National Science Board

International Science and Engineering Partnerships:

A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise

February 14, 2008

Cover Design by James J. Caras, Design and Publishing Section,
Information Dissemination Branch, National Science Foundation

NSB-08-4

International Science and Engineering Partnerships:

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Est. 1950

February 14, 2008

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MEMORANDUM FROM THE CHAIRMAN OF THE NATIONAL SCIENCE BOARD

SUBJECT: *International Science and Engineering Partnerships: A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise*

The National Science Board (Board) established the Task Force on International Science (Task Force) in September 2005 to examine the role of the U.S. Government in international science and engineering (S&E) partnerships. The Task Force was charged to focus on: facilitating partnerships between U.S. and non-U.S. scientists and engineers, both in the U.S. and abroad, and in developed and developing countries; and utilizing S&E partnerships in improving relations between countries and to raise the quality of life and environmental protection in developing countries.

The Task Force conducted a series of four roundtable discussions and meetings held in Washington, D.C. in May 2006, Singapore in September 2006, Brussels in March 2007, and the Middle East in July 2007 for Board Members to consult with the scientific community and science policy officials from U.S. Federal agencies and countries around the world. Throughout these discussions, the Task Force obtained a wide range of perspectives on the U.S. Government's role in supporting international S&E partnerships.

The Board, established by Congress in 1950, provides oversight for, and establishes the policies of, the National Science Foundation (NSF). It also serves as an independent body of advisors to the President and Congress on national policy issues related to S&E research and education.

We hope you will join the Board in supporting U.S. leadership in international S&E partnerships, which is crucial to global prosperity. Successful international S&E partnerships can build S&E capacity and expertise around the world and energize U.S. innovation, but the U.S. Government must now enhance a global strategy to support international S&E partnerships as new tools to strengthen diplomacy and foster capacity building in developing countries. This report presents the goals and recommended actions for the Nation, as well as guidance for NSF, to support international S&E partnerships.

Steven C. Beering
Chairman
National Science Board

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Acknowledgments

The National Science Board (Board) thanks the many members of the science and engineering community, both home and abroad, who generously contributed their time and intellect to the development of this report. A list of participants in roundtable discussions and meetings of the Task Force on International Science is provided in Appendix C, and categorized by the locations of those discussions and meetings in Washington, D.C., Singapore, Brussels, and the Middle East. The individuals who responded to requests for public comments to the draft report are listed in Appendix D.

The Board Office staff, led by Dr. Michael Crosby, Executive Officer and Board Office Director, provided essential support and contributions throughout this project. Especially deserving of recognition are: Ms. Clara Englert, Ms. Amanda Slocum, and Ms. Tami Tamashiro, who served as Executive Secretaries to the Task Force on International Science; and Ms. Ann Ferrante, for editorial and publishing support.

International Science and Engineering Partnerships:

A Priority for U.S. Foreign Policy and Our Nation's Innovation Enterprise

Executive Summary

The first decade of the 21st century has shifted the global landscape of science and engineering (S&E) related to research, education, politics, and the technical workforce. New security threats, globalization, and the rapid increase in health and environmental challenges have generated a need to reassess the U.S. Government's role in international S&E and diplomatic institutions. The U.S. Government needs to adapt rapidly to these changes so that our economy remains competitive, our national security remains sound, and our valuable resources are utilized effectively and efficiently in support of discovery and innovation. A critical mechanism for achieving U.S. goals in this development is international S&E partnering to serve new diplomatic purposes. Effective international S&E partnerships advance the S&E enterprise and energize U.S. innovation and economic competitiveness, but they also have great potential to improve relations among countries and regions and to build greater S&E capacity around the world.

Effective international S&E partnerships advance the S&E enterprise and energize U.S. innovation and economic competitiveness, but they also have great potential to improve relations among countries and regions and to build greater S&E capacity around the world.

The most recent notable change in global S&E dynamics occurred after September 11, 2001, when new security restrictions hindered the flow of ideas, knowledge, and researchers across borders. Visa restrictions prevented many foreign researchers from entering the U.S. to participate in research studies and scientific conferences. Decreases in foreign student enrollments from 2001 through 2005 were partly due to difficulties obtaining U.S. visas.[1] Export controls and restrictions on technology sharing dampened incentives for international researchers to participate in U.S.-led research initiatives. While foreign student enrollments have begun to increase again, these factors have made locations other than the U.S. more appealing for supporting cutting-edge innovation in S&E.

A second factor influencing shifts in the global S&E landscape is globalization – the growing interdependence and integration of global economic, social, technological, cultural, and political spheres. The U.S. is no longer the unquestioned leader in certain S&E fields, such as national cyberinfrastructure networking, and must increasingly rely on and learn from other countries. Centers of excellence are also emerging around the world at the forefront of new S&E developments.[2] To remain

competitive, the U.S. must no longer assume that it has a leading role in S&E; rather, it must actively strengthen its engagement in the global movement to work together on the frontiers of S&E.

A third factor influencing shifts in the global S&E landscape is the global nature of many societal challenges. These challenges include: building more secure national infrastructures in the wake of terrorist threats and actions; increasing national capacity and disseminating technology to underdeveloped and developing countries; preventing environmental change and degradation, especially global climate change; improving weather forecasting to improve the response to catastrophic natural disasters; and diminishing the threat of widespread health epidemics such as AIDS.[3] The next generation of scientists and engineers will need to lead the world in combating these global problems.[4] Advances in S&E will increasingly depend on the ability to draw upon the best minds regardless of national borders.[5]

U.S. efforts to build S&E capacity in developing countries will advance U.S. diplomacy throughout the world. In particular, the U.S. Government must harness the power of international S&E partnerships to strengthen science diplomacy and foster capacity building in developing countries. For such partnerships to achieve their full potential, there must be short-term and long-term mutual benefits and shared risk. The National Science Board (Board) urges the U.S. Government to undertake the recommended actions stated in the Strategic Priorities section of this report immediately. The Board also offers guidance to the National Science Foundation (NSF), which is interspersed throughout the Strategic Priorities section under the sub-heading "Guidance for NSF." The recommended actions of this report are summarized below.

A. Creating a Coherent and Integrated U.S. International S&E Strategy

- The National Science and Technology Council (NSTC) should reestablish a committee on international S&E to coordinate the activities of the U.S. Department of State, the U.S. Agency for International Development (USAID), and the various Federal mission agencies and to develop a coherent, integrated, national S&E strategy. With guidance from the Department of State, this committee should work with peer governments to establish coordinated programs across international boundaries.
- Each Federal agency involved in international S&E should designate a lead official empowered to proactively promote and develop international S&E strategy and coordination.
- Congress should amend the Government Performance and Results Act (GPRA) to require Federal agencies to address strategy development and performance planning for international S&E partnerships. The Office of Management and Budget (OMB) should include this in its Program Assessment Rating Tool (PART)[6] guidance to U.S. Federal agencies.

- The Department of State should consider elevating the role of qualified Science Advisors at key U.S. Embassies to promote science, engineering, and technology in their host countries.

B. Balancing U.S. Foreign and R&D Policy

- Office of Science and Technology Policy (OSTP) must work with the U.S. Department of State and OMB to make international S&E partnerships a priority for U.S. foreign and research and development (R&D) policy. OSTP and OMB should include this strategy in the annual OMB-OSTP memo on the science and technology priorities of the Administration. OSTP should consider reestablishing the position of Assistant Director for International Strategy and should directly charge Federal agencies to include specific components of international R&D in their integrated programs.
- The Department of State, USAID, scientific societies, and non-profit organizations should do more to encourage and to help fund S&E partnerships as instruments of diplomacy.
- The Administration and Congress should direct the Department of Commerce, OSTP, the Department of State, and the Department of Homeland Security to balance U.S. security policies with international S&E needs.
- OSTP, the Department of State, and other U.S. Federal agencies should work with non-governmental organizations and the private sector to build and sustain international S&E partnerships using "transformational diplomacy" and "soft power."
- The Administration and Congress should enact the recommendations of the National Research Council's report, *The Fundamental Role of Science and Technology in International Development: An Imperative for the U.S. Agency for International Development.*[7]

C. Promoting Intellectual Exchange

- Congress and the Department of State should facilitate "brain circulation," as opposed to "brain drain," in employing S&E talent through:
  - Reinvigorating the interest of American students in S&E by supporting study abroad opportunities, during which they would collaborate with foreign scientists and engineers;
  - Streamlining the visa process for foreign S&E scientists, engineers, and students;
  - Encouraging foreign study and collaborative scientific work for U.S. scientists, engineers, and students by easing their transition to working abroad and by providing professional and scientific opportunities upon their return to the U.S.;

    - Identifying and increasing the use of certain U.S. and foreign specialized facilities for collaborative work by scientists and engineers from around the world;[8] and
    - Supporting global fora to identify priority research ventures and to develop common funding and governance schemes, in order to draw scientists and engineers from around the world to gain international experience to return to their home countries.
- The U.S. Government should:
    - Continue to work with other countries with significant partnership potential to institute scientific standards and processes;
    - Create joint and collaborative program announcements for the following activities:
        - To review and fund proposed international S&E projects;
        - To grant ownership of intellectual property developed with government support; and
        - To develop and institute financial and compliance policies for international S&E projects.
    - Utilize the National Resource Center Program of the International Education Programs Service of the U.S. Department of Education in order to provide grants to establish, strengthen, and operate language and area/international studies centers that will be national resources for teaching modern foreign languages.

Accountability must be an integral part of planning successful collaborations to assure supporters that research integrity is a priority and that funds are used appropriately. Strengthening scientific capacity and promoting the free flow of information in developing countries will not only expand their S&E enterprises, but will help those countries attain a higher quality of life by supporting greater social stability. The U.S. Government needs to support successful international S&E partnerships as necessary tools to address critical global challenges and the new dynamics of S&E, to build S&E capacity and expertise, to energize U.S. innovation, to support international relations, and to foster capacity building in developing countries. U.S. leadership in international S&E partnerships is truly one of the key ingredients to global prosperity.

Introduction

International science and engineering (S&E) partnerships engage peoples and nations in cooperative work on mutual problems using the common language and values of S&E. International S&E partnerships provide wonderful opportunities for educating the participating partners in S&E and, perhaps more importantly, building trust and communication. An international S&E partnership can be as modest as two scientists or engineers collaborating on a problem of mutual interest across national boundaries or as complex as the International Space Station or the International Polar Year (IPY). Examples of existing international S&E partnerships are included in Appendix A.

