

# International Activities in Bioengineering

**Sohi Rastegar**

*National Science Foundation\**

\*Views expressed are not the official position of NSF

# Acknowledgements/References

- Colleagues at NSF Office of International Science and Engineering
- NIH, NSF, and OSTP websites
- NIH BRP Grantees
- NSF Bioengineering ERC Directors and Investigators
- Gary Gabriele for introducing *The World is Flat*

# Motivation

The image shows a screenshot of the Lund University website interface in Chinese. The top navigation bar includes links for 'Style preferences', 'Campus maps', 'Site Map', 'A - Z', and 'Extended search', along with a search box. The main content area features the Lund University logo and the text 'LUND UNIVERSITY In Chinese'. Below this, there is a 'Quick links' section with a dropdown menu set to 'Choose:'. The main text area contains the title '隆德大学' (Lund University) and a welcome message: '欢迎来到隆德大学！' (Welcome to Lund University!). The text describes the university's long history and its commitment to education and research. A sidebar on the left contains 'Quick links' for 'Homepage', 'På svenska', and 'In Chinese', with a red arrow pointing to the 'In Chinese' link. The bottom right of the page features a photograph of the university building and two buttons: 'Print version' and 'Tell a friend about this page'.

**Lund University, Sweden**

# Conclusion/Recommendation

- **COMPETE TO COLLABORATE:** Use funding opportunities to take advantage of international growth of bioengineering (knowledge, leverage human capital, train globally competitive workforce)
- **COMMERCIAL EXPLOITATION BALANCE:** Potential for Commercial Exploitation is an important factor

# Role of Federal Government in Science and Technology

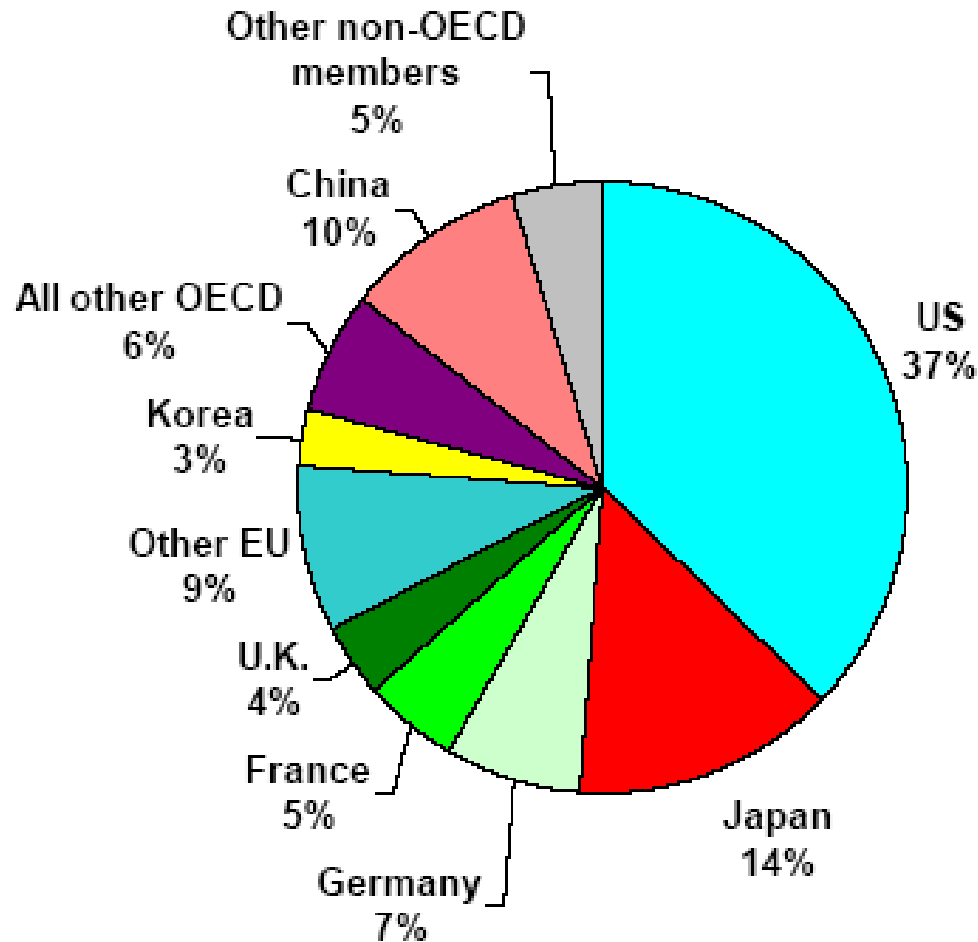
- Improve Nation's ability to innovate, enable discoveries, sponsor development of critical and enabling technologies, and maximize return on investment through cooperation across federal agencies
- Ensure National Security
- Strengthen the Economy
- Improve Health and Well-being
- Ensure an Educated Society

# Role of Policy

Must consider international perspective to

- Perform to highest global standard
- Access to frontiers of science
- Access to leading talent
- Augment human capital (visits & exchanges)
- Leverage non-US capabilities
- (Side Benefits: enhance science diplomacy, increase prestige and influence, ...)

## Shares of Total World\* R&D, 2002



Total World\* R&D =  
U.S. \$746.7 billion\*\*

\* World = OECD members plus  
Argentina, China, Romania,  
Israel, Russian Federation,  
Singapore, Slovenia, Taiwan

Source: OECD, Main Science and Technology Indicators, 2004.

