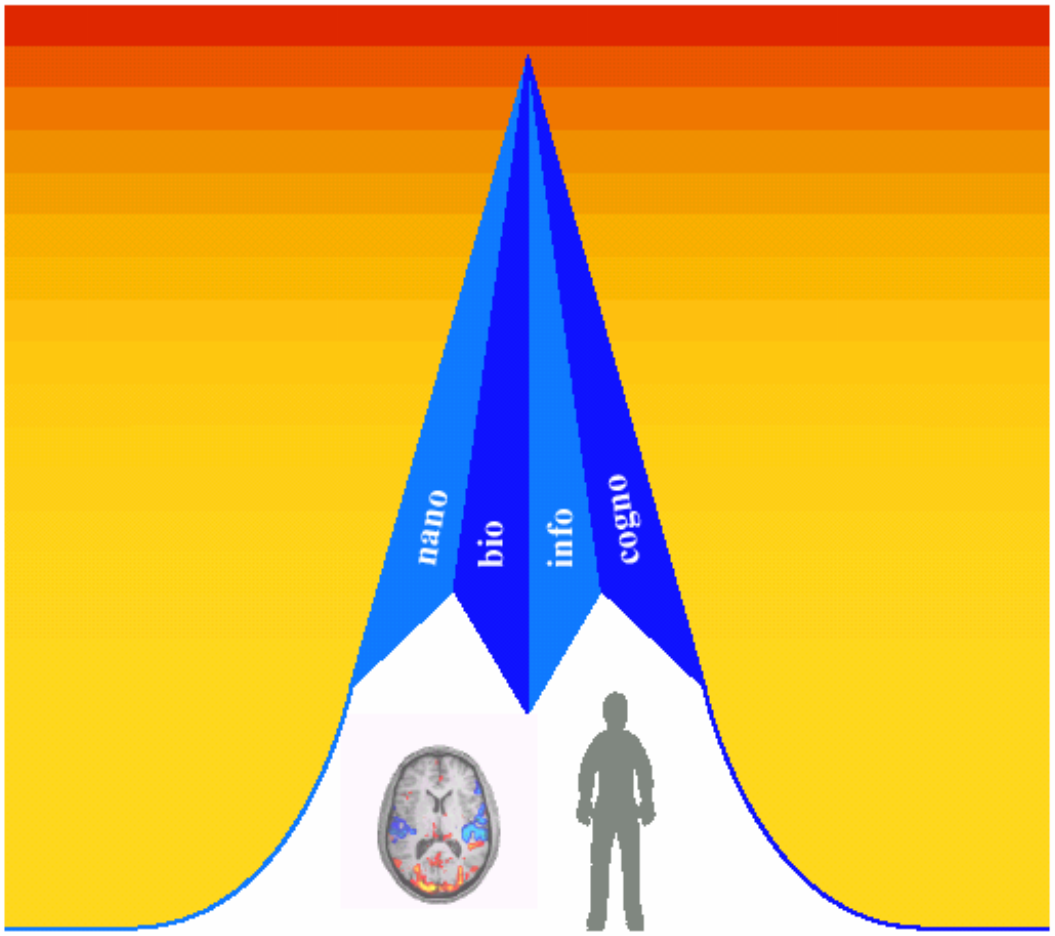
Summary of Federal Nanotechnology Investment

[$US millions]

Dept/Agency	FY 2000	FY 2001	FY 2002 (Request)
Department of Defense	70	110	133
Department of Energy	58	93	97
Department of Justice	0	0	1.4
Environmental Protection Agency	0	0	5
NASA	5	20	46
National Institutes of Health	32	39	45
National Institute of Standards and Technology	8	10	17.5
National Science Foundation	97	150	174
Total	270	422	518.9