International S&E partnerships provide wonderful opportunities for educating the participating partners in S&E and, perhaps more importantly, building trust and communication.

The National Science Board (Board) envisions international S&E partnerships as important tools of U.S. diplomacy. They may be used to strengthen diplomatic relationships worldwide and to promote basic scientific values such as accountability, meritocracy, transparency, and objectivity. Through international S&E partnerships, the U.S. can build and sustain a preeminent role in the international S&E arena; the rest of the world should see the U.S. as a home of strong S&E capabilities and fundamental research values. In today's global S&E enterprise, the U.S. is not the leader in all S&E fields, such as in cyberinfrastructure.[9] Hence, in order to be at the forefront of discovery and innovation, it is vital that our Nation be fully engaged in international S&E partnerships. The potential products of successful international S&E partnerships are numerous, including economic development, capacity building of civil society, elevation of women and underrepresented groups, and productive, socially responsible solutions to global S&E problems.

Dr. Vannevar Bush highlighted the importance of international science to the U.S. and to the National Science Foundation (NSF) in his 1945 report[10] that led to the establishment of NSF: *The Government should take an active role in promoting the international flow of scientific information.* At about the same time, the United Nations recognized the importance of international science by establishing the United Nations Educational, Scientific and Cultural Organization (UNESCO)[11] to contribute to peace and security by promoting international collaboration through education, science, and culture. Following the recognition of the importance of international S&E by these two bodies, a host of non-governmental organizations (NGOs) followed suit. These organizations include the International Council for Science (ICSU),[12] the World Federation of Engineering Organisations (WFEO),[13] and the Academy of Sciences for the Developing World (TWAS).[14]

Currently, the U.S. Government is actively involved in supporting international S&E partnerships. However, its involvement suffers from a lack of coordination among agencies and organizations because no Federal agency is singly responsible for taking the lead. Coordination is difficult because relevant policy issues often transcend individual agencies, requiring agencies – often with different objectives – to work together. The U.S. Government could play a more effective role in supporting international S&E partnerships by developing a coherent international S&E strategy to coordinate the activities and objectives of the various Federal agencies that play a role in such partnerships. An effective strategy would utilize the diverse roles and strengths of individual agencies and would respect the autonomy of those agencies. There also needs to be a firm and long-term commitment by U.S. and foreign leadership, and U.S. Federal agencies should have direct and assured budget lines for international programs.

Issues of international S&E are not new to the Board. In 2000, its interim report, *Toward a More Effective NSF Role in International Science and Engineering* (NSB-00-217),[15] made a number of specific recommendations to increase NSF's engagement in and to achieve higher visibility in international research and education. The subsequent Keystone Recommendation in the November 2001 Board report, *Toward a More Effective Role for the U.S. Government in International Science and Engineering* (NSB-01-187),[16] remains fundamental:

> *The U.S. Government should move expeditiously to ensure the development of a more effective, coordinated framework for its international S&E research and education activities. This framework should integrate science and engineering more explicitly into deliberations on broader global issues and should support cooperative strategies that will ensure our access to worldwide talent, ideas, information, S&E infrastructure, and partnerships.*

Two subsequent documents reinforced the importance of the Board's work in international S&E: the *National Science Foundation Investing in America's Future: Strategic Plan FY 2006-2011* (NSF-06-48)[17] and the *National Science Board 2020 Vision for the National Science Foundation* (NSB-05-142).[18] In its vision document, the Board recommended that NSF strengthen existing international and interagency partnerships and develop new partnerships.

In 2005, the Board decided that shifts in the international landscape, along with the unfulfilled recommendations of its 2001 report, warranted a careful reexamination of the U.S. Government's role in supporting international S&E. The Board was particularly interested in the potential of international S&E partnerships to improve international relations, build S&E capacity, improve quality of life, and protect the environment. The Board focused on issues related to partnerships with developing countries, but also considered the potential for the U.S. to partner with other developed nations to aid S&E conducted by developing countries.

Consequently, the Board charged its new Task Force on International Science (Task Force) to examine the role of the U.S. Government in international S&E partnerships and to focus on the following key issues:[19] (1) to facilitate partnerships between U.S. and non-U.S. scientists and engineers, both in the U.S. and abroad, and in developed and developing countries; and (2) to utilize S&E partnerships in improving relations between countries and to raise the quality of life and environmental protection in developing countries. As described in Appendix B, the Task Force consulted with members of the scientific community and science policy officials from U.S. Federal agencies and from countries around the world to better understand a wide range of perspectives on the U.S. Government's role in supporting international S&E partnerships. Appendix C lists participants in the Task Force's roundtable discussions and meetings, and Appendix D lists the individuals who submitted comments on drafts of this report.

This report distills key observations from these meetings and recommends actions for strengthening the value-added gained from international S&E partnerships. The Board highlights specific goals and recommended actions in the Strategic Priorities section under three categories: (A) creating a coherent and integrated U.S. S&E strategy, (B) balancing U.S. and foreign research and development (R&D) policy, and (C) promoting intellectual exchange.

Benefits of International S&E Partnerships

Successful international S&E partnerships have widespread benefits for the partners involved, for the advancement of S&E, and for the economic prosperity and well-being of countries. For the U.S. in particular, investing in international S&E partnerships will help energize the economy and promote S&E innovation and research. The U.S. can also benefit from partnerships by learning from the rest of the world in order to advance in S&E fields in which it is falling behind.

A. Builds Global S&E Capacity

International S&E partnerships can play a key role in advancing S&E capacity worldwide. Through cooperative cross-border endeavors, scientists and engineers gain access to foreign data, platforms, facilities, sites, expertise, and technology. Broad access to information and minds allows scientists and engineers to work together to address issues of global concern and to develop, test, and use new ideas on a global scale. The products of such collaborations are improved tools, models, products, and services. As these beneficial outcomes are experienced, governments will likely respond with policy changes that further foster international S&E partnerships.

Through cooperative cross-border endeavors, scientists and engineers gain access to foreign data, platforms, facilities, sites, expertise, and technology.

International S&E partnerships will also advance S&E capacity worldwide by helping to establish the necessary environment for future generations of scientists and engineers to tackle global problems. As S&E become increasingly global and competitive, it is critical that people working in these fields be able to perform in a globally-aware manner. These future professionals must be cognizant of and able to address international and cultural issues that could otherwise inhibit their ability to work together and generate solutions to global problems. Strengthening international S&E partnerships now can help lay the groundwork for international networks of S&E collaborators.

B. Energizes U.S. Innovation and Economic Competitiveness

International S&E partnerships can also play a key role in energizing U.S. S&E innovation and overall economic competitiveness. The U.S. has historically been recognized as a leader in S&E research and innovation; however, it now lags behind other countries in some S&E fields. As centers of research excellence emerge around the world and the international scientific community grows rapidly, the U.S. must increasingly strengthen and protect its eminence. U.S. leadership in international S&E partnerships would help to ensure that it maintains a lead position in the global S&E enterprise. Active involvement will ensure that U.S. industry stays at the cutting edge of technology and will help to energize both the U.S. and global economies.

A continuing issue in maintaining innovation and competitiveness is making sure that the U.S. attracts the best and the brightest from around the world and encourages U.S. students to pursue S&E fields. Many of today's most pressing societal problems – such as climate change, natural disasters, food shortages, sanitation, and safe drinking water, energy resources, and the spread of disease – have global consequences and require a global effort from scientists and engineers. International S&E partnerships can help to bring those scientists and engineers together to generate effective, innovative solutions. With its history of prominence in the international S&E community, the U.S. is uniquely positioned to provide leadership in building and shaping the direction of international S&E partnerships to address these important global issues.

Vision for U.S. Support of International S&E Partnerships

As previously discussed, there are tremendous possible benefits for the U.S. if it invests in international S&E partnerships. In this day and age, however, simply partnering with other individuals, organizations, and agencies is not sufficient. There must be a proactive effort on the part of the U.S. Government to utilize these international S&E partnerships as tools to strengthen diplomacy and capacity building around the world.

> ***The U.S. Government must advance "transformational diplomacy" by enhancing a global strategy to support international S&E partnerships.***

President George W. Bush and Secretary of State Condoleezza Rice have used the term "transformational diplomacy" to describe their vision for the U.S. to use its diplomatic power to help foreign citizens better their lives, build their nations, and transform their futures. Secretary Rice defined the objective of "transformational diplomacy" as "work[ing] with our many partners around the world to build and sustain democratic, well-governed states that will respond to the needs of their people – and conduct themselves responsibly in the international system."[20] International S&E partnerships are essential to advancing "transformational diplomacy," because they can lay the groundwork for achieving the goals cited in this definition by creating apolitical connections among people to build trust and communication. This will then facilitate future diplomatic endeavors. International S&E partnerships should therefore be a high priority of the U.S. Government.

Just as international S&E partnerships can advance "transformational diplomacy," they can also serve as instruments of "soft power." Dr. Joseph Nye, Harvard University professor, first coined the term "soft power" in 1990 to describe the ability of states to indirectly influence the behavior or interests of other states through an attraction to shared values or other cultural or ideological means.[21] Successful use of soft power relies heavily on a state's reputation within the international community and the quality of information flow between the states involved. International S&E partnerships can be important instruments of foreign policy by fostering S&E as an important, apolitical soft-power bridge between nations. International S&E partnerships can contribute to building more stable relations among communities and nations by creating a universal culture based on commonly accepted S&E values of objectivity, sharing, integrity, and free inquiry. Science, technology, and engineering education can also be instruments to promote democracy and good governance.

A. Strengthen Science Diplomacy

Science diplomacy can facilitate relationships throughout the world in developed, developing, and troubled regions. S&E – with its common language, methods, and values – has helped to initiate and to reinforce positive relations between peoples and nations with historic and deep-seated enmities. In developing countries in particular, educational and research partnerships are effective in creating primary through post-doctorate education programs that develop S&E interest and competency among young people.