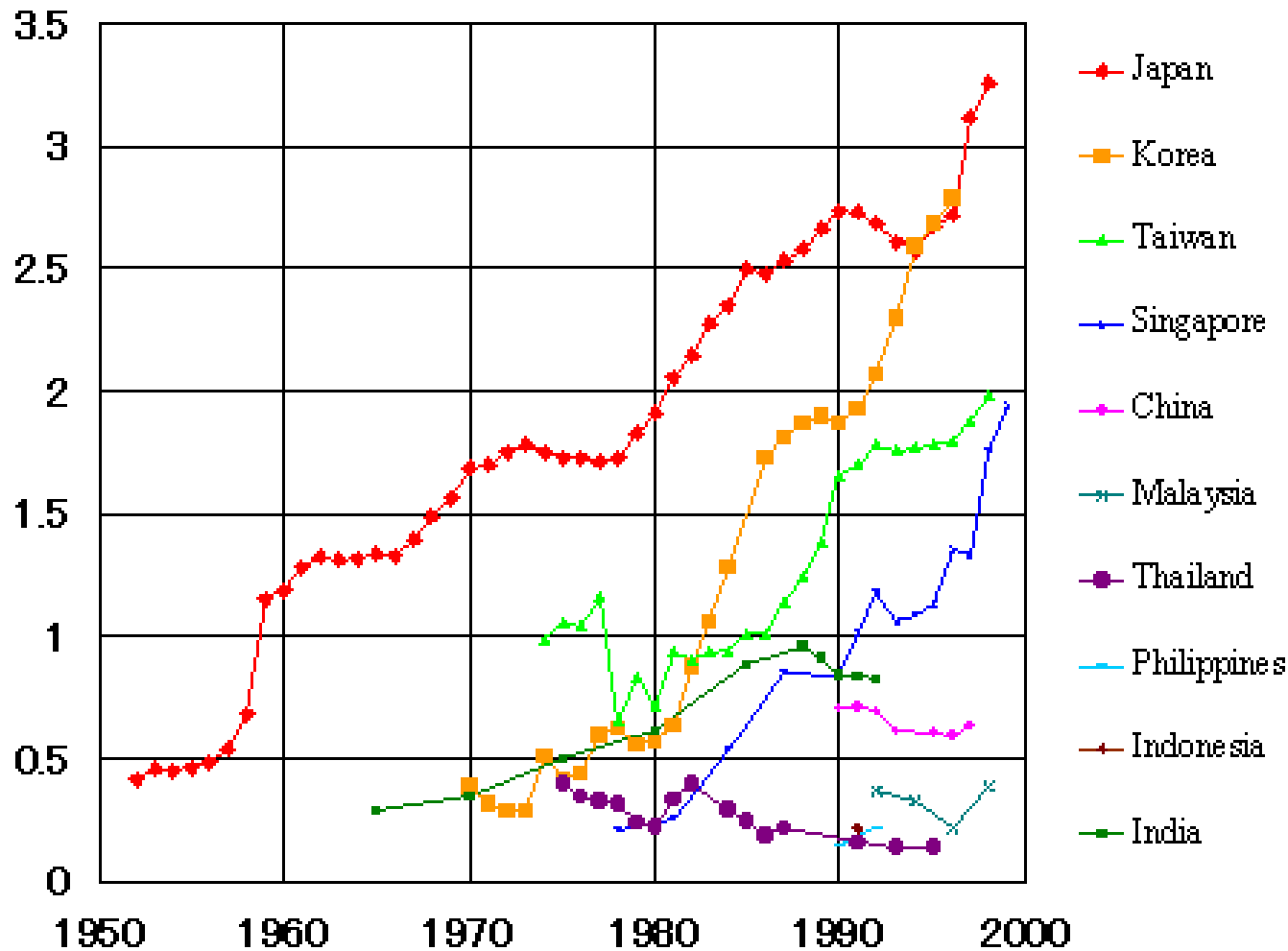
\*\* - calculated using purchasing power parities.

JAN. '04© 2004 AAAS



# Asian Science and Technology Indicator Series

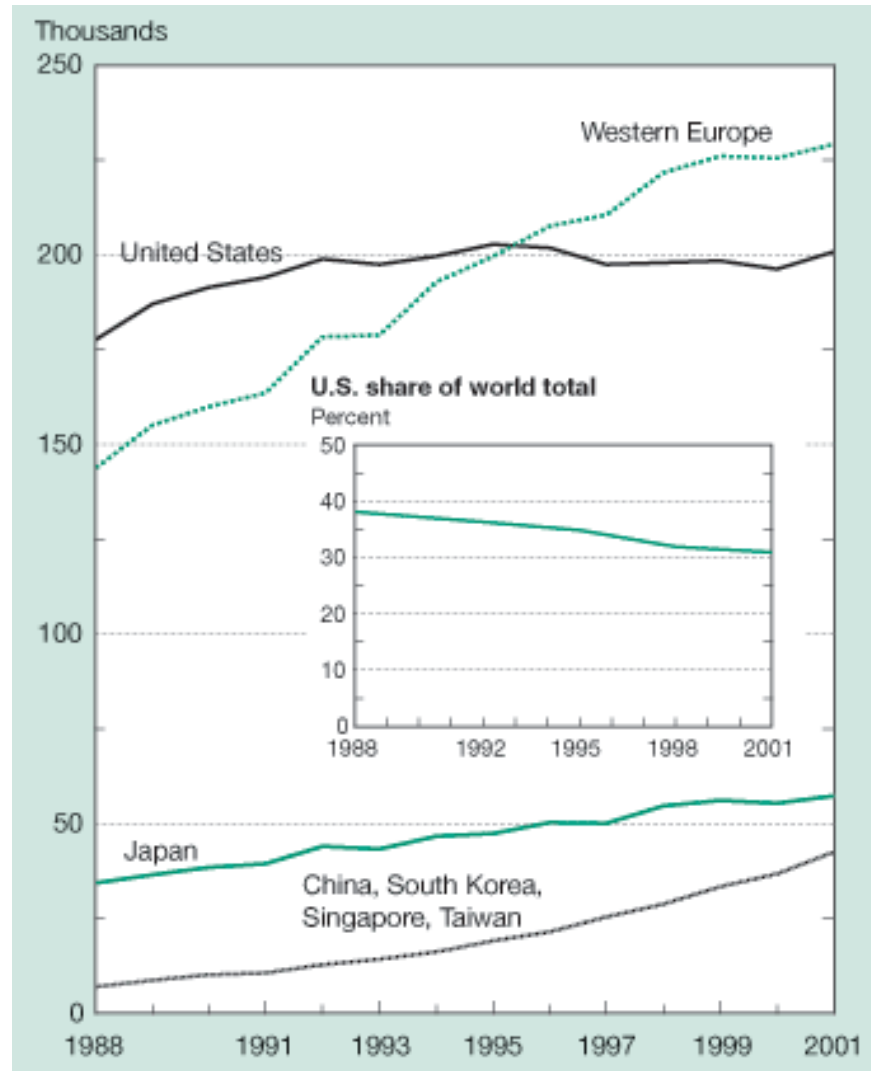
## R&D Expenditure/GDP (%)