Source: National Science Foundation

CT f

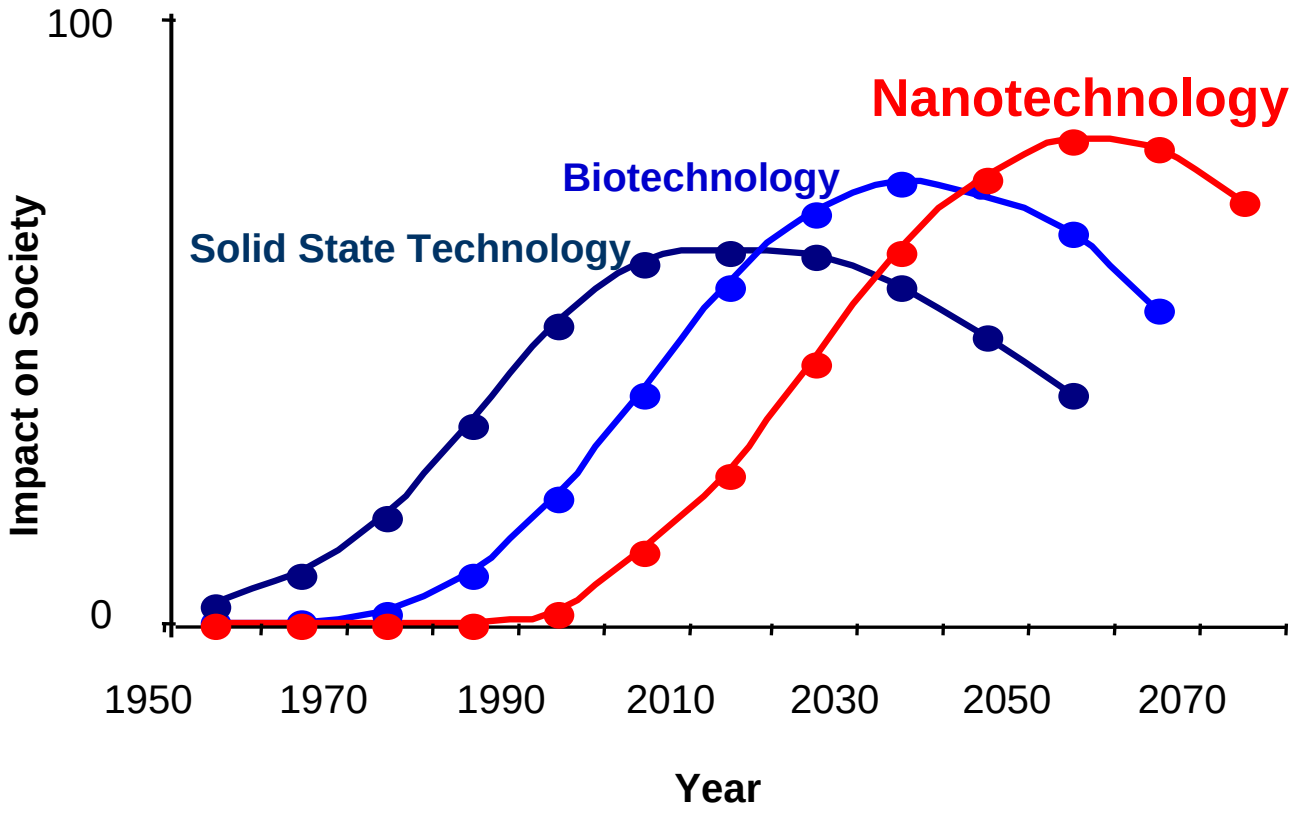


CONVERGING TECHNOLOGIES FOR IMPROVING HUMAN PERFORMANCE

June 2002

http://itri.loyola.edu/ConvergingTechnologies/

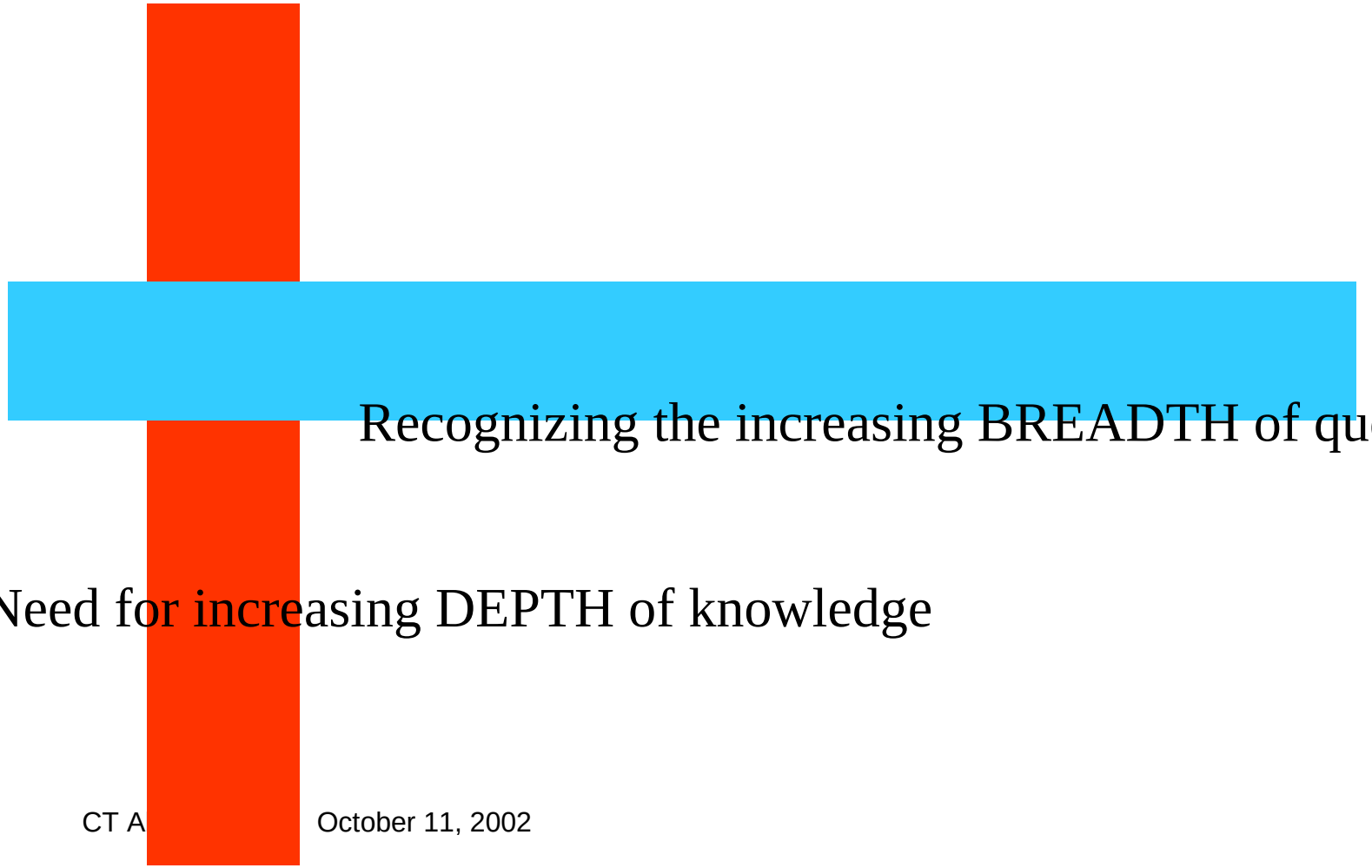
Nanotechnology, "The Next Industrial Revolution" *Dr. R. Siegel*



•"Seeing an old industry in a new way"
Phil Jones, V P Technology, Imerys

Source: ten Wold 1998

HYPE OR PARADIGM SHIFT?



