Creating a Culture for Innovation

Arthur B. Ellis
Vice Chancellor for Research
University of California, San Diego
What’s at Stake

Globalization of science and technology
COSEPUP Report

“Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future”
Grand Challenges

Research
Education
Human Resources

Undergraduate Research
Discovery: The Case for Support of Basic Research
Popular Culture
Updating the Curriculum: Ferrofluids

The synthesis and characterization of nanoscale materials.

Synthesis of Ferrofluid
Precipitate magnetite (~10 nm particle size)
\[2 \text{FeCl}_3 + \text{FeCl}_2 + 8\text{NH}_3 + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 8 \text{NH}_4\text{Cl}\]
Add NR$_4$OH surfactant
Add 4.0 mL of 1M \( \text{FeCl}_3 \) and 1.0 mL of 2M \( \text{FeCl}_3 \) solution to a 100 mL beaker. Add a magnetic stirring bar and begin stirring.

Continue stirring throughout the slow addition over a period of 5 minutes of 50 mL of 1.0 M aqueous \( \text{NH}_3 \) solution. After an initial brown precipitate, a black precipitate will form (magnetic). One way to accomplish a slow addition is to drip the ammonia solution from a buret or separatory funnel or by using a dropper to transfer the solution. CAUTION: Although 1 M \( \text{NH}_3 \) is fairly dilute, \( \text{NH}_3 \) is a strong base.
• Integrating research into the curriculum, undergraduates developed a one-step-two-reactant approach to the synthesis of nearly monodisperse silver nanowires based on wet chemical methods.

Scanning electron microscopy reveals that the selectivity for nanowires over nanospheres is 100%. The nanowires are about 200 nm in diameter and 2500 nm long.
Undergraduate Research Collaboratives

Exploring the Concept of Undergraduate Research Centers
A Report on the NSF Workshop

March 30 - April 1, 2003
National Science Foundation
Arlington, Virginia

NSF Pilot Program, Division of Chemistry
Strategy for Expanding Undergraduate Research

Target Audience

First- and second-year college students

All postsecondary institutions

Principles

New models and partnerships that provide scalability

Real research: Cutting-edge tools, methods; process of science

Promoting an understanding of and interest in research

Academic year involvement
Center for Authentic Science and Practice in Education (CASPiE)
Gabriela Weaver, PI

Purdue Univ.
Univ. Illinois-Chicago
Ball State Univ.
Northeastern Illinois Univ.
Chicago State Univ.
College of DuPage
Harold Washington College
Moraine Valley Community College
Olive-Harvey College

Other URCs: Consortia led by U. South Dakota, Ohio State University, Univ. Texas-Austin, and Harold Washington College
A 2006 URC: Research led by Community Colleges

TRAILBLAZERS Students Salome Njeri (left) and Angel Butron are currently doing research with Dr. Thomas Higgins at Harold Washington College. *Chemical & Engineering News*, Oct. 16, 2006. Courtesy of Thomas Higgins
Cyberinfrastructure

http://cseo.net
Distributed and Simulation-Informed Experiments

Folding@Home

V. Pande, MCB 02-38342

“Citizen Science”
Remote and Networked Instrumentation

Workflow for CASPiE Instrument Network

CHE 04-18902

operations within different colored regions occur at different times
Databases and Data Mining

Davidson College, DBI 04-08386
http://www.bio.davidson.edu/projects/magic/magic.html
Cyber Site Visit
Communicating the Value of Undergraduate Research
Scientometrics
Mapping All of Science
Kevin Boyack, Sandia National Laboratories

1.07 M papers
24.5M references
7300 journals

Their methods found 671 clusters (i.e. disciplines, indicated by dots)

http://ella.slis.indiana.edu/~katy/events/05-iy-tech-transfer.ppt
Science Funding – NSF or NIH?

http://ella.slis.indiana.edu/~katy/events/05-iu-tech-transfer.ppt
Science Funding – NSF

http://ella.slis.indiana.edu/~katy/events/05-iu-tech-transfer.ppt
Science Funding - DOE

http://ella.slis.indiana.edu/~katy/events/05-iu-tech-transfer.ppt
2003 Map of Science
Where US Leadership is Strong
Relative share > 5:1

Courtesy of Richard Klavans
2003 Map of Science
Where US Leadership is Weak/Non-Existent
Relative share <2:1

Courtesy of Richard Klavans
Nanotechnology and the Map of Science

Kevin Boyack and Richard Klavans
UCSD (2004)

Circle size – number of papers
Circle color – relative vitality of papers
- dark orange – much higher than average (> 1.2)
- orange – higher than average (1.05 – 1.2)
- white – average (0.95 – 1.05)
- light blue – lower than average (0.8 – 0.95)
- dark blue – much lower than average (< 0.8)

Slide courtesy of Kevin Boyack,
Sandia National Laboratories
Trends in the Ceramics Portfolio
Mapping the Evolution of Co-Authorship Networks
Won 1st price at the IEEE InfoVis Contest
(Ke, Visvanath & Börner, 2004)

Color Code:

Line color
86 - 90
91 - 95
96 - 00
01 -

Node color
0 - 9
10 - 19
20 - 29
30 - 39
40 - 49
50 -

line color ~ year of first time co-authorship
node color ~ number of citations
node size ~ number of papers
Tools for Managing the Research Portfolio

“Research Intelligence”

Jerry Sheehan, Calit2, UCSD and UCI

• Data mining and visualization
• Proliferation of electronic publications including public on-line databases (NIH, NSF, Public Library of Science, USPTO)
• Evolution of the Web, Web 2.0

Apply the lessons learned from the private sector’s “business intelligence” efforts to research, creating “Research Intelligence”
Calit2 Research Intelligence: Federal Funding Opportunities

October 2, 2006

- Innovation: Create a “Data Channel” of Federal Funding
- Application: Better and Faster Knowledge of Grant Opportunities
  - Visualize in “real time” new funding opportunities.
- Tool Status:
  - Tools deployed for Calit2 principal investigator and program development: November 2006.
  - Make data available for UCSD campus, December 2006.

Treemap of One Day of Federal Funding Opportunities
Color indicates agency, Size indicates funding amount
More Information

ellis@ucsd.edu

Chronicle of Higher Education
April 14, 2006, p. B20

www.mrsec.wisc.edu/nano

Thanks to NSF, UW, and UCSD