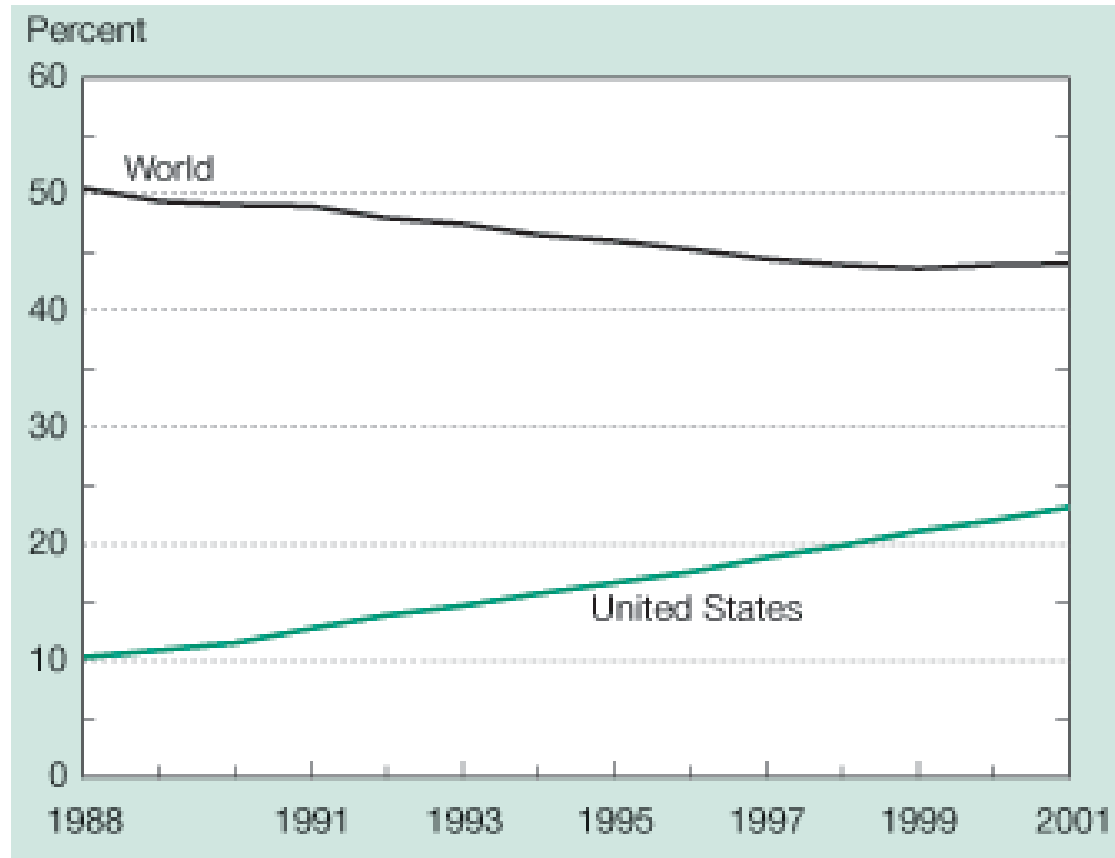
Ref: <http://kjs.nagaokaut.ac.jp/mikami/asianSTP/>  
from Dr. C.K. Lee Presentation at NSF



# U.S. share of S&E Articles



# Extent of Interactions (Published Articles)



Science and  
Engineering  
Indicators 2004

**World's internationally coauthored articles with one or more U.S. authors**  
**U.S. articles with one or more foreign-based authors**