The Board has inferred the following conclusions about U.S. foreign policy in utilizing successful international S&E partnerships:

- Science diplomacy can be very effective at promoting communication among peoples and nations who otherwise are not disposed to cooperate – for example, a third partner from a "neutral" nation can help to moderate tensions in partnerships among scientists, engineers, and educators from nations with tenuous relations;

- Evenhandedness is important in S&E partnering policies – generous support for one nation can lead to frustration in others unless great care is exercised in explaining the apparent favored status;
- While traditional diplomacy favors bilateral agreements, the regional character of many S&E challenges (such as energy resources for non-oil producing countries in the Middle East) calls for multilateral approaches that engage many regional partners;
- Just as developing regions can benefit from multilateral agreements with a major funding nation such as the U.S., so too can funding nations benefit from entering joint funding agreements – for example, opportunities for diplomatic, aid, and S&E partnerships seem particularly strong between the U.S. and the European Union (EU);[22]
- Regional S&E partnerships that have demonstrated positive impacts in improving regional relations should be encouraged by the provision of longer term funding commitments;[23] and
- Much of the tension between neighboring nations can be mitigated by improving communication and trust; U.S. diplomatic efforts can do so by increasing support of S&E partnerships as apolitical vehicles of science diplomacy.

B. Foster S&E Capacity Building

Another potential benefit of international S&E partnerships between developed and developing countries is indigenous capacity building. Indigenous capacity building refers to improving the ability of developing countries to become self-sufficient and to participate in the global enterprise. Improving the national capabilities of developing countries in this way stands to benefit citizens in those countries, as well as citizens in developed countries with whom they interact. S&E partnerships among, and led by, developing countries are equally important in capacity building.

International S&E partnerships have facilitated indigenous capacity building in sustainable development, agriculture, and environmental protection with priority areas defined by the UN Commission on Sustainable Development or by the UN Development Programme's Millennium Development Goals.[24] The eight Millennium Development Goals seek to help the world's poorest people and can only fully be achieved through cooperative scientific and technological research. The U.S. Agency for International Development (USAID)'s Initiative to End Hunger in Africa uses science and technology (S&T) to innovate ways to increase agricultural productivity while reducing vulnerabilities from the environment.[25] The Caribbean Sea of the Millennium Ecosystem Assessment[26] brings together participants from various nations to undertake integrated ecosystem analyses.[27] Partnership among the involved nations helps to provide unique interdisciplinary scientific and analytical information to protect the Caribbean Sea ecosystem. NSF and USAID also partner in supporting international S&E programs to facilitate capacity building.[28] The new Library at Alexandria exemplifies a different kind of capacity building based on infrastructure development. The Library was established by Egypt in partnership with UNESCO, the EU, and a number of private sources.[29] Partnerships that recognize the benefits in promoting opportunities and careers for women in S&E can also contribute significantly to gender equity and other UN Millennium Development Goals. The potential to use international S&E partnerships for both capacity building and gender equity was exemplified by a workshop, *Empowering Women in Engineering, Science and Technology* that was held in Tunis in June 2007. It was sponsored by WFEO, with support from the Tunisian Government and engineering organizations such as the Society of Women Engineers. Modest funding for initiatives and partnerships like these can result in substantial benefits to the U.S., other nations, and the international scientific enterprise.

Strategic Priorities

A. Creating a Coherent and Integrated U.S. International S&E Strategy

In order to achieve the Board's vision of utilizing international S&E partnerships to strengthen science diplomacy and foster capacity building, the Nation must generate a clear, coherent, and integrated national S&E strategy.[30] This national strategy must balance and align contributions from the U.S. Government, NGOs, and the private sector.

In order to achieve the Board's vision of utilizing international S&E partnerships to strengthen science diplomacy and foster capacity building, the Nation must generate a clear, coherent, and integrated national S&E strategy.

(1) Goal: <u>Ensure that the U.S. develops a clear, coherent, and integrated national S&E strategy, to be leveraged worldwide to strengthen government S&E missions and to advance national economic, security, and sustainability goals</u>

No single U.S. agency is responsible for coordinating or supporting international S&E partnerships, and few U.S. agencies that do S&E work have explicit missions in international relations.[31] Fewer still are committed to assisting developing countries. Thus, responsibility falls to individual agencies to establish their own international S&E research priorities and policies. These agencies, however, have varying latitude in how they fund international institutions and partnerships between U.S. and non-U.S. researchers. In particular, some U.S. Federal agencies are unable to supplement international researchers and institutions from developing countries, where even very modest funding could make a tremendous difference, or to build creative mechanisms to support international S&E partnership programs. Fortunately, some inter-agency coordination is accomplished through information exchanges through various roundtables and panels; however, more needs to be done. For example, the National Academies could organize an annual conference to make on-going international efforts more transparent and better aligned, and to cooperatively work out duplicative efforts.[32]

Among Federal leadership bodies, the National Science and Technology Council (NSTC), a cabinet-level council to coordinate S&T policy across the Federal R&D enterprise, has the most critical role regarding international S&E cooperation. NSTC should reestablish an inter-agency committee on international S&E in order to develop a coherent, integrated, national S&E strategy. This committee must strengthen government S&E missions and advance national economic, security, and sustainability goals. This committee should also prepare a composite budget including all non-classified science, engineering, and technology activities sponsored by the U.S. Government in foreign countries. Budget development would help to coordinate and focus international S&E efforts supported by the U.S. Government. To ensure that policymakers consider both policy concerns and scientific excellence, it is important to ensure active participation by the Office of Science and Technology Policy (OSTP), the Department of State, and USAID.

> **Recommended Action:** ***The National Science and Technology Council should reestablish a committee on international S&E to coordinate the activities of the Department of State, the U.S. Agency for International Development, and various Federal mission agencies and to develop a coherent, integrated, national S&E strategy. With guidance from the Department of State, this committee should work with peer governments to establish coordinated programs across international boundaries.***

(2) Goal: Coordinate international S&E activities across Federal agencies and align Federal agency S&E activities with a national S&E strategy

In addition to participating in an overarching committee to organize international S&E activities, each Federal agency stakeholder must designate and strengthen its own point of command for international S&E. Each relevant agency should designate a lead S&E official empowered to facilitate international S&E cooperation in order to increase U.S. ability to participate effectively in international S&E partnerships. This lead official would be responsible for coordinating activities within the agency and with other Federal agencies.

> **Recommended Action:** ***Each Federal agency involved in international S&E should designate a lead official empowered to proactively promote and develop international S&E strategy and coordination.***

(3) Goal: Ensure that relevant U.S. Federal agencies subject their international S&E programs and activities to planning, execution, and accountability guidelines

In order for international S&E partnerships to be successful and effective, they must be subject to planning, execution, and accountability guidelines. The Government Performance and Results Act (GPRA) requires Federal agencies to develop strategic plans, performance plans, and scheduled performance assessments. Relevant U.S.

Federal agencies should be directed to incorporate international S&E as a GPRA priority. Including international S&E under GPRA guidelines will better ensure that the U.S. is gaining the benefit of a global planning perspective.

Recommended Action: ***Congress should amend the Government Performance and Results Act to require Federal agencies to address strategy development and performance planning for international S&E partnerships. The Office of Management and Budget should include this in its Program Assessment Rating Tool[33] guidance to U.S. Federal agencies.***

(4) Goal: Strengthen emphasis on S&E at USAID missions abroad by improving communication among science officers and U.S. embassy personnel both at home and abroad

In order to support international S&E partnerships and activities in foreign countries, U.S. embassy officials and Foreign Service Officers should become more actively involved in promoting international S&E. In 2001, the Board recommended that the Department of State consider the importance of S&E in achieving the agency's objectives and identify mechanisms for improving communication and information sharing among science officers and U.S. embassy personnel both at home and abroad.[34] In addition to implementing this recommendation, the Department of State should place a higher priority on S&E at USAID missions abroad and apply new emphasis to the roles of science advisors at key U.S. embassies. Ambassadors overseas should also organize – when warranted by host country size and the scope of its scientific enterprise – science committees in embassies composed of representatives from all science-, engineering-, or technology-related agencies in the host country.

Recommended Action: ***The Department of State should consider elevating the role of qualified science advisors at key U.S. embassies to promote science, engineering, and technology in their host countries.***

B. Balancing U.S. Foreign and R&D Policy

To achieve the Board's vision of utilizing international S&E partnerships to strengthen science diplomacy and to foster capacity building, it will be important to balance U.S. foreign policy with R&D policy.

(1) Goal: Make international S&E partnerships a priority for U.S. foreign policy and for U.S. R&D policy

International S&E partnerships can provide increasingly important means to remain at the forefront of new S&E insights and discoveries and to maintain U.S. prominence in key S&E fields. There are currently many examples of bilateral and interagency S&T programs – involving OSTP, the Department of State, USAID, NSF, and other Federal agencies – that achieve foreign policy objectives, but a more concerted effort is necessary to ensure that international S&E partnering is regarded as a high national priority. OSTP needs to charge U.S. mission agencies to develop specific mechanisms that encourage support for international S&E partnerships.

Recommended Action: ***The Office of Science and Technology Policy (OSTP) must work with the Department of State and the Office of Management and Budget (OMB) to make international S&E partnerships a priority for U.S. foreign and R&D policy. OSTP and OMB should include this strategy in the annual OMB-OSTP memo on the science and technology priorities of the Administration. OSTP should consider reestablishing the position of Assistant Director for International Strategy and should directly charge Federal agencies to include specific components of international R&D in their integrated programs.***

(2) Goal: Create and sustain more stable relationships among nations and help build the economic capacity of developing countries, by exercising the universal language and values of S&E[35]

Many scientific societies and NGOs already engage in S&E partnerships that foster science diplomacy and capacity building. These partnership activities could be expanded and strengthened by access to modest U.S. Government funding. U.S. Federal agencies need to ensure that appropriate NGOs and non-profits are aware of international S&E partnership opportunities and any available support for strengthening their capacity building programs.

Recommended Action: ***The Department of State, the U.S. Agency for International Development, scientific societies, non-governmental organizations, and non-profits should do more to encourage and to help fund international S&E partnerships as instruments of diplomacy.***

(3) Goal: Balance U.S. security policies with international S&E needs, including intellectual property protection, management and access to data, data representation policies, export controls, materials/technology transfer, manufacturing standards, and visa access for researchers

Issues of vital importance to international S&E partnerships…require careful balancing between S&E needs and security needs of the U.S. and its allies around the world.

