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U.S. National Academies Promote Interdisciplinary Research

More than 150 people gathered last November in Irvine, Calif., at the second annual National Academies Keck Futures Initiative Conference. Each year's conference focuses on an interdisciplinary theme. November's conference, "Designing Nanostructures at the Interface between Biomedical and Physical Systems," attracted scientists, engineers, and medical researchers to explore the intersection of nanotechnology with their fields.

To encourage further interdisciplinary work on nanotechnology, the Academies announced the availability of \$1 million in seed grants—up to \$75,000 each—which will be awarded on a competitive basis to conference participants and their research partners in other disciplines to spur new lines of research identified at the conference between fields in areas related to nanotechnology. Grant recipients will be announced in April 2005.

"Nanotechnology creates new intersections between science, engineering, and medical researchers," said Harvey Fineberg, president of the Institute of Medicine. "The conference joined researchers from diverse fields. They forged teams, explored new ideas, and identified novel directions for research."

The centerpiece of the conference was breakout sessions in which 10 focus groups of researchers from different fields spent eight hours developing research plans to solve various problems in the field of nanotechnology. Among the challenges were building a nanosystem that can multiply and isolate RNA or DNA, developing a system to detect disease *in vivo*, and creating a biological system that will create a local hydrogen fuel source.

"Putting researchers from such diverse fields in a room together and asking them to address a problem was a remarkable experience," said Cherry Murray, senior vice president of physical sciences research at Bell Laboratories, Lucent Technologies, who chaired the conference planning and steering committees. "The purpose of this exercise was to enable researchers from multiple disciplines to connect with each other. The collaboration was inspiring."

Participants also presented posters describing their latest research, which covered such topics as an autoregulated, noninvasive insulin delivery system, biomedical imaging technology, gecko-inspired synthetic dry adhesives, and biodegradable nanofibers for tissue regeneration.

During the conference, the National Academies released its report, *Facilitating*

Interdisciplinary Research. The report is a comprehensive review of the promise of and impediments to interdisciplinary efforts which are increasingly becoming an integral part of research. It also provides recommendations for those who play a key role in strengthening interdisciplinary partnerships, including students, postdoctoral scholars, researchers, educators, institutions, funding organizations, professional societies, and journal editors.

"This report identifies steps that individuals and institutions can take to more effectively conduct, facilitate, and evaluate

interdisciplinary research programs and projects," said Nancy Andreasen, co-chair of the committee that wrote the report. Andreasen is the Andrew H. Woods Chair of Psychiatry at the University of Iowa and director of the MIND Institute in Albuquerque, N.M.

The committee urged academic institutions to explore new models that foster and reward interdisciplinary interactions. They should revise recruitment and hiring practices to reach across departments, placing greater emphasis on people with valuable interdisciplinary backgrounds. Promotion criteria should include methods

Electronics Industry Drives R&D in Finland

In 2003, expenditure on research and development (R&D) grew by almost €200 million in Finland to more than €5 billion, but is estimated to decrease in 2004 by nearly €100 million, according to Statistics Finland. The share of the electronics industry of the whole enterprise sector's R&D expenditure reached a record 56% in 2003 (see Table I). The underlying reason for the expected decline in R&D expenditures in 2004 is believed to be the electronics industry. The data, announced on December 3, 2004, were derived from Statistics Finland's assessment on R&D activity in Finland in 2003.

The R&D expenditure of business enterprises was slightly more than €3.5 billion in 2003. This represents a growth rate of 4.5%, whereas in 2002, the respective rate was 2%. The growth is explained by the electronics industry, which increased its R&D expenditure by €230 million while the total R&D spending of business enterprises went up by €150 million. Without the additional input of the electronics industry, business enterprises' R&D expenditure would have declined by nearly €80 million. The most substantial drop was in the chemical industry, where R&D spending fell from €322 million to €286 million.

In the university sector, R&D expenditures reached nearly €980 million in 2003, which represents 5.5% growth. It is estimated that the growth in 2004 will also amount to more than €50 million. The share of the university sector of all money invested in R&D has been increasing since the year 2000, according to Statistics Finland.

When compared internationally with countries participating in the Organisation for Economic Co-operation and Development (OECD), Statistics Finland found that the R&D share of the gross domestic product (GDP) is high in Finland. Among the OECD countries, only Sweden had a higher GDP share (4.3%) than Finland. The shares of Japan (3.1%), Iceland (3.1%), South Korea (2.9%), and the United States (2.7%) approached that of Finland. The share was the highest in Israel, where expenditure on R&D amounted to 4.7% of GDP in 2002. Finland accounts for only 0.7% of the total R&D expenditure of the OECD countries.

Table I: Business Enterprise R&D Expenditures by Industry for Finland, 2001–2003.

Industry	2001		2002		2003*	
	€ (millions)	%	€ (millions)	%	€ (millions)	%
Food	60.4	1.8	49.5	1.5	50.0	1.5
Textile, clothing, and leather	14.7	0.4	11.1	0.3	14.2	0.4
Wood processing	92.9	2.8	97.2	2.9	110.5	3.3
Chemical	288.0	8.8	321.6	9.5	271.4	8.0
Metal and mechanical	400.3	12.2	367.0	10.9	370.5	11.0
Electronics	1,700.6	51.8	1,732.1	51.3	1,777.3	52.6
Other	16.8	0.5	19.2	0.6	21.5	0.6

Source: Extracted from Statistics Finland; updated November 27, 2003.