Recognizing the increasing BREADTH of questions

Need for increasing DEPTH of knowledge

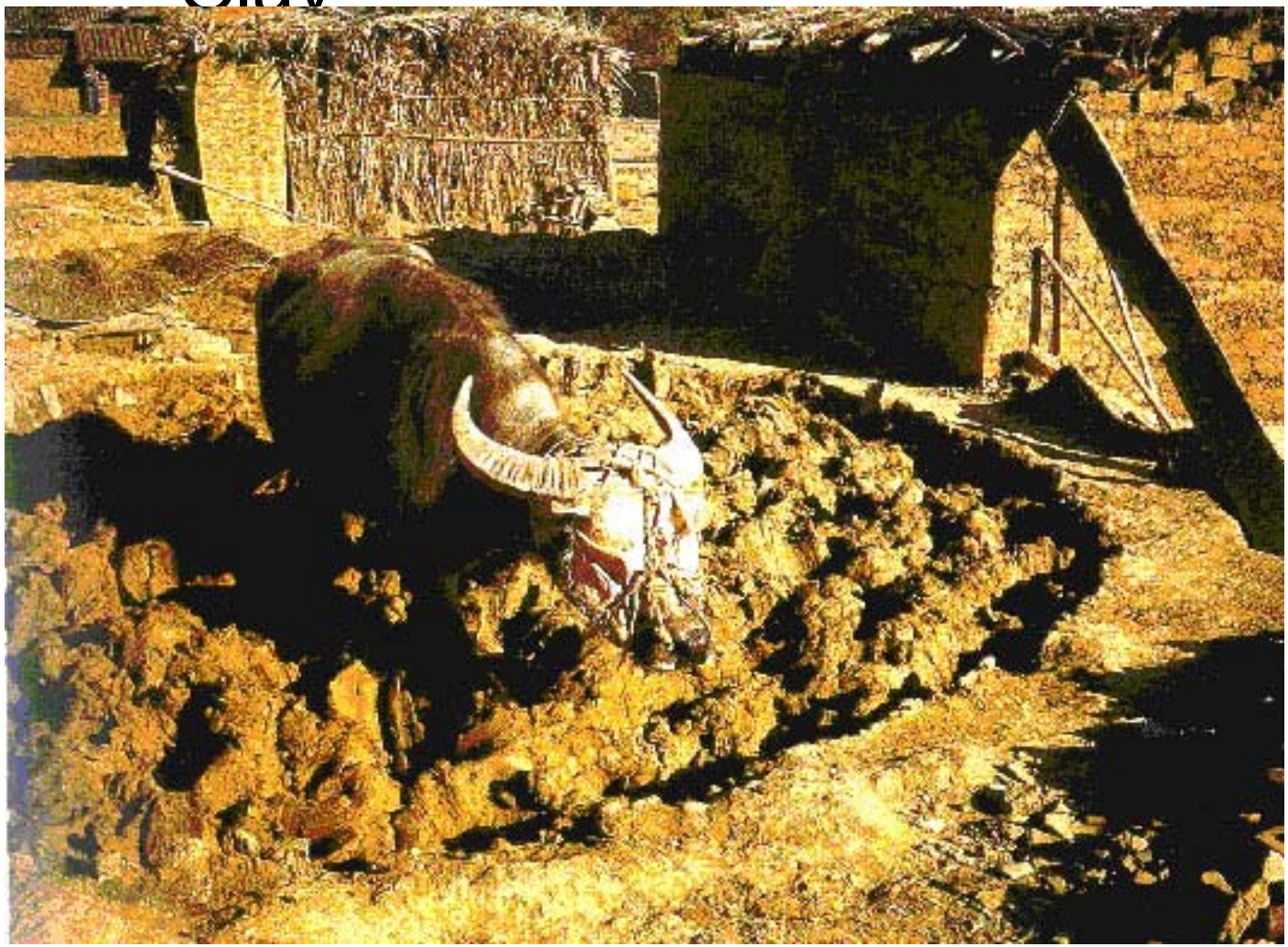
The basis for the policy is rooted in the significant and rapid changes that have occurred in the civil engineering profession. Some of these changes include the following:

- **Onset of globalization**
- **Rapid rise in information technology**
- **Diversification of society**
- **Explosion of knowledge & technology in engineering & construction**
- **Enhanced public awareness and involvement in engineered projects**
- **Complexity of civil infrastructure systems within the United States**

These changes, along with a national trend of reduced credit hours for the bachelor's degree, have created an untenable situation. Civil engineers are expected to possess simultaneously greater breadth of capability and specialized technical competence than that required of previous generations. With fewer credits in the civil engineering curriculum, it will become increasingly difficult for civil engineers to do more with less. Enter Policy 465.