International S&E partnerships require that collaborators from foreign nations have access to U.S. education, facilities, information, and researchers. Security concerns following September 11, 2001 led to the implementation and/or strengthening of policies that inhibit international S&E partnerships, such as limitations on visas.[36] Some countries have more restrictive policies regarding the ownership of intellectual property, which can further complicate S&E partnerships. Issues of vital importance to international S&E partnerships – such as intellectual property protection, management and access to data, data representation policies, export controls, materials/technology transfer policies, manufacturing standards, and visa access for researchers – all require careful balancing between S&E needs and security needs of the U.S. and its allies around the world. Policymakers should work with U.S. scientists and engineers to understand these needs and problems that transcend Federal agencies and research institutions and to formulate effective and appropriate solutions.

Recommended Action: ***The Administration and Congress should direct the Department of Commerce, the Office of Science and Technology Policy, the Department of State, and the Department of Homeland Security to balance U.S. security policies with international S&E needs.***

***(4) Goal*:** Improve relations between countries and improve the quality of life and environmental protection in developing countries

International S&E partnerships stand to benefit from the involvement of industry, universities, and NGOs. These entities are uniquely positioned to participate in programs promoting societal benefit through S&E by offering leveraging resources. For example, industrial partners facilitate the transition of technologies from the laboratory to the market, and NGOs and universities can frequently occupy an apolitical role in the international political environment, allowing projects to be pursued regardless of the political situation between their home countries.[37] In such situations, these organizations have more flexibility in working with foreign governments and institutions that, for political reasons, do not want to be seen conducting work with or on behalf of the U.S. Government.

Involving NGOs in international S&E partnerships can also help to raise funds for the partnerships. For example, the Green Revolution was instigated and initially funded by two NGOs, the Rockefeller Foundation and the Ford Foundation, and facilitated international as well as domestic progress on many critical societal problems. Currently, although some bodies and organizations fund specific international projects, no body or organization is specifically devoted to fund or to help coordinate the funding of international partnerships and programs. One major challenge is finding "glue money" for initial planning and for continued coordination in developing and maintaining international partnerships and programs. Efforts to coordinate a multitude of national funding bodies to jointly fund a strategic planning activity (e.g. a high-risk activity with no specific short-term tangible product) are often stymied by the diversity of interests and objectives among potential funding bodies. There is hope, though, that NGOs can play a greater role in bringing together funding bodies. For example, the multi-billion dollar IPY program is actually held together on a shoestring, organized through ICSU and the World Meteorological Organization (WMO). The IPY involves over 200 projects, with thousands of scientists from over 60 nations examining a wide range of physical, biological, and social research topics focused on the Arctic and the Antarctic from

March 2007 to March 2009. The U.S. should take a lead role in providing adequate funding to NGOs and scientific and engineering organizations that are planning and coordinating international S&E programs like the IPY.

> **Recommended Action:** ***The Office of Science and Technology Policy, the Department of State, and other U.S. Federal agencies should work with non-governmental organizations and the private sector to build and sustain international S&E partnerships using "transformational diplomacy" and "soft power."***

(5) Goal: Renew USAID's role in building S&E capacity in developing countries and encourage USAID to better employ S&E

In the past, USAID achieved widespread improvements in the stability and well-being of many developing countries through a commitment to S&E capacity building.[38] Unfortunately, the underdevelopment of S&E infrastructure in many countries and more immediate imperatives for USAID to deal with conflict and disaster situations have discouraged long-term efforts, such as sustained capacity building. By recommitting to S&E capacity building, USAID, with the help of the Executive and Legislative branches, can advance S&E in many countries across a wide range of S&E frontiers. Developing economies are home to the greatest biodiversity, climate sensitivity, and health challenges in the world. USAID can help bring many benefits of S&E advances to these countries.

It is vital that USAID restart its efforts now to ensure that critical S&E problems are addressed in developing countries. Previous USAID programs were successful at populating universities in developing countries with U.S.-trained faculty; today, however, there is a stark paucity of similar programs. In order to ensure that future generations in developing countries are occupied with trained scientists and engineers, these programs should begin now to enable and constructively engage young people in these countries. Adequate aid funding is essential to these programs.

The Board supports the key recommendations put forth in the National Academies report, *The Fundamental Role of Science and Technology in International Development: An Imperative for the U.S. Agency for International Development*:[39]

- USAID should reverse the decline in its support for building S&T capacity within important development sectors in developing countries;
- USAID should strengthen the capabilities of its leadership and program managers in Washington, DC and in the field to recognize and take advantage of opportunities for effectively integrating S&T considerations within USAID programs; and
- USAID programs that promote substantive S&E partnering to address issues of sustainable development and capacity building should be revitalized and augmented.

USAID should also encourage other U.S. Federal departments and agencies that engage in S&E-related activities in developing countries to orient these programs towards the development priorities of the host countries. As an overall goal, USAID should provide leadership in improving interagency coordination of development-related activities.

Recommended Action: ***The Administration and Congress should enact the recommendations of the National Research Council's report,*** **The Fundamental Role of Science and Technology in International Development: An Imperative for the U.S. Agency for International Development.**[40]

➤ **Guidance for NSF**

By continuing to assist USAID to support international S&E partnerships, NSF can both advance its basic science mission and play a key role in building S&E capacity in developing countries.

C. Promoting Intellectual Exchange

To achieve the Board's vision of utilizing international S&E partnerships to strengthen science diplomacy and to foster capacity building, it is essential to enhance the global mobility of scientists and engineers so that they can participate fully in joint research ventures and intellectual exchange. It is also important to find ways to actively engage more U.S. scientists and engineers in international S&E partnerships.

(1) Goal: Promote global quality of life and economic well-being by facilitating the involvement of and exchange among the best and brightest scientists and engineers, regardless of home country

Historically, the U.S. has been at the forefront of scientific discovery and innovation due to the work of both U.S.-born scientists and engineers and of foreign nationals who relocated to the U.S. to conduct science. In the past, some other parts of the world – especially the developing world in the 1980s – experienced the problem of "brain drain." Scientists and engineers left their home countries to be educated and did not return because their home countries lacked S&E infrastructure. With increasing S&E capacity and globalization, however, "brain circulation" may become the prevalent phenomenon. Under this model, scientists and engineers leave their home countries to build bridges with foreign professionals leading innovative studies abroad. Unlike in "brain drain," these researchers then return to their home countries to share their knowledge and networks with their compatriots and to assist in capacity building and infrastructure development.

Scientists and engineers in the U.S. and in other developed countries also stand to benefit from participating in research and educational opportunities abroad.[41] Discovery and problem solving are often catalyzed by bringing together different expertise and varied perspectives, and by enabling access to unique data and resources. Global fora can be held to identify priority research ventures and to develop common funding and governance schemes. Priority research sites could draw scientists and engineers from around the world to gain international experience to take back to their home countries.

...the circulation of scientists and engineers from the U.S., other developed countries, and the developing world represents a new pattern of international S&E interaction and workforce migration.

Taken together, the circulation of scientists and engineers from the U.S., other developed countries, and the developing world represents a new pattern of international S&E interaction and workforce migration. In order to continue to enhance this pattern, two challenges must be addressed: (1) barriers to migration and (2) lack of supportive home environments to which scientists and engineers can return.

The U.S. has always attracted many international students and researchers, but numbers declined when security regulations implemented after the September 11, 2001 attacks made it more difficult for foreign students and researchers to enter the country.[42] The Department of State has done much to address these problems, but a perception continues to persist in the international community that the U.S. does not welcome non-U.S. scientists, engineers, and students as it once did.

Scientists and engineers around the world report being discouraged from leaving their home countries by a lack of viable opportunities after their return. U.S. Federal agencies can do more to encourage U.S. scientists and engineers to participate in international exchange programs. Agencies must create incentives for international training by establishing international research fellowships. These fellowships could include financial provisions for moving and working abroad, and professional and research opportunities upon returning to the U.S.

Recommended Action: ***Congress and the Department of State should facilitate "brain circulation," as opposed to "brain drain," in employing S&E talent through:***

- ***Reinvigorating the interest of American students in S&E by supporting study abroad opportunities, during which they would collaborate with foreign scientists and engineers;***
- ***Streamlining the visa process for foreign S&E scientists, engineers, and students;***
- ***Encouraging foreign study and collaborative scientific work for U.S. scientists, engineers, and students by easing their transition to working abroad and by providing professional and scientific opportunities upon their return to the U.S.;***
- ***Identifying and increasing the use of certain U.S. and foreign specialized facilities for collaborative work by scientists and engineers from around the world;[43] and***

- ***Supporting global fora to identify priority research ventures and to develop common funding and governance schemes, in order to draw scientists and engineers from around the world to gain international experience to take back to their home countries.***

(2) Goal: Encourage partnerships with the accountability community so that common ground rules can be established in international S&E partnerships in order to minimize both misconduct and bureaucratic overhead

For the U.S. to support international S&E partnerships, there must be accountability, research integrity, and minimal bureaucratic overhead from many sources. Common standards for research integrity among participants in international S&E partnerships must be created, because scientific misconduct and excessive bureaucratic overhead have become issues of global concern. Currently, efforts are underway to foster common research integrity values and to establish definitions of misconduct – generally considered to include plagiarism, fabrication, and falsification of data. A well-designed strategy to promote integrity, deter misconduct, and minimize bureaucracy within international partnerships should be an integral part of all collaborative agreements. While there is no established methodology for setting common research integrity standards, the Organisation for Economic Co-operation and Development (OECD) Global Science Forum is working to develop models that may facilitate accountability in international S&E partnerships.[44] These efforts are supported by OSTP, NSF, and the NSF Office of Inspector General.

A well-designed strategy to promote integrity, deter misconduct, and minimize bureaucracy within international partnerships should be an integral part of all collaborative agreements.

A number of U.S. and foreign scientists and organizations report that they have been discouraged from participating in international S&E partnerships due to the difficulty of working with different funding agencies in the countries involved. The burden of bureaucratic overhead appears to outweigh the obvious scientific and societal benefits of such partnerships. This difficulty can be mitigated by developing common standards and rules for research integrity and information sharing. NSF has made good progress in employing common standards with the EU, its member states, and other developed countries, but partnerships with scientists and engineers in developing countries are still hindered by excessive bureaucratic intervention. One method to decrease the potential of overly bureaucratic intervention in international S&E partnerships is to encourage partnerships with the accountability community so that common ground rules can be established.