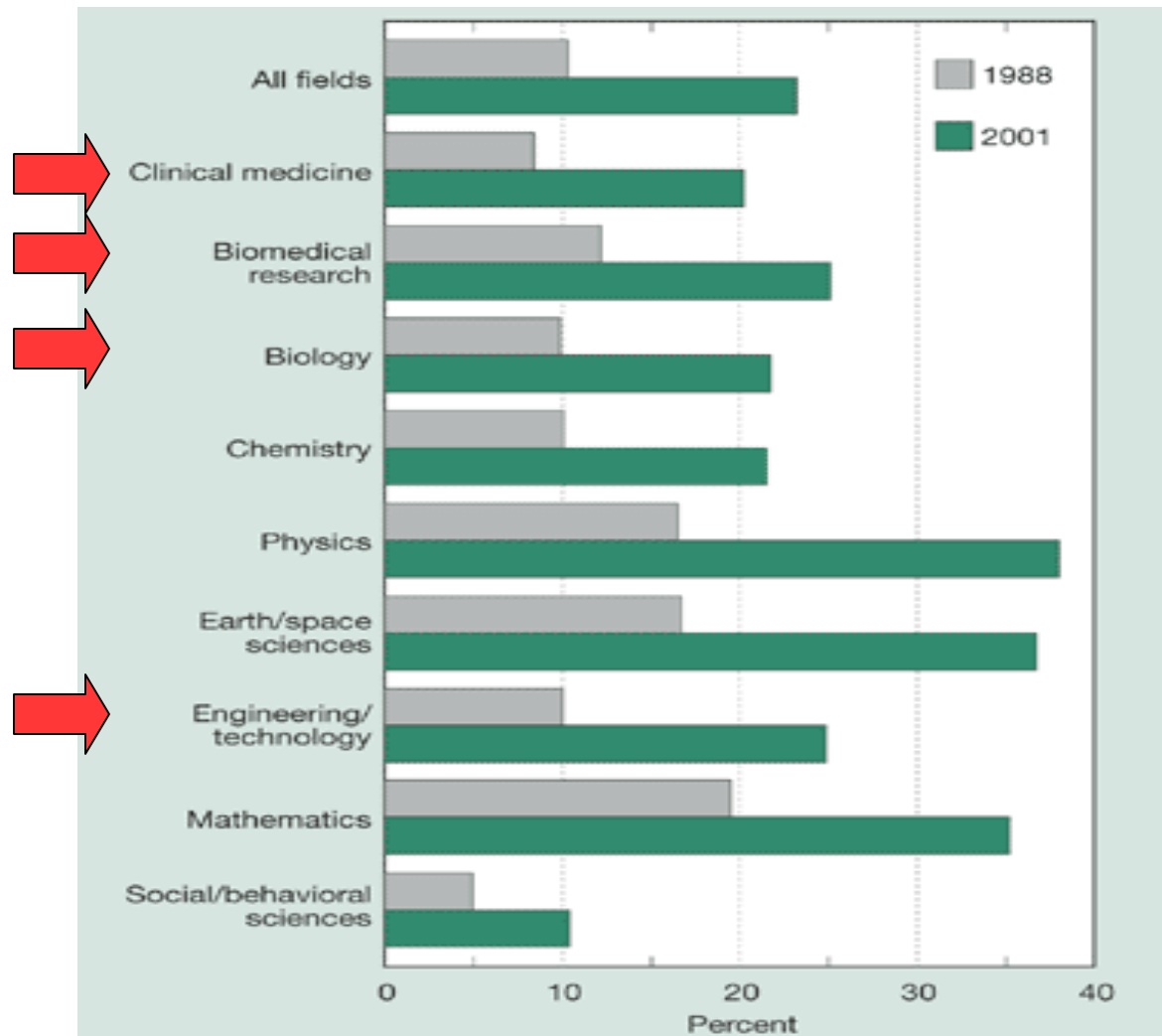
# Extent of International Collaboration by REGION



Percent  
Articles with  
at least 1 non-  
US Co-authors

Science and  
Engineering  
Indicators  
2004

# Extent of International Collaboration by FIELD



Percent  
Articles with  
1+ non-US  
Co-authors

Science and  
Engineering  
Indicators 2004

# Activities Overview

# International Federation of Medical and Biological Engineering (50 Countries)

## Affiliated Organizations

[Argentina](#)

[Australia](#)

[Austria](#)

[Belgium](#)

[Brazil](#)

[Bulgaria](#)

[Canada](#)

[China](#)

[China-Taipei](#)

[Colombia](#)

[Croatia](#)

[Cuba](#)

[Cyprus](#)

[Czech Republic](#)

[Denmark](#)

[Estonia](#)

[Finland](#)

[France](#)

[Germany](#)

[Greece](#)

[Hong Kong](#)

[Hungary](#)

[Iceland](#)

[Ireland](#)

[Israel](#)

[Italy](#)

[Japan](#)

[Korea](#)

[Latvia](#)

[Mexico](#)

[The Netherlands](#)

[Nigeria](#)

[Norway](#)

[Poland](#)

[Portugal](#)

[Serbia &](#)

[Montenegro](#)

[Singapore](#)

[Slovakia](#)

[Slovenia](#)

[South Africa](#)

[Spain](#)

[Sweden](#)

[Switzerland](#)

[Thailand](#)

[Ukraine](#)

[United Kingdom](#)

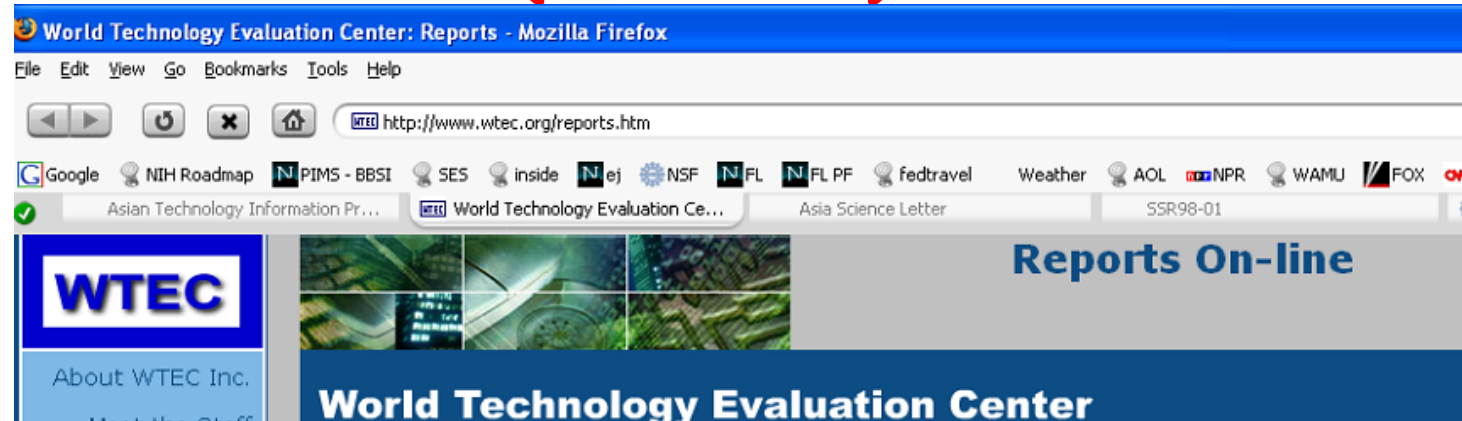
[United States](#)

[IEEE EMBS](#)

[ESEM](#)

[www.ifmbe.org](http://www.ifmbe.org)