Clay has many uses

Clay



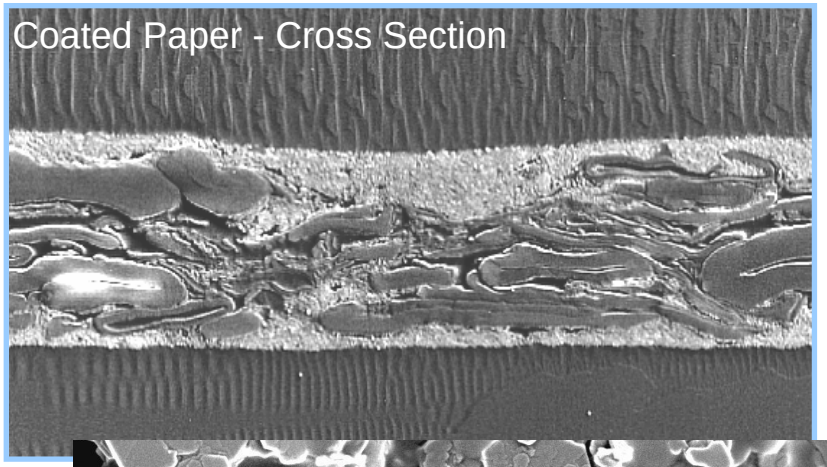
Water Buffalo Make-down system

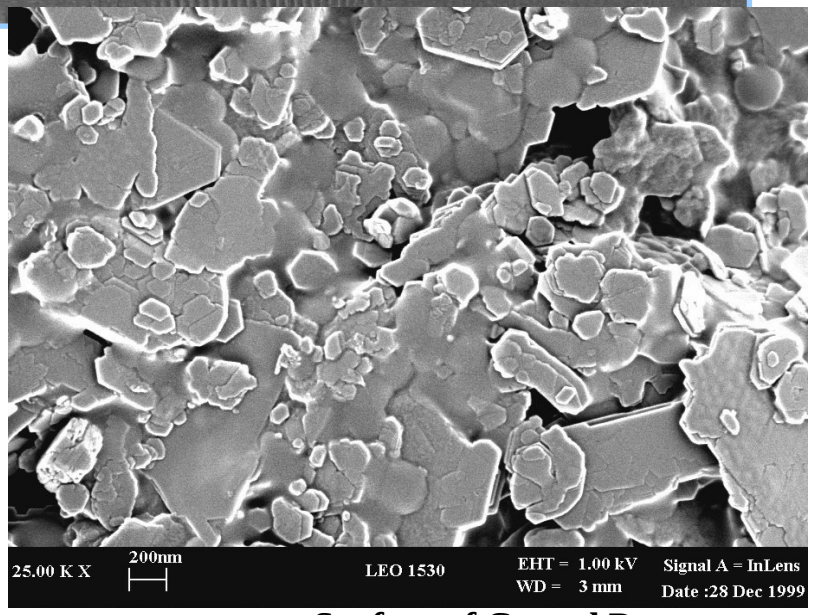
•"Seeing an old industry in a new way"
Phil Jones, V P Technology, Imerys

http://www.nanofab.psu.edu/education/nsf-nue-program.htm

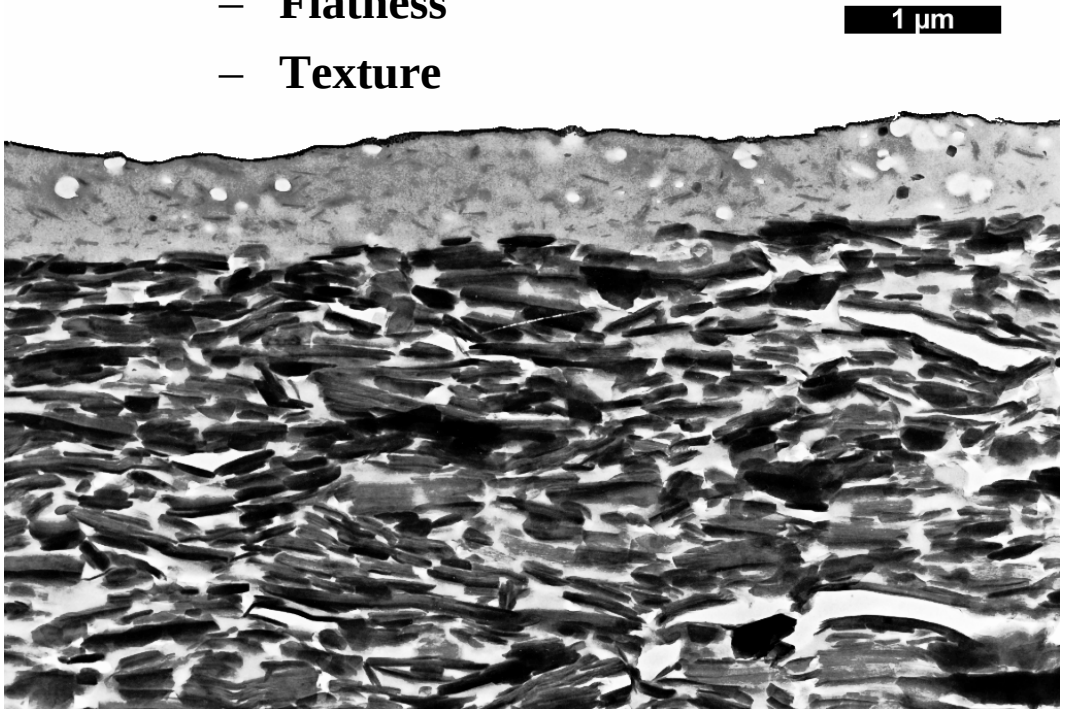
Coated Paper

- **Interaction of Light**
  - **Brightness/Colour**
    - **Colour more demanding of uniformity**
  - **Opacity**
  - **Gloss**
  - **Micro-gloss/Mottle**
  - **Flatness**
  - **Texture**





Surface of Coated Paper

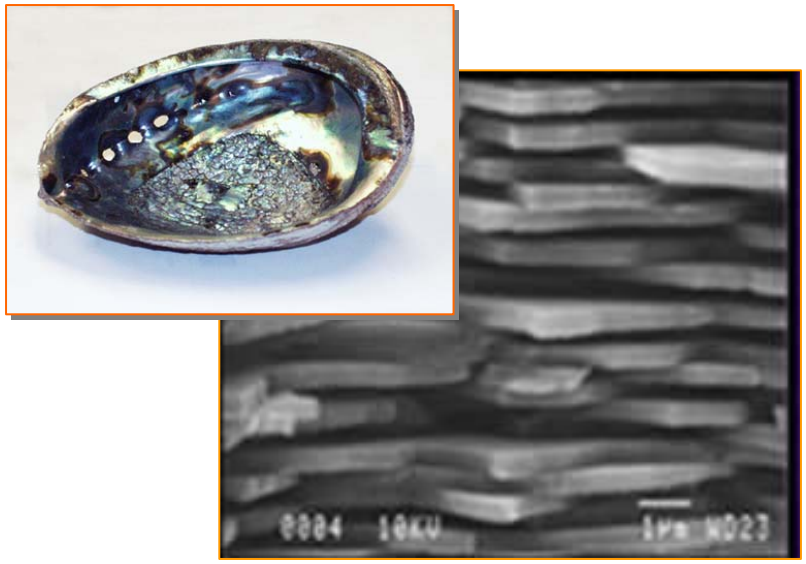


Cross-section of Paper coating

•"Seeing an old industry in a new way"
Phil Jones, V P Technology, Imerys

Bio-mimetic Processes Leveraging Bio-Technology

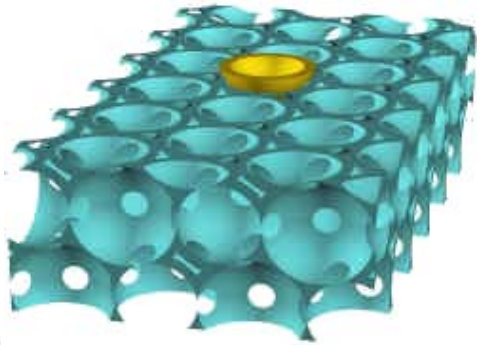
Light interacts with features similar in size with its wavelength