Recommended Action: ***The U.S. Government should:***

- ***Continue to work with other countries with significant partnership potential to institute scientific standards and processes;***
- ***Create joint and collaborative program announcements for the following activities:***
  - ***To review and fund proposed international S&E projects;***
  - ***To grant ownership of intellectual property developed with government support; and***

  - ***To develop and institute financial and compliance policies for international S&E projects.***
- ***Utilize the National Resource Center Program of the International Education Programs Service of the U.S. Department of Education in order to provide grants to establish, strengthen, and operate language and area/international studies centers that will be national resources for teaching modern foreign languages.***

➢ **Guidance for NSF**

NSF should continue to facilitate international S&E partnerships by continuing to work towards the establishment of scientific standards and practices in foreign countries.

(3) Goal: Actively promote and fund U.S. scientists and engineers to engage in and sustain international S&E partnerships throughout NSF

Adequate funding is essential to international S&E partnerships. Unlike the EU, the U.S. Government has few significant sources of funds specifically identified for building international S&E partnerships. Moreover, science, engineering, and technology agreements between nations are often viewed as being no more than statements of good intentions, because they lack funds to actually support research initiatives.

In addition to having no significant central funding source, international S&E partnerships are financially supported in only a piecemeal manner by U.S. funding agencies. With the notable exceptions of the Department of Defense, the National Institutes of Health (NIH), and NSF, most U.S. funding agencies have varying, but little, latitude to fund international institutions and partnerships between U.S. and non-U.S. researchers.

NSF currently funds international S&E partnerships through its Office of International Science and Engineering (OISE), which also brokers additional funding from other directorates. Unfortunately, many U.S. researchers perceive that NSF does not provide tangible incentives or much funding for international S&E partnerships. It is essential, therefore, for NSF to better promote and encourage international partnerships. NSF currently provides supplementary funding to U.S. principal investigators to cover the costs of their collaborators in developing countries, but there needs to be greater publicity of these opportunities. NSF should also continue to encourage the huge potential for improving S&E education in international S&E partnerships, both in the preparation of future teachers at the elementary and secondary levels, and in the development of higher education curricula.

➢ **Guidance for NSF**

NSF should:

- ***Better publicize its practice of encouraging principal investigators to request supplemental funding through their research grants for foreign collaborators from developing countries;***
- ***Encourage all of its directorates to develop specific plans and programs to support international partnerships and then to publicize them to the appropriate domains and disciplines;***
- ***Link international S&E research partnerships with curricular pathways for students; and***
- ***Through OISE, and in coordination with NSF directorates, continue to provide services such as training, research matchmaking, culture and language information, software tools, and legal and intellectual property information in support of international partnerships.***

Conclusions

The U.S. Government must support international S&E partnerships for multiple beneficial reasons, which must be understood by both Congress and the greater public. These benefits are not only vital to the future prosperity of the U.S., but also stand at the forefront of solving the most pressing issues facing the entire world. Climate change, natural disasters, food shortages, sanitation, safe drinking water, energy resources, and the spread of disease are a few issues that have global consequences and that require a collaborative worldwide effort from not only scientists and engineers, but from policymakers at all levels. The U.S. must help shape the direction of international partnering and provide leadership in building international S&E partnerships that address these important global issues.

Climate change, natural disasters, food shortages, sanitation, safe drinking water, energy resources, and the spread of disease are a few issues that have global consequences and that require a collaborative worldwide effort from not only scientists and engineers, but from policymakers at all levels.

In addition to addressing global challenges, U.S. leadership in international S&E partnerships would help ensure that the U.S. moves forward as a full partner in the global S&E enterprise. These partnerships can enable U.S. scientists, engineers, and students to participate more fully in the rapidly growing international S&E effort, which can in turn help the U.S. business community stay on the cutting edge of technologies and help energize both the U.S. and global economies. Economic development, cultivation of civil society, elevation of the roles of women and underrepresented groups, and redirection of scientists and engineers towards more productive, socially responsible pursuits are also indirect positive benefits of these partnerships.

International S&E partnerships are important tools of international diplomacy; they strengthen international relationships and uphold many ideals that the U.S. holds dear: accountability, meritocracy, transparency, and objectivity. The U.S. puts its best face forward in international S&E partnerships, so that the rest of the world can view it as a great place to conduct S&E and as a Nation that upholds fundamental research values. Robust and vibrant international S&E partnerships and effective communication are also vital for Federal agencies to carry out their missions.

The U.S. Government currently plays an active role in supporting international S&E partnerships. However, that role could be performed far more effectively. In the U.S., no single agency is responsible for coordinating international S&E partnerships, in spite of the fact that some policy issues transcend individual agencies and require greater cross-agency coordination. Greater coordination of international S&E partnership activities among U.S. Federal agencies needs to occur, while respecting the autonomy of individual agencies.

Moreover, individual Federal agencies have varying latitude in how they fund international institutions and partnerships between U.S. and non-U.S. researchers. Some domestic research funding agencies are unable to supplement international researchers and institutions from developing countries, where even very modest funding could make a tremendous difference. The U.S. needs to address this issue and build creative mechanisms to support international S&E partnership programs.

Finally, security measures put in place following September 11, 2001 have presented new challenges for international S&E collaboration. While the U.S. Government has made progress on these issues, further improvements are needed. The U.S. must continue to attract the best and brightest from around the world, while also encouraging its citizens to choose S&E careers. U.S. researchers and students should be encouraged to take advantage of research and educational opportunities abroad (e.g. at foreign centers of S&E research excellence). For the U.S. to continue to prosper, these global issues and concerns should be addressed now through international S&E partnerships as described in this report. As a Nation, we must not only face the challenges that require S&E expertise today, but we must be prepared to confront issues of global opportunity, and even survival, of the future.

The Board's goals and recommended actions in this report are the beginning of a more high profile, coordinated, and vigorous course of action for the U.S. Government to ensure its leadership as goodwill ambassadors in S&E. These recommended actions can only succeed with the firm and long-term commitment of U.S. and foreign leadership. U.S. Federal agencies should have direct and constant budget funding lines and appropriate assessment mechanisms for international S&E partnerships and programs. By doing so, the U.S. will remain a leader in S&E issues, help solve global challenges, and gain respect and admiration throughout the world.

Endnotes

[1] National Science Board, *Science and Engineering Indicators 2008*, (Arlington, VA: National Science Foundation (Volume 1, NSB-08-01; Volume 2, NSB-08-01A), 2008), pg. 2-19.

[2] For example, Europe leads the world in certain areas of physics while Japan leads the world in earthquake research, monitoring the global environment, and computational facilities.

[3] Through international S&E cooperation, the U.S. can provide leadership on many of these international challenges. For example, a high priority of the U.S. Government is the Global Earth Observation System of Systems (GEOSS), a global network that will enable coordinated observations, better data management, and increased data sharing. The success of GEOSS is highly dependent on meaningful and lasting international cooperation.

[4] In the past, research addressing these global challenges led to the use of oral rehydration therapy, which became a cornerstone in controlling diarrheal diseases. S&E research also found that two cents worth of vitamin A given to children every six months could reduce mortality in many countries by over one-third, and it established rice-wheat rotation techniques that have substantially improved agricultural productivity. For more information, see National Research Council, Committee on Science and Technology in Foreign Assistance, *The Fundamental Role of Science and Technology in International Development: An Imperative for the U.S. Agency for International Development*, (Washington, DC: The National Academies Press, 2006).

[5] For example, the National Institutes of Health permits funding of the best and brightest minds regardless of nationality to research and fight human diseases. For more information, see John E. Fogarty International Center for Advanced Study in the Health Sciences, U.S. National Institutes of Health, Global Research Initiative Program for New Foreign Investigators (GRIP). Available online at: *http://www.fic.nih.gov/programs/research_grants/grip/index.htm*.

[6] According to the Office of Management and Budget, the Program Assessment Rating Tool (PART) was developed "to assess and improve program performance so that the Federal government can achieve better results. A PART review helps identify a program's strengths and weaknesses to inform funding and management decisions aimed at making the program more effective. The PART therefore looks at all factors that affect and reflect program performance including program purpose and design; performance measurement, evaluations, and strategic planning; program management; and program results. Because the PART includes a consistent series of analytical questions, it allows programs to show improvements over time, and allows comparisons between similar programs." For more information, see *http://www.whitehouse.gov/omb/part/*.

[7] National Research Council, Committee on Science and Technology in Foreign Assistance, T*he Fundamental Role of Science and Technology in International Development: An Imperative for the U.S. Agency for International Development*, (Washington, DC: The National Academies Press, 2006).

[8] Closer coordination between policymakers and the users of these facilities will better ensure that U.S. funding policies do not present unintended hurdles to U.S. scientists' access to international research facilities.

[9] U.S. Federal disinvestment in national networking, the most fundamental infrastructure that underlies cyberinfrastructure, has resulted in the clear and substantial loss of U.S. leadership in a field that the U.S. invented and still led as recently as a decade ago. It also seems evident that the current lack of balanced investment in an integrated U.S. cyberinfrastructure strategy is likely to lead to deterioration of any leadership in cyberinfrastructure to which the U.S. may aspire.

[10] Bush, Vannevar, A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development, *Science – The Endless Frontier*, (Washington, DC: United States Government Printing Office, July 1945).

[11] UNESCO, an intergovernmental organization with universal membership, recently celebrated its sixtieth anniversary with a publication, "Sixty Years of Science at UNESCO 1945-2005," which recounts its science efforts encouraging international cooperation in research, education and in science policy advice to governments. For more information about UNESCO, see *http://www.unesco.org*.

[12] For more information about the International Council for Science, see *http://www.icsu.org*.

[13] For more information about the World Federation of Engineering Organisations, see *http://www.wfeo.org*.

[14] For more information about the Academy of Sciences for the Developing World, see *http://www.twas.org.*

[15] National Science Board Interim Report, *Toward a More Effective NSF Role in International Science and Engineering* (NSB-00-217), (Arlington, VA: National Science Foundation, December 14, 2000).

[16] National Science Board, *Toward a More Effective Role for the U.S. Government in International Science and Engineering* (NSB-01-187), (Arlington, VA: National Science Foundation, November 15, 2001).

[17] National Science Foundation, *Investing in America's Future: Strategic Plan FY 2006-2011* (NSF-06-48), (Arlington, VA: National Science Foundation, September 2006).