# World Technology Evaluation Center (WTEC)



- WTEC Report on Tissue Engineering
- WTEC Report on Biosensing
- WTEC on Brain-Computer Interface (launched)

Search This Site

Windows IE 5.0 Users

Problems viewing this page?  
Please go to

Find:  Find Next Find Previous Highlight  Match case

Done

- Metabolic Engineering working Group: First Grantees Conference (2000)  
*Sponsored by: DOD, DOE, EPA, NASA, NIH, NIST, NSF, and USDA*
- Quantitative Systems Biotechnology (2000)  
*Sponsored by: NSF*

### Study reports completed by WTEC Inc.

- Operations Research for Healthcare Delivery Systems (2005)  
*Sponsored by: NSF, AHRQ*  
| [Study Information](#) | [Final Report in PDF Format](#) |

# WTEC on Tissue Engineering (2002)

## Potential Sources of U.S. vulnerability

- inability to attract top biologists to work on tissue engineering problems
- inability to develop strong multidisciplinary teams fast enough to retain a competitive advantage
- fickle private sector support forcing potential technologies to languish or be driven into less effective
- product development strategies
- widespread growth of stem and progenitor cell research outside of the United States
- insufficient work on basic biological science related to tissue-engineering problems



# Tissue Engineering

- UK (Liverpool/Manchester): Tissue Engineer/Regenerative Medicine Center since 2001
- Dutch Tissue Engineering Program (2004)
- Germany: DFG - Will announce a new regenerative medicine center
- Sweden: Gov. funded BME research and translation to clinic
- Singapore: Tissue Eng Center established in at University of Singapore
- China, Japan, Korea: Significant Investment
- Egypt: US-Egypt Workshop on Tissue Engineering (Jan 2006)
- India: (Trivandrum) Tissue Engineering Center

# WTEC on Biosensing (2004)

- Europe leads in development and deployment of inexpensive distributed sensing systems.
- Europe leads in integration of components and materials in microfabricated systems.
- Europe and Japan both have much R&D on DNA array technology, but the impact is likely to be only incremental.
- US leads in surface engineering applied to biosensing and in integration of analog-digital systems.
- Both Europe's and Japan's communication infrastructures are better suited for networked biosensing applications.
- Integrated biosensing research groups are more common in Europe and Japan.

# Areas Gaining Leadership

- Embryonic Stem Cells Research  
Canada, UK, Sweden, China, Korea, Japan, Singapore
- Tissue Engineering (Worldwide)
- Surgical Robotics Instruments (Japan)
- Technology Transfer in Stem Cell (Asia)

# Stem Cell and Therapeutic Cloning Research in South Korea

*Woo Suk Hwang, Seoul National University*



*Prospect of genetically  
identical animal models for  
the study disease processes  
and treatment pathways*

# South Korea Visit

## Modern Facilities

(Yonsei University BME Dept)



## State-of-the-Art

Well Equipped Labs



Well-trained  
Human Resources

# Collaboration Opportunities

# NSF Office of International Science and Engineering

The screenshot shows a Mozilla Firefox browser window displaying the NSF Office of International Science & Engineering (OISE) website. The browser's address bar shows the URL <http://www.nsf.gov/div/index.jsp?org=OISE>. The website header features the NSF logo and the text "National Science Foundation OFFICE OF International Science & Engineering (OISE)". A search bar is located in the top right corner. Below the header is a navigation menu with links for HOME, FUNDING, AWARDS, DISCOVERIES, NEWS, PUBLICATIONS, STATISTICS, ABOUT, and FastLane. The main content area is titled "Office of International Science & Engineering (OISE)" and includes an "Important Notice" section. The notice states: "In addition to the Programs and Funding Opportunities listed below and special OISE [Regional Opportunities](#), OISE encourages funding applicants to include an international component in proposals submitted to the appropriate research directorate. See the [Dear Colleague Letter on OISE Support for International Activities](#) for a description of recent changes in OISE activities." Below the notice is a section for "Programs and Funding Opportunities" with a key: **Key:** [Crosscutting](#) | [NSF-wide](#). The list of programs includes: [Developing Global Scientists and Engineers](#) [East Asia and Pacific Summer Institutes for U.S. Graduate Students](#) [International Research and Education: Planning Visits and Workshops](#) [International Research Fellowship Program](#) [Pan-American Advanced Studies Institutes Program](#) . A left sidebar contains a "Office of International Science & Engineering (OISE)" header with a world map and a list of navigation links: OISE Home, About OISE, Funding Opportunities, Awards, News, Events, Discoveries, Publications, Advisory Committee, Career Opportunities, and Staff by Country. The browser's search bar at the bottom contains the text "bio".

# NSF International Opportunities

<http://www.nsf.gov/pubs/2004/nsf04034/nsf04034.htm>

1. Planning Visits and Workshops
2. Global Scientists and Engineers
3. Partnerships for International Research and Education (PIRE): Began in FY2005 long-term international research and educational activities build on institutional strengths to provide an international collaborative experience that can involve U.S. researchers at all levels.



# NSF Opportunities

- **International Research Fellowship Program (IRFP)**

<http://www.nsf.gov/pubs/2005/nsf05599/nsf05599.htm>

- The objective of the International Research Fellowship Program (IRFP) is to introduce scientists and engineers in the early stages of their careers to research opportunities abroad, thereby furthering NSF's goal of creating a diverse, competitive, and globally-engaged U.S. workforce of scientists, engineers, technologists and well-prepared citizens. These awards are available in any field of science and engineering research and education supported by NSF.
- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):
- October 11, 2005  
Second Tuesday in September annually thereafter

# AAAS-NSF WISC Program

- Women's International Science Collaboration (WISC)
- Men and Women with PhD or equivalent
- US Citizen/Permanent Resident
- \$5K for travel and living support to visit a partner country
- [www.aaas.org/international/wisc/](http://www.aaas.org/international/wisc/)

# NIH OPPORTUNITIES Fogarty International

**FIC - Programs and Initiatives - Mozilla Firefox**

File Edit View Go Bookmarks Tools Help

http://www.fic.nih.gov/programs/grants.html#otherops

Reciting Google weather NSF AOL Novell WebAccess Headlines NPR WAMU WETA FOX CNN BBC Le Monde

## NIH Opportunities

### Fellowship Opportunities in Japan (JSPS)

The Japan Society for the Promotion of Science (JSPS), as the funding agency, provides three types of scientific collaboration fellowships using the NIH as a nominating authority. One type of Fellowship Program allows Japanese Biomedical and Behavioral Scientists to conduct research at NIH. The other two types allow U.S. (and permanent resident) Scientists to participate in research in eligible universities and institutes in Japan.