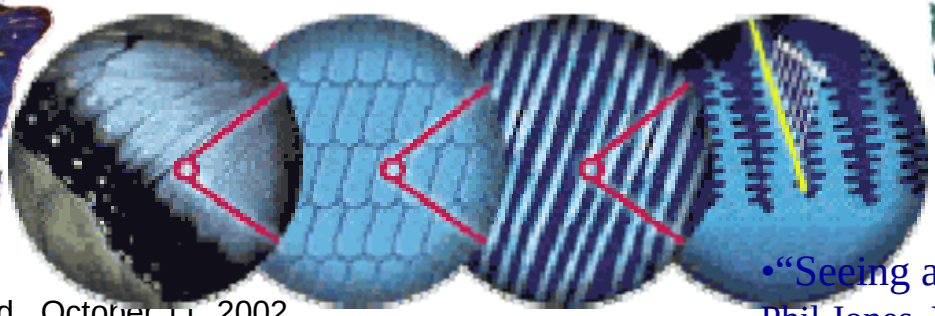
Source: Belcher et al 1999

Photonics Developing New Materials to interact with Light in Precise Ways

Inverse Opal



Source: Busch & John 2000



•"Seeing an old industry in a new way"
Phil Jones, V P Technology, Imerys

a) New **materials designed to have superior properties** (stronger, lighter) using materials with nanoscale dimensions will lead to **faster, cheaper, and safer transportation**.

b) **Improved catalysts** can reduce or eliminate the emission of pollutants from engines that lead, for instance, to smog.

c) **Miniature sensors and machines** will be incorporated in ever increasing numbers within structures, engines and other components to provide better understanding of their condition and detect and **report early signs of wear**.

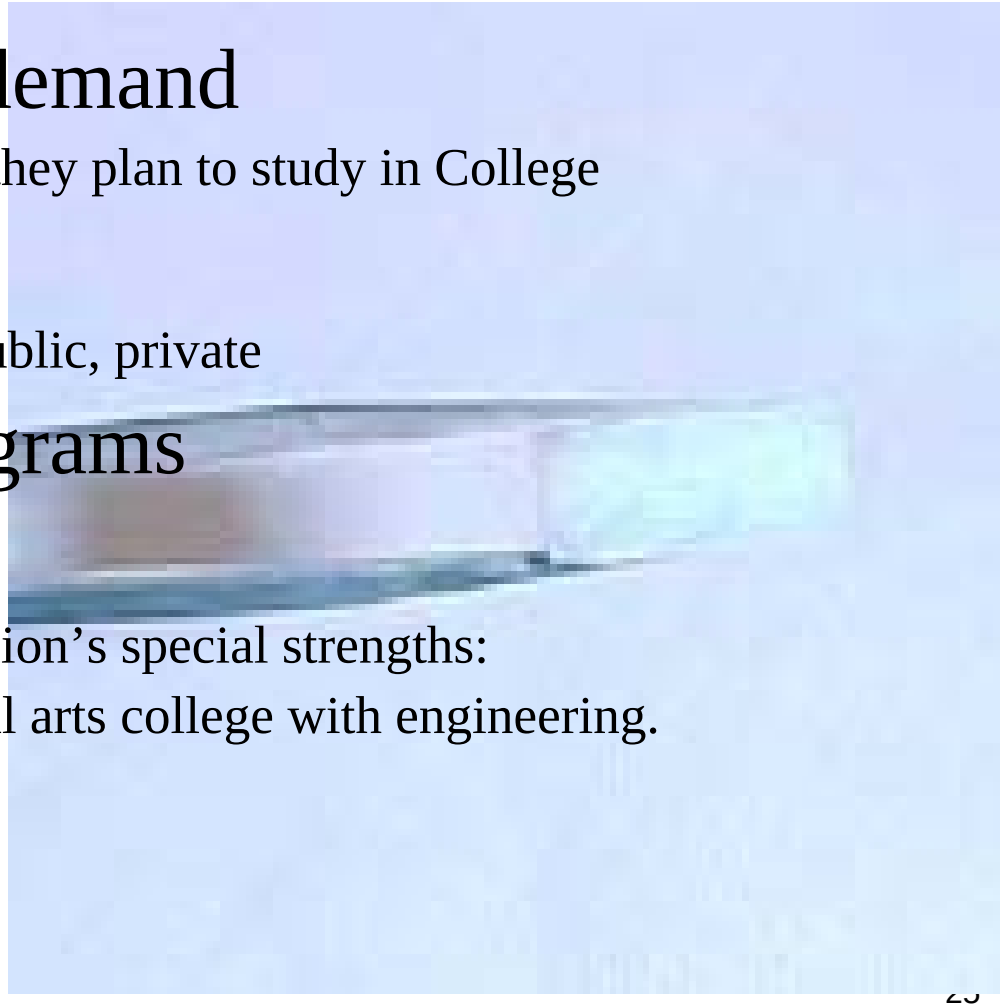
d) **New photonic nanodevices** can replace the heavy and costly RF transmission equipment on board aircraft, ships, or satellites or be exploited for inexpensive **remote control** of vehicles.

e) Very small **chemical sensors** with parts smaller than a human hair can now be designed to **detect trace chemicals** with sensitivities far higher than previously possible.