[18] National Science Board, *National Science Board 2020 Vision for the National Science Foundation* (NSB-05-142), (Arlington, VA: National Science Foundation, December 2005). Available online at: *http://www.nsf.gov/pubs/2006/nsb05142/nsb05142.pdf.*

[19] National Science Board, Committee on Programs and Plans, Charge to the Task Force on International Science, September 29, 2005 (NSB-05-134). Available online at: *http://www.nsf.gov/nsb/committees/is_charge.jsp.*

[20] Secretary Condoleezza Rice, Transformational Diplomacy, Georgetown University, Washington DC, January 18, 2006. Available online at: *http://www.state.gov/secretary/rm/2006/59306.htm.*

[21] Nye, Jr., Joseph. *Bound to Lead: The Changing Nature of American Power*, (New York: Basic Books, 1990).

[22] Dr. Janez Potočnik, Commissioner for Science and Research for the European Commission, is actively seeking such partnering.

[23] It is important that partnerships with developing countries align with national and regional needs and priorities, as well as, catalyze positive future development.

[24] For more information, see *http://www.un.org/millenniumgoals/index.html.*

[25] For more information, see *http://www.usaid.gov/locations/sub-saharan_africa/initiatives/ieha.html.*

[26] The Millennium Ecosystem Assessment was, "called for by the United Nations Secretary-General Kofi Annan in 2000. Initiated in 2001, the objective of the MA was to assess the consequences of ecosystem change for human well-being and the scientific basis for action needed to enhance the conservation and sustainable use of those systems and their contribution to human well-being. The MA has involved the work of more than 1,360 experts worldwide. Their findings, contained in five technical volumes and six synthesis reports, provide a state-of-the-art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide (such as clean water, food, forest products, flood control, and natural resources) and the options to restore, conserve or enhance the sustainable use of ecosystems." For more information, see *http://www.millenniumassessment.org/en/About.aspx#1.*

[27] The lead institutions involved in this assessment are the University of the West Indies, the Cropper Foundation, the Institute of Marine Affairs, the Island Resources Foundation, the University of Florida, the Association of Caribbean States Secretariat, the Caribbean Community Secretariat, the Economic Commission for Latin America and the Caribbean for the Caribbean Office, the Caribbean Conservation Association, the United Nations Environment Programme Regional Office for the Latin America and the Caribbean, and the Caribbean Agricultural Research and Development Institute.

[28] For example, the U.S.-Pakistan Science and Technology Program, led by a coordinating committee chaired by Dr. Arden Bement, NSF Director, and Dr. Atta-ur-Rahman, Pakistan Minister of Education and Science Advisor to the Prime Minister. USAID funds the U.S. contribution of the joint program and supports other programs in Pakistan involving NIH and other agencies. This U.S.-Pakistan S&T program supports a number of joint research projects peer reviewed by the National Academy of Sciences and approved by the joint S&T committee.

[29] The new Library at Alexandria is a magnificent complex that was established by Egypt in partnership with UNESCO, the EU, and a number of private sources near the site of the ancient Library. It includes a Planetarium, a Conference Center, and numerous research institutes and educational support facilities, in addition to, a modern library with extensive digital collections, databases, archives, and journals. The Library also provides extensive educational and research support services and stands as an important monument to the peoples of Egypt and other Arabic speaking nations.

[30] In the United Kingdom for example, coordination of international S&E partnerships between government departments is facilitated via the UK Global Science and Innovation Forum (GSIF). GSIF is chaired by the UK Government's Chief Scientific Advisor and brings together senior officials from the Department for Innovation, Universities and Skills, Foreign and Commonwealth Office, Department for International Development, Department for Health, and a number of other departments and bodies, including the UK Research Councils. GSIF provides useful information for greater sharing and coordination of activities on international S&E partnerships.

[31] However, many Federal agencies do engage in international S&E partnerships to fulfill their individual mission objectives. Due to the global nature of U.S. national interests and the rapidly growing international S&E enterprise, the Department of Defense, for example, has a presence around the world with offices in Tokyo, Singapore, Chile, Argentina, and Australia. The National Science Foundation's Office of International Science and Engineering has representatives in Beijing, Tokyo, and Paris to facilitate mutually advantageous research collaborations. The work of agencies such as the Department of Commerce's National Oceanic and Atmospheric Administration and the National Aeronautic and Space Administration is inherently trans-boundary in nature and global in scope.

[32] Although this annual conference would be primarily for U.S. Federal agencies to coordinate their international S&E partnerships, it would be beneficial to also include leadership from industry and academia.

[33] According to the Office of Management and Budget, the Program Assessment Rating Tool (PART) was developed "to assess and improve program performance so that the Federal government can achieve better results. A PART review helps identify a program's strengths and weaknesses to inform funding and management decisions aimed at making the program more effective. The PART therefore looks at all factors that affect and reflect program performance including program purpose and design; performance measurement, evaluations, and strategic planning; program management; and program results. Because the PART includes a consistent series of analytical questions, it allows programs to show improvements over time, and allows comparisons between similar programs." For more information, see *http://www.whitehouse.gov/omb/part/*.

[34] National Science Board, *Toward a More Effective Role for the U.S. Government in International Science and Engineering* (NSB-01-187), (Arlington, VA: National Science Foundation, November 15, 2001).

[35] The State Department does provide support to UNESCO, the Organization of American States, and OECD for capacity building in developing countries, and NSF provides direct leadership to these three international bodies.

[36] The Government Accountability Office has, "made several recommendations to strengthen the visa process in a way that reduces barriers for international students while balancing national security and recent changes have improved the process. Processing times for certain security reviews have declined, and recent data show more student visas issued in the last few years. The Department of State has also taken steps to ease the burden on students, including expediting interviews, and extending the length of time that some visa clearances are valid. The United States must maintain an appropriate balance between protecting national security interests and ensuring our long-term competitiveness. Monitoring current trends and federal policies is essential to ensuring that the United States continues to obtain talented international students in the face of greater global competition." See statement of George A. Scott, Director, Education, Workforce, and Income Security Issues, Testimony before the Subcommittee on International Organizations, Human Rights and Oversight, Committee on Foreign Affairs, House of Representatives, *Higher Education – Challenges in Attracting International Students to the United States and Implications for Global Competitiveness* (Washington, DC: U.S. Government Accountability Office, June 29, 2007).

[37] The Rockefeller and Gates Foundations, corporations such as Microsoft and Cisco and their foundations, the Abdus Salam International Centre for Theoretical Physics, and the U.S.–Israel Binational Science Foundation are excellent examples of non-governmental stakeholders that are able to successfully partner internationally in S&E.

[38] For example, USAID supported the first engineering design and construction phase of a Kabul to Kandahar highway, generating employment, engineering knowledge and improving access to markets, health care, schools, and jobs.

[39] National Research Council, Committee on Science and Technology in Foreign Assistance, *The Fundamental Role of Science and Technology in International Development: An Imperative for the U.S. Agency for International Development*, (Washington, DC: The National Academies Press, 2006).

[40] Ibid.

[41] Recently, Japan and Australia have emerged as premiere funding countries of international S&E partnerships with the developing countries of Asia. The European Union has also been very active in funding S&E partnerships in the developing countries of the former Soviet Union, the Middle East, South America, and Africa. In addition, South-South cooperation is promoting partnerships among developing countries with Brazil, China, and India.

[42] According to the 2005 Survey of Graduate Students and Postdoctorates in Science and Engineering, co-sponsored by the National Science Foundation and the National Institutes of Health, total U.S. enrollment of foreign graduate students in S&E fields continued to decline in 2005, but enrollment of first-time, full-time foreign S&E graduate students rose 4% over the 2004 level - the first increase since 2001. For more information, see *http://www.nsf.gov/statistics/infbrief/nsf07312/.*

[43] Closer coordination between policymakers and the users of these facilities will better ensure that U.S. funding policies do not present unintended hurdles to U.S. scientists' access to international research facilities.

[44] For more information, see *http://www.oecd.org/department/0,3355,en_2649_34319_1_1_1_1_1,00.html.*

Selected Acronyms

CRDF	Civilian Research and Development Foundation
GPRA	Government Performance and Results Act
ICSU	International Council for Science
ICTP	International Center for Theoretical Physics
IPY	International Polar Year
NSTC	National Science and Technology Council
OECD	Organisation for Economic Co-operation and Development
OMB	Office of Management and Budget
OSTP	Office of Science and Technology Policy
TWAS	The Academy of Sciences for the Developing World
USAID	U.S. Agency for International Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
WFEO	World Federation of Engineering Organisations

Appendix A

Examples of International S&E Partnerships

The Task Force heard about the following examples of international S&E partnerships during its meetings and discussions. This list is not meant to be comprehensive or exhaustive but is instead a limited selection of S&E partnerships that emerged in conversations with various individuals.

The U.S. Civilian Research and Development Foundation (CRDF) is an example of a NGO dedicated to building international S&E partnerships. Congress created CRDF in the wake of the collapse of the Soviet Union to address problems that arose when thousands of scientists and engineers, many of them former weapons scientists, no longer had an outlet for their work. CRDF provided research grants, training, and exchange programs that enabled these scientists and engineers to continue making productive contributions in their fields and to participate in the rebuilding of their countries, while also building S&E partnerships with American counterparts. CRDF is now applying its programs and expertise in other regions of the world, including the Middle East and North Africa.

The U.S.-Israel Binational Science Foundation (BSF), the U.S.-Israel Binational Agricultural Research and Development Fund, and the Israel-U.S. Binational Industrial Research and Development Foundation (BIRD) were jointly endowed by the U.S. and Israel to organize, fund, and help achieve common goals for international partnerships in science, agriculture, and entrepreneurship. The U.S.-Israel BIRD Foundation, in particular, is an excellent example of a facilitator organization for partnerships in entrepreneurial business development. The truly exciting aspect of these venture partnerships is that once seeded, they have the potential to be economically self-sustaining and can generate additional funding for seeding similar future enterprises. Additionally, the BSF Board of Governors recently called for Palestinian involvement in workshops sponsored by BSF, which emphasizes the power of science diplomacy to bring together otherwise very antagonistic populations. With support from the U.S. Department of State, regional scientific workshops have proved to be a very cost effective way of bringing scientists together around common issues in the Middle East and in other regions of the world. These regional scientific workshops should continue to be a high priority, but subsequent funding for actual research collaborations are also needed.