### NIH Visiting Program

This program provides support for scientists who wish to conduct research at NIH intramural laboratories.

Individuals interested in applying for a foreign research grant, a research grant with a foreign component, or a National Research Service Award (NRSA) through other [NIH Institutes and Centers](#) may contact program officers in the relevant area of science to inquire about the possibility.

The [NIH Office of Education](#) provides information on training opportunities at the NIH and searchable abstracts on the research being conducted in NIH laboratories.

### The Oncology Research Faculty Development Program

The [National Cancer Institute \(NCI\)](#) supports this program for cancer researchers from developing countries.

### Short-Term Scientist Exchange Program

The NCI handles this exchange program that promotes collaborative research between U.S. and foreign scientists through short exchange visits.

### NIDA Fellowships

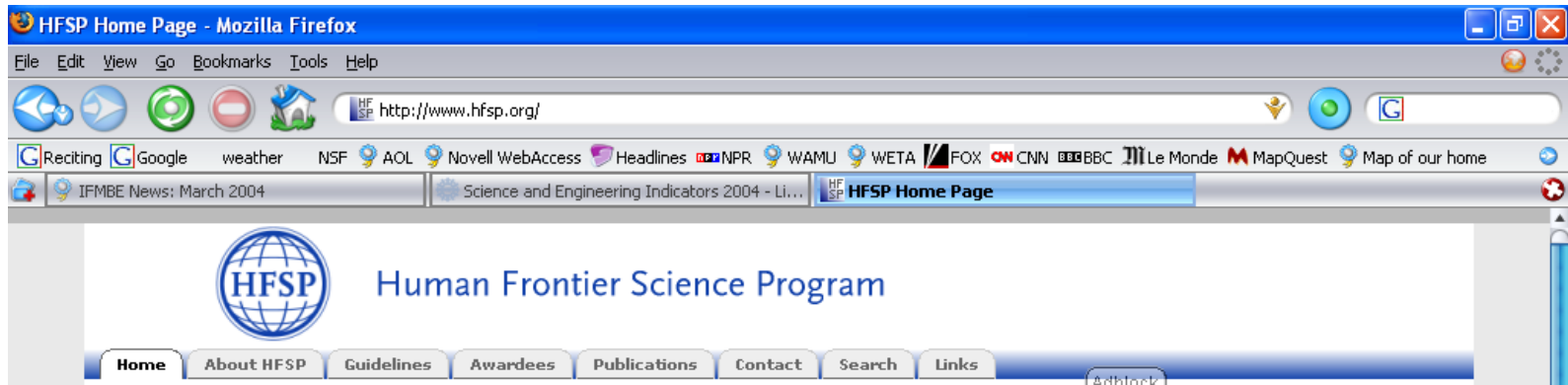
The [National Institute of Drug Abuse \(NIDA\)](#) provides international opportunities. Visit the [NIDA International Page](#) for information about these programs.

### NIDCR Programs

The [National Institute of Dental and Craniofacial Research \(NIDCR\)](#) provides international