*Estimate based on survey response and other calculations.

to evaluate interdisciplinary faculty and programs as well. The committee concluded that the process by which institutions evaluate interdisciplinary research programs is often imperfect. The peer-review process for both people and programs should include researchers with interdisciplinary expertise in addition to experts in single disciplines. Also, greater flexibility in resource allocation is often needed to serve the needs of these programs.

The report's recommendations are not targeted solely to academic institutions. "Our objective is to stimulate interdisciplinary research, so we offer suggestions for everyone who plays a key role in the research process, including students, postdoctoral scholars, researchers, educators, funding organizations, professional societies, and journal editors," said committee co-chair Theodore Brown, founding director emeritus of the Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign.

The report acknowledges that industrial and national laboratories have traditionally operated successful interdisciplinary programs because their research goals are established and pursued in terms of projects rather than by discipline. Teams of researchers from various fields are formed to solve particular problems, an approach that stimulates interdisciplinary interactions.

The study was sponsored by the National Academies Keck Futures Initiative, which was launched in 2003 to stimulate new modes of scientific inquiry and to break down the conceptual and institutional barriers to interdisciplinary research.

Facilitating Interdisciplinary Research is available from the National Academies Press, tel. 202-334-3313 or 1-800-624-6242 or on the Internet at www.nap.edu.

CAS Scientists Appeal to U.S. Regarding Visa Situation

In a recent issue of *Science*, Ya-Ping Zhang and Shigang He of the Chinese

Academy of Sciences (CAS) called on the U.S. administration to facilitate collaboration and exchanges between the United States and international scientific communities by improving the current visa situation.

Collaboration is important for both Chinese and U.S. science, said Zhang and He in their editorial (*Science* 306, December 10, 2004, p. 1861). Over the past decades, tens of thousands of Chinese students have been educated in the United States, they said. Many of them remain there, establishing their laboratories and excelling in their research. Those who returned to China have kept extensive connections with the U.S. scientific community. As of September 17, 2004, for example, 53% of the research papers published in *Science* and *Nature* in 2004 that were from Chinese laboratories were co-authored with U.S. scientists, said Zhang, vice director of the CAS Kunming Institute of Zoology, and He, a professor at the CAS Institute of Biophysics in Beijing.

However, the current visa situation has affected the cooperative activities between the two countries. The CAS scientists cite that an increasing number of Chinese scientists and students are encountering delays and refusals when applying for visas to go the United States. This has even frustrated prominent scientists, they said.

In a recent survey to Chinese professors and graduate students at CAS and the Universities of Peking, Fudan, Yunnan, and Wuhan, Zhang and He found that 71% of respondents said they would avoid collaborations with U.S. scientists, 91% are seriously rethinking their collaboration with U.S. scientists and intend to work with scientists in countries where obtaining a visa is not a problem, and 95% believe that the visa situation is damaging to scientific exchange between China and the United States.

Fencing the United States off from the rest of the world is a backward step, the CAS researchers said.

"We sincerely hope that unnecessary barriers between U.S. and international

scientific communities can be removed and healthy collaboration and exchange can be encouraged," they said.

Nanoforum Releases Survey Results on European Strategy for Nanotechnology

Nanoforum, a thematic network funded by the European Commission (EC) under the Fifth Framework Programme, has announced the results of its online survey determining the community's attitude toward all nanoscience and nanotechnology development. The aim of the survey was to assess the wider response to the EC's proposed strategy for nanotechnology—released in May 2004—and provide input to shape future European initiatives. Among the respondents were not only participants in the research and development (R&D) community, but also journalists, lecturers, and members of the business community. The survey was conducted between August and October 2004.

The survey revealed common attitudes. A high percentage of the respondents said that nanotechnology will have a strong impact on European industry (90%) and its citizens (80%) within 10 years. Respondents expect the greatest impact to be in the area of chemistry and materials (94%), followed by biotechnology (88%), information and communications technologies (79%), healthcare (77%), and security and defense (58%), with a moderate to high impact on energy and the environment. Europe is perceived to be far behind the United States in both nanoscience (76%) and the transfer of nanotechnology to industry (77%), and 79% of the respondents called for a significant increase in research funding through the Framework Programme. The opinions were divided as to whether the Programme should be oriented more toward basic or applied R&D.

The report, *Outcome of the Open Consultation on the European Strategy for NANOTECHNOLOGY*, can be accessed at www.nanoforum.org. □

For Science Policy Affecting Materials Research . . .

. . . access the Materials Research Society Web site: www.mrs.org/pa/

2005 WORKSHOP

Immediately following the 2005 MRS Spring Meeting in San Francisco, *The Physics and Chemistry of Switching in Condensed Matter* workshop will explore fundamental mechanisms of switching in a variety of materials. Switching phenomena will include phase-transitions, as well as other sudden transitions in conductivity, magnetism and optical density.

The Physics and Chemistry of Switching in Condensed Matter

April 1-2, 2005 • San Francisco, California

Technical Committee Chair—Dr. Arthur Edwards of AFRL/VS, Albuquerque.

For the most up-to-date information on this workshop and other meeting activities from the Materials Research Society, visit www.mrs.org/meetings/