The USAID-funded Red Sea Marine Peace Park Cooperative Research, Monitoring, and Management Program serves as a good example of a multilateral Israel-Jordan-U.S. science partnership with great benefits to science, to those nations, to the region, and to the pursuit of peace. Funding requirements for such partnerships are modest and pay substantial long-term dividends. Developing scientific institutions in developing countries can also facilitate cooperation, communication, and trust. An example of this is the Africa Science Academies Development Initiative at the National Academy of Sciences, which demonstrates the benefit of taking a regional, in addition to a country-by-country approach, to increase the capacity of scientists in bringing their knowledge to policy debates.

Egypt and the U.S. have also experienced great success in establishing collaborative partnerships under the aegis and support of the jointly funded Egypt-U.S. Joint Science and Technology Fund. Like the U.S.-Israel partnerships mentioned before, this fund represents an excellent example of science diplomacy that could well serve as a model for other bilateral and multilateral diplomatic relationships in the Middle East and elsewhere. Very recently, the U.S. established the Community College Initiative with Egypt under the aegis of the Fulbright Commission. This innovative program will sponsor up to 200 Egyptians to study for up to 2 years at community colleges in the U.S.

The U.S. and Jordan have recently signed an Agreement on Science and Technology Cooperation. However, unlike the agreements with Israel and Egypt, this agreement is not yet funded. In fact, only 2 out of the 42 S&T partnerships that the U.S. established with other nations are funded. S&T agreements with no funding may well engender more frustration than good will. Some argue, however, that by developing relationships between scientists through the S&T working groups of the U.S. and partner countries, the best projects will rise to the surface and attract funding from a pool that already exists.

The new Library at Alexandria is a magnificent complex that was established by Egypt in partnership with UNESCO, the EU, and a number of private sources near the site of the ancient Library. It includes a Planetarium, a Conference Center, and numerous research institutes and educational support facilities, in addition to, a modern library with extensive digital collections, databases, archives, and journals. The Library also provides extensive educational and research support services and stands as an important monument to the peoples of Egypt and other Arab speaking nations. Another great resource is the Iraqi Virtual Science Library, developed by the U.S. Departments of State and Defense, which provides Iraqi researchers with the same access to scientific journals and research as one would expect on any university campus in the U.S.

There are also examples where NSF and USAID partner in supporting international S&T programs to facilitate capacity building. For example, the U.S.-Pakistan Science and Technology Program, led by a coordinating committee chaired by Dr. Arden Bement, NSF Director, and Dr. Atta-ur-Rahman, Pakistan Minister of Education and Science Advisor to the Prime Minister. USAID funds the U.S. contribution of the joint program and supports other programs in Pakistan involving NIH and other agencies. This U.S.-Pakistan S&T program supports a number of joint research projects peer reviewed by the National Academy of Sciences and approved by the joint S&T committee. Over the past year, the Committee has also established sixteen S&T working groups that involve interagency participation in Pakistan and in the U.S. to carry out joint research projects of mutual interest (with direct benefit to Pakistan). Through this collaboration, NSF just completed a network connection of *Internet 2* with Pakistan to facilitate research and education collaborations and data exchanges under the program.

The USAID Initiative to End Hunger in Africa uses science and technology to innovate ways to increase agricultural productivity while reducing vulnerabilities from the environment. This initiative encourages partnerships among U.S. universities, international researchers, and African researchers that invest in agricultural research, institutions, networking, and training in order to accelerate the development of science-based solutions for the problems of African farmers. There needs to be a long-term commitment of funding for this type of S&E initiative in Africa in order for capacity building to be effective.

The Caribbean Sea of the Millennium Ecosystem Assessment brings together participants to undertake integrated ecosystem analyses. The assessment aims to determine the policies and governance structures that will protect the ecosystem of the Caribbean Sea to sustain and supply services that support human well-being in all countries of the region. Partnership among the involved nations helps to provide uniquely interdisciplinary scientific and analytical information to protect the Caribbean Sea ecosystem.

International centers serve as another means to build international S&E partnerships. Examples of these centers include the Abdus Salam International Center for Theoretical Physics (ICTP) in Trieste, Italy; the International Centre for Pure and Applied Mathematics; the Trace Elements Institute of UNESCO; and the International Centre for Chemical Studies. ICTP is supported by Italy, UNESCO, the Synchrotron-light for Experimental Science and Applications in the Middle East project, and the International Atomic Energy Agency to provide education and to stimulate research in a wide variety of scientific fields for scientists in developing countries. With modest additional funding from other developed countries, this center could serve as an important broker to establish productive international collaborations between scientists and engineers in developed and developing countries. In the Southern African Millennium Ecosystem Assessment, the International Centre for Researching Agroforestry works together with national research systems and NGOs to take a soil nutrient replenishment approach in rebuilding soil fertility.

In 1999, UNESCO, together with the International Council for Science, convened a World Conference on Science. The final documents of this conference offer a contract for international cooperation among the scientific community and governments, to serve the needs of humanity for peace and sustainable development. In response to this conference, UNESCO adopted a more integrated approach to problem-solving and the promotion of research and science education through multilateral cooperation.

Appendix B

Summary of Board Activities

In determining how the U.S. can best move forward as a full partner in the current international scientific enterprise, representatives of the Board's Task Force first met informally with individual federal agencies, NGOs, foundations, and other organizations. The Task Force then convened a formal public Roundtable Discussion in May 2006 at The George Washington University in Washington, D.C. This forum enabled the Board to gain insight on the current and potential role of the U.S. Government in supporting international science and engineering.

The Task Force also met with the leadership of NSF and OISE to assess NSF's progress with the recommendations from the prior Interim Report *Toward a More Effective NSF Role in International Science and Engineering.*[1] The Task Force was pleased to find substantial progress with all nine recommendations from the Interim Report and additional progress in such areas as, the new Partnerships for International Research and Education program, a new international cyberinfrastructure program, IPY, and other such large-scale research programs. There has also been significant participation by NSF in multilateral/international organizations engaged in science and engineering, such as the International Institute for Applied Systems Analysis; OECD; ICSU; the Human Frontier Science Program; the WMO; UNESCO; and the Organization of American States.

With respect to international partnerships, the Task Force was encouraged to learn of many bilateral S&E programs involving OSTP, the Department of State, USAID, NSF, and various Federal Agencies to help achieve foreign policy objectives. In addition to the U.S., nations participating in these S&E programs include Pakistan, India, Israel, China, Brazil, and Iraq. The NSF Inspector General also provided valuable insights in the challenges that governments face on research integrity and in handling allegations of misconduct in research. Through the Global Science Forum, members of OECD have developed a strategy to promote integrity and deter misconduct throughout the scientific enterprise.

Based on the information obtained from the discussions and meetings in the U.S., the Task Force met formally and informally with scientists and engineers around the world in order to gather additional insight on S&E initiatives and international partnerships that would help formulate the Task Force's subsequent findings and recommendations. To obtain diverse perspectives, meetings were set up in Asia, Europe, and the Middle East.

The first of three international gatherings was held in September 2006, when Task Force members traveled to Singapore to hold a round table discussion with representatives of the Industrial Science and Technology Working Group of the Asia-Pacific Economic Cooperation economies. This discussion provided important insights on the value of international S&E partnerships to other, particularly developing nations, and identified challenges faced by Asia-Pacific economies in developing and sustaining these partnerships.

A second discussion forum was held in March 2007 in Brussels with representatives from the European Commission and leaders in science and technology from the European Community to discuss European experiences with international partnerships. Interestingly, the new EU 7th Framework Programme

(2007-2013) makes an explicit budgetary provision for international partnerships with developing countries and seeks to "mainstream" international cooperation throughout the programme. Discussions were also held with representatives from the ICTP and TWAS to learn their unique perspectives on the value of international S&E partnerships to improve the quality of life of, environmental protection and scientific capacity in, and relationships with, developing countries.

The final set of discussions were held in July 2007, when Task Force representatives traveled to the Middle East to better understand the power of science diplomacy to improve relations in this troubled part of the world. Discussions were held with the Board of Governors of the U.S.-Israel BSF in Jerusalem; representatives from the Israeli-Palestinian Science Organization; the Director and staff of the Bibliotheca Alexandria (the modern successor to the ancient Library at Alexandria); HRH Princess Sumaya and the staff of the Royal Scientific Society in Amman, Jordan; and with many other individual scientists, university leaders, and government representatives in Israel, Palestine, Egypt, and Jordan to learn of their experiences and needs in international science and engineering partnerships.

Following these international gatherings and discussions, the Task Force drafted a report outlining goals and recommendations to increase U.S. Government support for international S&E partnerships. The Board approved this draft report for a formal public comment period at its October 2007 meeting in order to receive further input from stakeholder communities. The Board subsequently approved and finalized the report in its current form.

[1] National Science Board Interim Report, *Toward a More Effective NSF Role in International Science and Engineering* (NSB-00-217), (Arlington, VA: December 14, 2000).