Done

# Human Frontier Science Program (www.hfsp.org)



**ISACOFF**  
Ehud Y.

Molecular and Cell Biology  
University of California Berkeley

USA

**CHARPAK**  
Serge

Dept. of Neurophysiology and New Microscopies  
INSERM U603, ESPCI, Paris

FRANCE

**REUVENY**  
Eitan

Biological Chemistry  
Weizmann Institute of Science, Rehovot

ISRAEL

**TRAUNER**  
Dirk

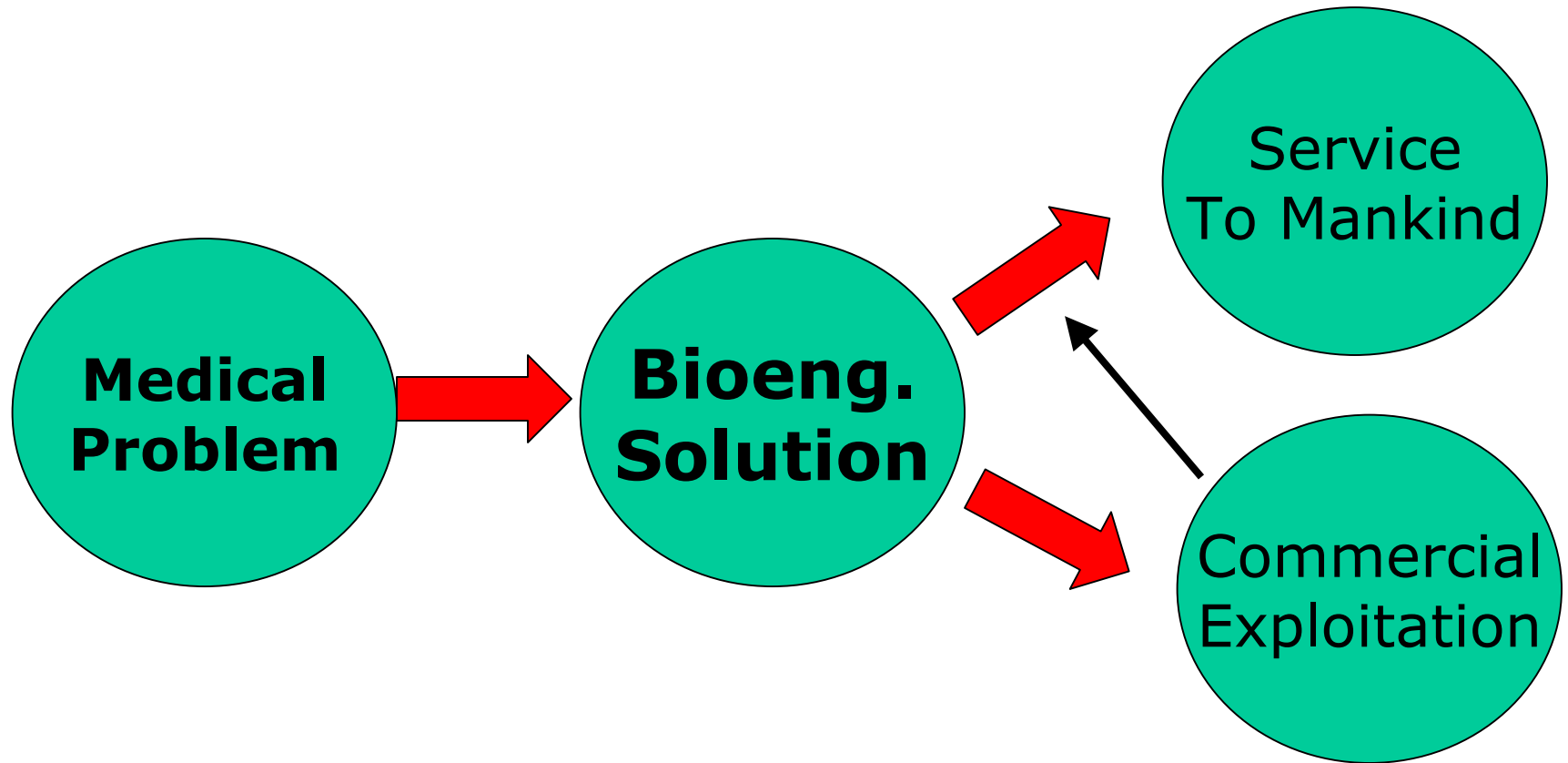
Dept. of Chemistry  
University of California, Berkeley

USA  
(AUSTRIA)

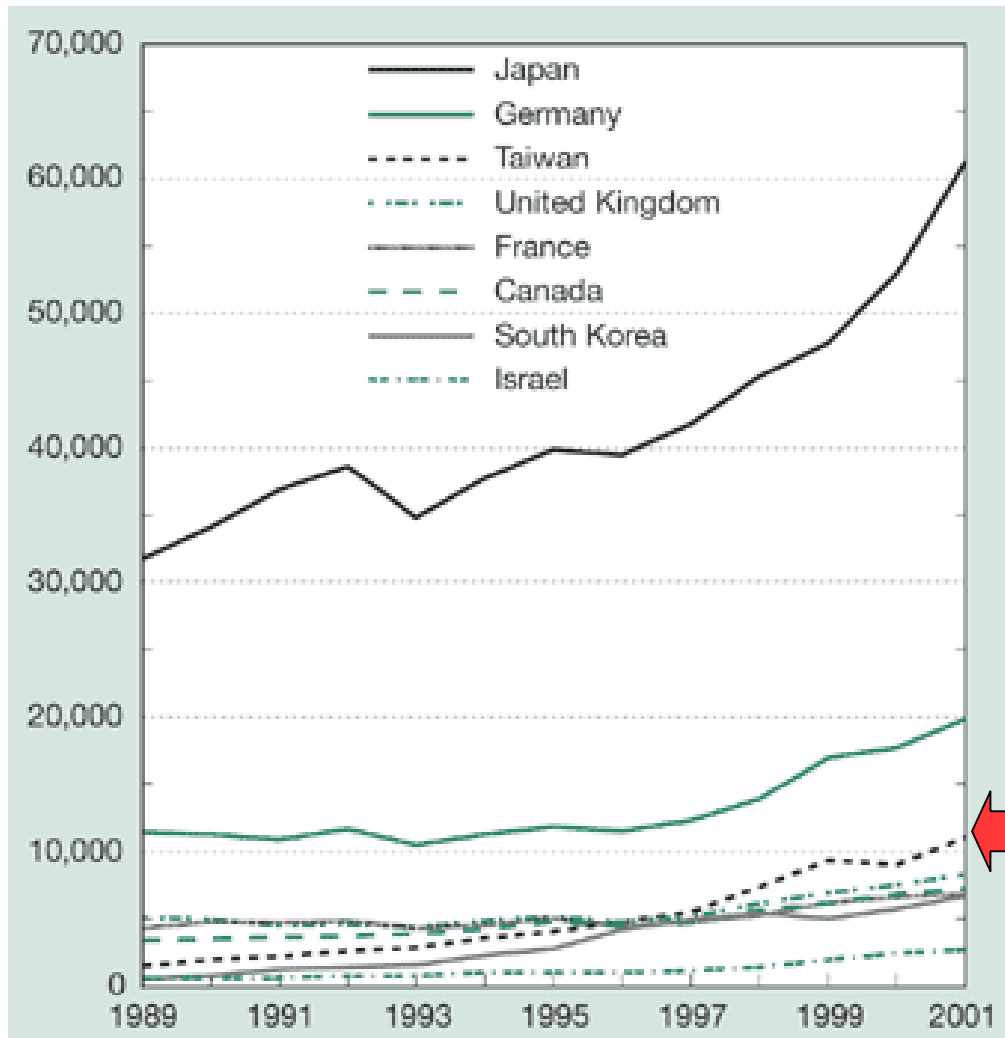
**Optical detection and manipulation of protein signaling - sensory processing in the mammalian brain**