At Northwestern University a team of scientists, engineers, and transportation experts has been assembled to work in these areas. **Breaking through the traditional barriers which isolate researchers into particular disciplines**, they are working in research teams to develop new applications of nanotechnology in transportation as well as move these applications from the laboratory into the marketplace.

The last slide

- Student and faculty demand
  - –ask a HS junior what they plan to study in College
- Support
  - – internal, external; public, private
- Flexibility of ID programs
- Marketing
  - –takes advantage of Union's special strengths:
  - an undergraduate liberal arts college with engineering.



Penn State University

Nanofabrication Manufacturing Technology [NMT]

nmtpartnership@psu.edu

- Taking the High-Tech Road
- Facilitating Learning
- The Nanofabrication Facility
- FAQs on NMT: The Field and The Program
- Financial Assistance
- Additional Information

ALBANY NanoTech

October 10, 2002

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centers and programs
infrastructure and facilities
technology focus
school of nanosciences and nanoengineering
business acceleration

Search

UNIVERSITY AT ALBANY

Albany Symposium on Global Nanotechnology
Lake George, NY.
September 11-13 2002

Albany Nanotech - Leading the Nanotechnology Revolution

Albany NanoTech is a global research, development, technology deployment and education resource supporting accelerated high technology commercialization and job creation through leveraged partnerships between business, government and academia.

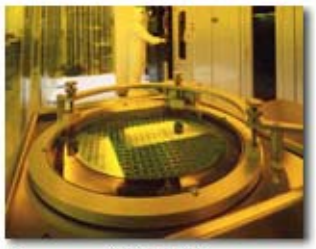
Albany NanoTech complex with Business Incubator/Technology Accelerator on left, 300 mm wafer R&D fab in center (both under construction) and existing 200mm wafer R&D facility on right.

Nanotechnology innovations are driving the dramatic growth in the information technology, biomedical and energy industries.

Albany NanoTech at the University at Albany - SUNY serves as an integration point bringing together the nanoelectronics, nanosystems and nanophotonics technologies that will power the nanotechnology revolution.

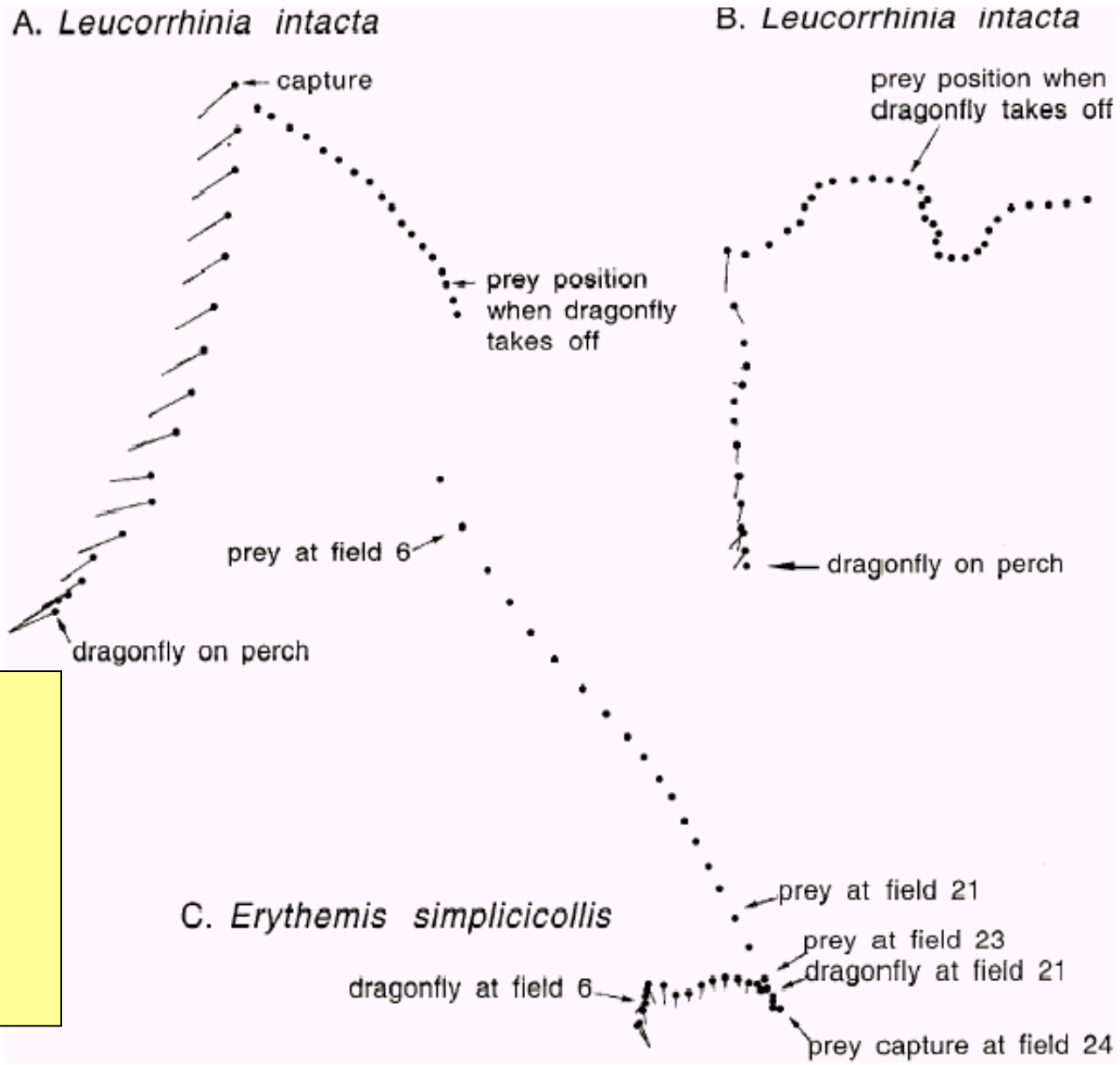
Center of Excellence in Nanoelectronics is announced. [enlarge]

Class 10 clean room occupied with 200 mm wafer metrology tools.