Appendix C

List of Participants in Task Force Roundtable Discussions and Meetings

(Categorized by location of discussion and in no particular order)

Location	Name	Affiliated Organization
Washington, D.C.	Natalia Agapitova	World Bank
Washington, D.C.	John Boright	National Academy of Sciences
Washington, D.C.	William Brennan	National Oceanic and Atmospheric Administration
Washington, D.C.	Michael Brown	The George Washington University
Washington, D.C.	Cathleen Campbell	U.S. Civilian Research and Development Foundation
Washington, D.C.	Margaret Goud Collins	International Institute for Applied Systems Analysis
Washington, D.C.	Al Condes	National Aeronautics and Space Administration
Washington, D.C.	Owen Cylke	NRC Committee on Science and Technology in Foreign Assistance
Washington, D.C.	David Evans	Smithsonian Institution
Washington, D.C.	Sharon Hrynkow	National Institutes of Health, Fogarty International Center
Washington, D.C.	Marina Koch-Krumrei	German Research Foundation
Washington, D.C.	Carol Linden	U.S. Department of Homeland Security
Washington, D.C.	John Marburger	Office of Science and Technology Policy
Washington, D.C.	Franklin Moore	U.S. Agency for International Development
Washington, D.C.	Norman Neureiter	American Association for the Advancement of Science
Washington, D.C.	Charles Owens	U.S. Civilian Research and Development Foundation
Washington, D.C.	Joan Rolf	Office of Science and Technology Policy
Washington, D.C.	Hratch Semerjian	National Institute of Standards and Technology
Washington, D.C.	Stephen Trachtenberg	The George Washington University
Washington, D.C.	Nicholas Vonortas	The George Washington University
Washington, D.C.	Thomas Weber	National Science Foundation
Washington, D.C.	Timothy Wirth	United Nations Foundation
Washington, D.C.	Dan Arvizu	National Science Board Member
Washington, D.C.	Barry Barish	National Science Board Member
Washington, D.C.	Steven Beering	National Science Board Chairman
Washington, D.C.	Kelvin Droegemeier	National Science Board Member
Washington, D.C.	Louis Lanzerotti	National Science Board Member
Washington, D.C.	Alan Leshner	National Science Board Member
Washington, D.C.	Jon Strauss	National Science Board Member; Task Force on International Science Chairman
Washington, D.C.	Kathryn Sullivan	National Science Board Member
Washington, D.C.	Michael Crosby	National Science Board Executive Officer
Singapore	Vanessa Chang	Industry Canada

Singapore	Finarya Legoh	The Ministry of State for Research and Technology
Singapore	Yasuyuki Yagi	National Institute of Advanced Industrial Science and Technology
Singapore	Kazuhito Oyamada	Japan Society for Promotion of Science
Singapore	Isao Kiso	Japan Society for Promotion of Science
Singapore	Reiko Nagata	Ministry of Economy, Trade and Economy
Singapore	Masanori Kawabata	Ministry of Education, Culture, Sports, Science and Technology
Singapore	Watanabe Sonoko	Ministry of Education, Culture, Sports, Science and Technology
Singapore	Jeong Hyop Lee	Science and Technology Policy Institute
Singapore	Tobias Nischalke	Ministry of Research Science and Technology
Singapore	Ester Ogena	Science Education Institute
Singapore	Elenita Leus	Republic of the Philippines
Singapore	Jennifer Hu	National Science Council
Singapore	C.K. Lee	National Science Council
Singapore	Joseph Mullinix	National University of Singapore
Singapore	Lock Kai Sang	The Institution of Engineers
Singapore	Tan Seng Chuan	The Institution of Engineers
Singapore	Churdchan Juangbhanich	Ministry of Science and Technology
Singapore	Bui Quoc Khanh	Ministry of Science and Technology
Singapore	Le Thanh Binh	Ministry of Science and Technology
Singapore	Dan Arvizu	National Science Board Member
Singapore	Patricia Galloway	National Science Board Member
Singapore	Jon Strauss	National Science Board Member; Task Force on International Science Chairman
Singapore	Michael Crosby	National Science Board Executive Officer
Brussels	Tamera Bowcutt	United States Mission to the European Union
Brussels	Allesandro Damiani	International Dimension of the Framework Programme, Research Directorate-General
Brussels	Jan Alexander Dekker	Royal Institute of Engineers, Netherlands
Brussels	Juri Engelbrecht	All European Academies
Brussels	Peter Fischer-Appelt	Universitat Hamburg, 1970-1991
Brussels	Aglaja Frodl	Deutsche Forschungsgemeinschaft
Brussels	Sigi Gruber	European Commission
Brussels	Charlotte Haentzel	European Commission
Brussels	Peter Heffernan	Marine Institute
Brussels	Ashley Ibbett	Office of Science and Innovation
Brussels	Daniel Jacob	European Commission
Brussels	Angelika Lange-Gao	European Commission, Directorate S
Brussels	David Livesey	League of European Research Universities
Brussels	Jean-Paul Malingreau	Programme and Resource Management
Brussels	Tony Mayer	European Science Foundation

Brussels	Par Omling	Swedish Research Council
Brussels	Antonio Pita	Tecnologico De Monterrey
Brussels	Hendrik Schlesing	European Association of Research and Technology Organizations
Brussels	Brigitte Serreault	CTO Office
Brussels	Carthage Smith	International Council for Science
Brussels	Horst Soboll	European Research Advisory Board
Brussels	Mark Suskin	National Science Foundation
Brussels	Steven Beering	National Science Board Chairman
Brussels	Arthur Reilly	National Science Board Member
Brussels	Jon Strauss	National Science Board Member; Task Force on International Science Chairman
Brussels	Michael Crosby	National Science Board Executive Officer
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Egypt	Ismail Serageldin	Bibliotheca Alexandrina
Egypt	Magdy Madkour	Bibliotheca Alexandrina
Egypt	Magdy Nagi	Bibliotheca Alexandrina
Egypt	Mohamed El-Faham	Bibliotheca Alexandrina
Egypt	Mohsen Youssef	Bibliotheca Alexandrina
Egypt	Salah A. Soliman	Bibliotheca Alexandrina
Egypt	Sohair F. Wastawy	Bibliotheca Alexandrina
Egypt	Yehia Halim Zaki	Bibliotheca Alexandrina
Egypt	Hany Mahfouz Helal	Ministry of State for Higher Education and Scientific Research
Egypt	Maged El Sherbini	Ministry of State for Higher Education and Scientific Research
Egypt	Hany El Nazer	National Research Centre
Egypt	Essmat Abdel Meged	National Research Centre
Egypt	Nihad M. El-Chazly	National Research Centre
Egypt	Osama El-Shabrawy	National Research Centre
Egypt	Sally El Nakkadi	* Not Available
Egypt	Sherif Omar	Education and Scientific Research Committee, Egyptian Parliament; Cairo University
Egypt	Ayman El-Dessouki	National Authority for Remote Sensing and Space Sciences
Egypt	Maged M. Al-Sherbiny	Ministry of Higher Education & State Ministry for Scientific Research
Egypt	Mohammed H. Swellam	Academy of Scientific Research & Technology, Science & Technology Center
Egypt	Hassan Moawad	Academy of Scientific Research and Technology, Inter-Islamic-Network on Genetic Engineering and Biotechnology
Egypt	Amr Shaarawi	The American University in Cairo
Egypt	Marie Ricciardone	U.S. Department of State
Egypt	Esmat Abdel Ghaffar	National Research Centre

Egypt	Nat Turner	Embassy of the United States of America
Egypt	Hany Hamroush	Embassy of the United States of America
Egypt	Noha Adly	Bibliotheca Alexandrina
Israel	Dan Bitan	The Israeli-Palestinian Science Organization
Israel	Menahem Yaari	The Israel Academy of Sciences and Humanities
Israel	Micha Spira	The Hebrew University of Jerusalem
Israel	Avi Baranes	Interuniversity Institute for Marine Sciences
Israel	Michael Schreuder	Consulate General of the United States of America
Israel	Richard H. Jones	Embassy of the United States
Israel	Ibrahim Shaqir	Embassy of the United States of America
Jerusalem	Hussein Jaddu	Al-Quds University
Jerusalem	Hasan Dweik	Al-Quds University
Jerusalem	Ziad Abdeen	Al-Quds University
Jerusalem	Sari Nusseibeh	Al-Quds University
Jerusalem	Mustafa Khamis	Al-Quds University
Jerusalem	Amin Aleghrouz	Al-Quds University
Jordan	HRH Princess Sumaya	Royal Scientific Society
Jordan	HE Walid Al Turk	The Higher Council for Science and Technology
Jordan	Khaled Al-Karaki	The University of Jordan
Jordan	Nabil T. Shawagfeh	The University of Jordan
Jordan	D. Arafeh	The University of Jordan
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Jordan	Mashhoor Al-Refai	Yarmouk University
Jordan	Fawwaz Al-Abed Al-Haq	Yarmouk University
Jordan	Hamed Zurcikat	Yarmouk University
Jordan	Wajih M. Owais	Jordan University of Science and Technology
Jordan	Fawzi Banat	Jordan University of Science and Technology
Jordan	Omar Shdeifat	The Hashemite University
Jordan	Mousa S. Mohsen	The Hashemite University
Jordan	HE Dr. Turki Obaidat	Ministry of Higher Education and Scientific Research
Jordan	Sharif M. Al-Saifi	Masar United Contracting Co
Jordan	Salim M. Al-Moghrabi	Aqaba Special Economic Zone Authority
Jordan	Ahmad Y. Majdoubeh	The University of Jordan
Jordan	D. M. Dalabeih	The University of Jordan

Jordan	Tareq Al-Hadid	Royal Scientific Society
Jordan	Rafat Ahmad	Royal Scientific Society
Jordan	Saqer Abdel-Rahim	Royal Scientific Society
Jordan	Khaled Kahhaleh	Royal Scientific Society
Jordan	Khaldoon H. Tabaza	Riyada Ventures
Jordan	Firas Abu-Wishah	Petra Engineering Industries Co.
Jordan	Aiman Soleiman Oklat	Institutional Support to the Aqaba Special Economic Zone Authority
Jordan	Hasan I. Tashtoush	Yarmouk University
Jordan	M. Al-Sheyyab	King Abdullah University Hospital
Jordan	Khaled H. Abu-Elteen	The Hashemite University
Jordan	Hani Tabbá	The Hashemite University
Jordan	Falak H. Sarraf	The Higher Council for Science and Technology
Jordan	Isam Mustafa	The Higher Council for Science and Technology
Jordan	Rana Safadi	Embassy of the United States of America
Jordan	Natalie Brown	Embassy of the United States of America
Jordan	Manu Bhalla	Embassy of the United States of America
Jordan	Seyfeddin Muaz	Royal Scientific Society
Jordan	Bilal Al-Bashir	Aqaba Special Economic Zone Authority
Egypt, Israel, Jerusalem, Jordan	Jon Strauss	National Science Board Member; Task Force on International Science Chairman
Egypt, Israel, Jerusalem, Jordan	Michael Crosby	National Science Board Executive Officer

Appendix D

List of Individuals Who Submitted Comments on Drafts of the Report

(In alphabetical order)

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Zara Khatib
Young Kim
David Lassner
Miron Livny
Kristin Lord
Joe Mambretti
Warren Matthews
Anthony Mayer
Richard Nader
Sidney Passman
Thomas Pickering
Antonio Pita
Ruth Pordes
James Porter
Glenn Schweitzer
Carthage Smith
Helen Thorne
Herman Winick

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