# Technology Transfer Challenge

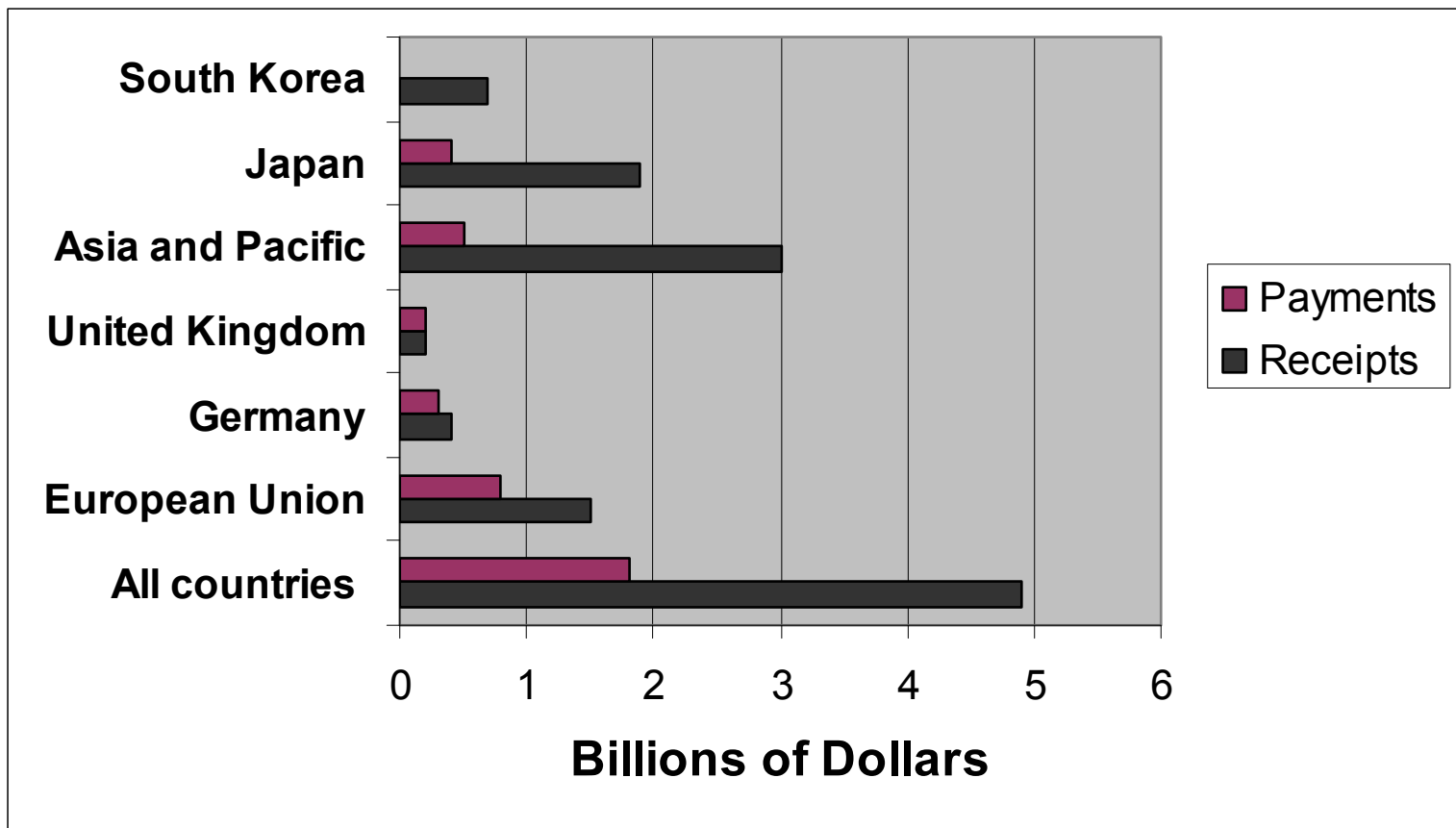
# Medical Solution and Commercial Exploitation



# US Patent Applications by non-US Inventors



# U.S. Royalties and Fees Generated From Exchange of Industrial Processes (2001)





# Summary

- Hot beds of bioengineering expertise and know-how go beyond the US.
- Compete to collaborate is a needed strategy for solving problems while maintaining US leadership in Bioengineering.
- Common desire to solve tough medical problems is a strong force for successful collaborations.
- Commercial exploitation of discoveries is an important element- (issue of US Regulatory and Reimbursement barriers).
- There are many opportunities for international collaboration.

# Resources and Opportunities

## INFORMATION

- Science and Engineering Statistics <http://www.nsf.gov/statistics/seind04/prsntlst.htm>
- International Federation of Medical and Biological Engineering [www.ifmbe.org](http://www.ifmbe.org)
- World Technology Evaluation Center [www.wtec.org](http://www.wtec.org)
- Asian Technology Information Program [www.atip.org](http://www.atip.org)
- Asian Office of Aerospace R&D <http://www.tokyo.afosr.af.mil/>

## OPPORTUNITIES

- NSF Office of Science and Engineering [www.nsf.gov/](http://www.nsf.gov/)
- NSF Graduate Summer Institutes [www.nsf.gov/eapsi](http://www.nsf.gov/eapsi)
- NIH Fogarty International <http://www.fic.nih.gov/programs/grants.html#otheropps>
- Global Scientists and Engineers <http://www.nsf.gov/pubs/2004/nsf04036/nsf04036.htm>
- International Research Fellowship <http://www.nsf.gov/pubs/2005/nsf05599/nsf05599.htm>
- Human Frontier Science Program [www.hfsp.org](http://www.hfsp.org)
- US Scholars Program, Fulbright [www.cies.org/us\\_scholars](http://www.cies.org/us_scholars)
- Women's International Science Collaboration (WISC) [www.aaas.org/international/wisc/](http://www.aaas.org/international/wisc/)

Columbus reported to his king and queen that the world was round, and he went down in history the man who first made this discovery. I returned home and shared my discovery only with my wife, and only in a whisper.

"Honey, I confided,

"I think the world is flat"

--Thomas Friedman

*The World is Flat*