Micrascan II DUV Stepper Scanner Photolithography System

Fig. 2A–C Three examples of prey capture flights. *Filled circles* indicate prey positions and *filled circles with tails* indicate dragonfly positions. *Arrows* indicate prey and dragonfly position at the start of the pursuit flight. Plotting interval: 16.7 ms. **A** *Leucorrhinia intacta*. Duration of prey capture flight = 283.3 ms (17 fields). **B** *L. intacta*. Duration of flight = 216.7 ms (13 fields). **C.** *Erythemis simplicicollis*. Prey does not appear on video until field 5. Dragonfly is moving away from the camera. Last view of prey before capture is field 23. Duration of flight: 400 ms (24 fields)



Multi-neuronal encoding of visual target information to direct flight in the dragonfly –
Prof. Rob Olberg

Rob Olberg, Biology

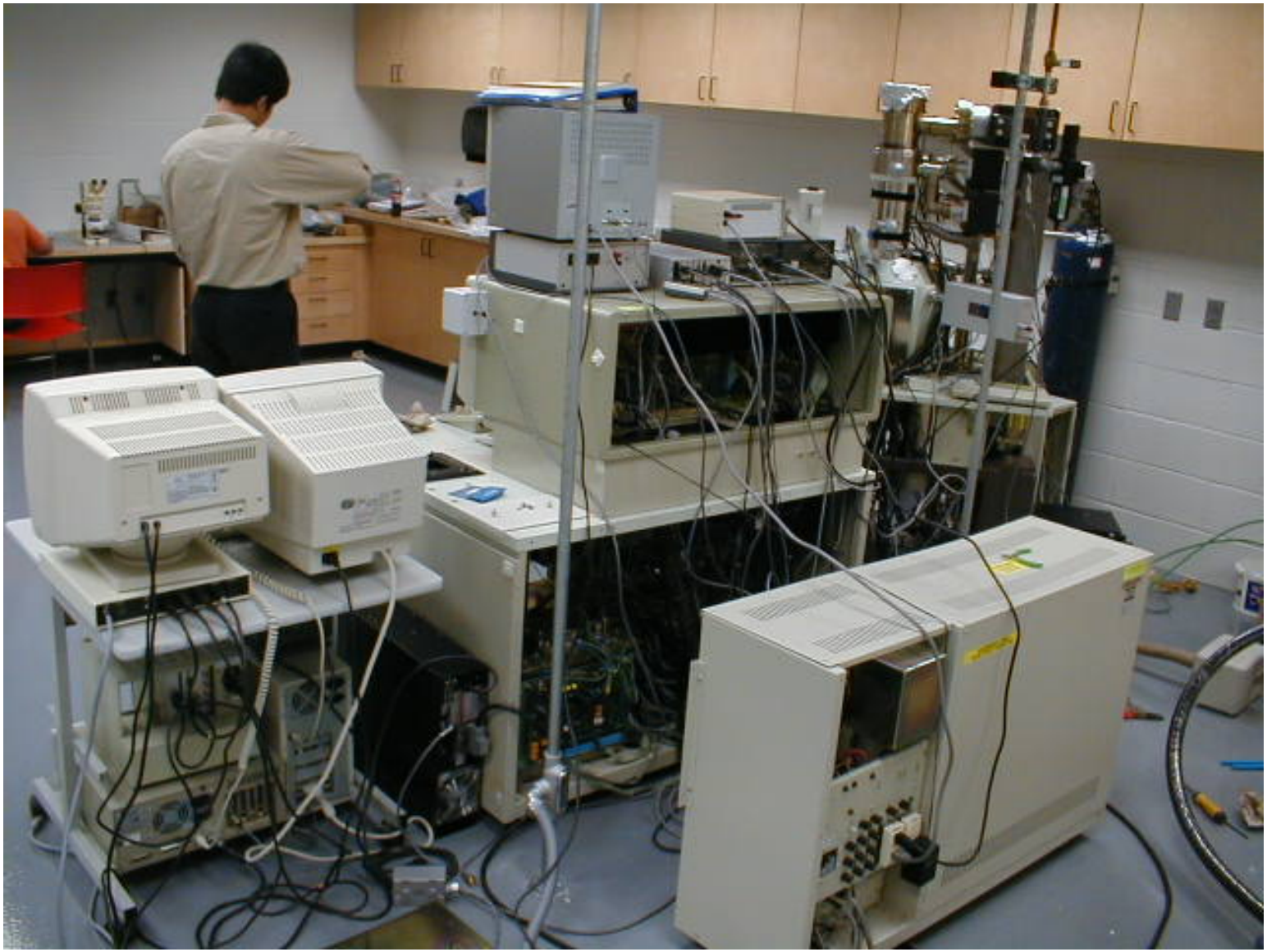
Multi-neuronal encoding of visual target information to direct flight in the dragonfly –

Impact on Converging Technologies at Union

NSF funding of this proposal will accelerate and enhance the development of this new initiative. The students from **biology and engineering** who will be brought together to focus their efforts on this project will form a **natural bridge among departments**.

Research teams consisting of students and faculty members from different traditional disciplines, and focused on a common problem, such as the neural control of interception flight, could become a model for CT in an undergraduate institution.

($214K NSF 3-year grant began September, 2002)



Rebecca Wolfe, ’03 Chem major, French minor
Research project: Investigation of Doped Sol-Gels

Alumna observation

… on my team of five people (which builds relational databases for commercial finance end-users), we have one person with a degree mechanical engineering; one mathematics; one communications; and two economics. So the trend has actually shifted - at least in our world - to having more people with diverse academic backgrounds, rather that just the "IT Computer Geeks" of the past model.

I'm glad to read that your "interdisciplinary approach" is getting great press and attention that it deserves. Liberal Arts degrees are sometimes considered impractical for the "real world." But When combined with engineering/ computer science courses, they become ever more valuable...and vice versa!

Graduate from the Class of 1996
ID degree, Economics-German
Employed by GE Capital

Science and Technology Literacy

MONDAY, OCTOBER 7, 8PM
THEATRE OF IDEAS

The Dark Side of the Universe
David Helfand

Miller Theatre proudly introduces its newest addition to the *Theatre of Ideas:* a six-evening series featuring some of Columbia University's top scientists. Each evening, a different distinguished professor will lead the audience through a major scientific topic, using highly visual presentations and everyday language. This is a terrific opportunity for the public to confront some of Columbia's great minds.

David Helfand
Chair, Department of Astronomy

http://www.columbia.edu/cu/arts/miller/series/ideas.html

HP	CALL #	COURSE	TITLE	CARD	LOCATION & MEETING TIME	INSTRUCTOR
	Cls 002787	ESC-016-01	Fundamentals of Engg I W/Lab		OLIN 115 TTH 09:15AM-10:05AM OLIN 115 T 10:15AM-11:05AM	Wicks, F.

Number of students = 20

Student Name	Class	Advisor Name	Major
Agostino, Aaron L	FR	Wicks, F.	Engg Unspecified
Boyer, Michael W	FR	Wicks, F.	Engg Unspecified
Davis, Joshua S	FR	Wicks, F.	Engg Unspecified
Dunton, Robert A	SO	Lawson, M.	Engg Unspecified
Farley, John P	FR	Wicks, F.	Engg Unspecified
Frumess, Barnaby H	SO	McFadden, T.	LA Humanities
Glover, Samantha L	FR	Wicks, F.	Engg Unspecified
Hammond, Jonathan M	FR	Wicks, F.	Engg Unspecified
Hoeffner, Stephen J	FR	Wicks, F.	Engg Unspecified
LaRocca, Alaina M	FR	Wicks, F.	Engg Unspecified
Moffitt, Thomas P	FR	Wicks, F.	Engg Unspecified
Nealon, Christopher A	FR	DeBono, K.	Engg Unspecified
Nonna, Timothy J	FR	Wicks, F.	Engg Unspecified
Perrin, Nathan A	FR	Wicks, F.	Biochemistry
Schulman, Jerome S	FR	Cervone, D.P.	LA Sciences
Simon, Trevor H	FR	Teixeira, P. Niefield, S.	Mathematics
Spoor, Daniel J	FR	Wicks, F.	Computer Science
Stone, Andrew D	FR	Wicks, F.	Engg Unspecified
Wasserman, Robert J	FR	Wicks, F.	Engg Unspecified
Yost, Kristina A	FR	Heinegg, P.	Political Science

Last updated: 09 October 2002 at 23:26:33

ESC - 016

Goals

Breadth

Depth

Literacy

Relevance

No. 419:
ELIPHALET NOTT

by John H. Lienhard

…At 31 he was made president of Union College. Religion and classics were all they taught at Union, but Nott had other ideas, "Go with Newton," he cried in his inaugural address. "Span the heavens and number and measure the orbs."

He added scientists to the four-man faculty. … By 1830, Union was our third largest college. Only Harvard and Yale were bigger. Nott started a basic academic reform. He was first to divide the curriculum. You could now major in either science or classics. Students flocked to the science program. …

http://www.uh.edu/engines/epi419.htm

UNION COLLEGE

MISSION STATEMENT

Union, a college of liberal arts and engineering, is committed to three basic beliefs about individual development through learning.

First, the College believes it is obligated to create in students a lifelong commitment to truth and joy in learning, so that students weave the pursuit of knowledge into the fabric of their lives, and develop an historical awareness and intellectual integrity that will support a resolve to defend the dignity of all people.

Second, the College believes that knowledge of the self is an important goal of liberal education, a goal that is best attained as one learns about other cultures and one's own. Consequently, we offer extensive opportunities for study abroad, and curricular and residential experiences that enable students to see the ways in which they are part of something larger—a community, a culture, and a world of many cultures.

Third, the College believes that the close relationship between its faculty and students motivates to learn, as manifested most clearly in undergraduate research and other forms of independent study. We therefore maintain a community of inquiry, discourse, and experiment in which it is clear that scholarship and teaching are parts of a single enterprise. Consistent with the belief that professional education is best done in the context of liberal arts undertaking, the College supports the oldest such engineering program in the nation and a selected group of professional programs at the graduate level.

In many respects, then, Union is distinctive, but in an important sense it is like other good liberal arts colleges, with strong departments, staffed by a scholarly faculty with an exacting care for the students' accuracy of understanding and for the improvement of their ability to do their work well. One conviction underlies life at Union, its common beliefs, and its long heritage: in citizenship as well as work, a liberal education is the best path to personal fulfillment.

Education of Nanoscientists, Nanotechnologists, and Nanofabrication Technicians

The United States faces the daunting challenge of attracting enough of the best graduate students to the physical sciences and engineering disciplines. Under present conditions, far too few good students are attracted to the fields relevant to nanotechnology. To some extent, this is a problem faced by all of the sciences, but the problem is especially acute for nanotechnology because a very large number of talented scientists, engineers, and technicians will be needed to build the nanotechnology industries of the future, and these professionals will require an interdisciplinary perspective.

Development of nanotechnology will depend upon multidisciplinary teams of highly trained people with backgrounds in biology, medicine, applied and computational mathematics, physics, chemistry, and in electrical, chemical, and mechanical engineering. Team leaders and innovators will probably need expertise in multiple subsets of these disciplines, and all members of the team will need a general appreciation of the other members' fields. Developing a broadly trained and educated workforce presents a severe challenge to our four-year degree and two-year degree educational institutions, which favor compartmentalized learning. Because current educational trends favor specialization, there must be fundamental changes in our educational systems. However, introducing new degree programs in nanotechnology that provide a shallow overview of many disciplines, none in sufficient depth to make major contributions, may not give students the training that is needed to meet the future challenges. The right balance between specialization and interdisciplinary training needs to be worked out through innovative demonstration programs and research on the education process and workforce needs.

http://itri.loyola.edu/ConvergingTechnologies/