APPENDICES

APPENDIX I. - TABLE OF EXTERNAL EVALUATIONS

The Table below provides information on program assessments and evaluations other than Committee of Visitor and Advisory Committee assessments - with one exception – the CAREER program. The CAREER program is an agency-wide activity, and the assessment was contracted to an external private vendor.

The table lists other types of evaluations, not used in GPRA performance assessment, that were completed in FY 2002. These reports, studies, and evaluations are frequently used in setting new priorities in a field or in documenting progress in a particular area. The reader is encouraged to review the reports for additional information on findings and recommendations that are beyond the scope of this report.

Reports (other than COV reports) produced by NSF are available online at http://www.nsf.gov/pubs/start.htm using the NSF's online document system and the publication number indicated.

Information on obtaining reports produced by the National Research Council or National Academy of Sciences can be found online by searching www.nap.edu or from the National Academy Press, 2101 Constitution Avenue, N.W., Lockbox 285, Washington, D.C. 20055 (1.800.642.6242).

Evaluations Completed in FY 2002

	Directorate for Biological Sciences (BIO)
Fourth Workshop on the Development of a National Ecological Observatory Network (NEON): Standard Measurements and Infrastructure Needs	**Findings:** Planning for NEON requires the development of a plan for standardized equipment needs and measurements for all NEON observatories. As in previous workshops, the group enthusiastically endorsed the proposed development of a national network of ecological observatories. This report provides examples of how NEON will expand research capabilities beyond anything current available, which will greatly advance ecological research and our understanding of the environment. It also provides examples of how such a network can be of service to the Nation's, including the development and training of future generations of the Nation's technological workforce. **Recommendations:** 1. For measuring climate and hydrology: a spatially distributed network of weather-monitoring stations, a subnetwork of sun photometers, a subnetwork of ecohydrologic sensors, a broader-scale ecohydrologic network, 2.Biological monitoring at the broadest phylogenetic level, including microbes, plants and metazoans 3. the inputs, internal dynamics and outputs of carbon, nitrogen, phosphorus and biologically important base cations across the landscape. 4. Monitoring of the dynamics of all major and minor taxa. **Availability:** http://www.nsf.gov/bio/neon/NEON4.pdf

Microbial Ecology and Genomics: A Crossroads of Opportunity	**Findings:** The scientific and technological developments of the last several years have been so rapid as to bring us to a new crossroads of opportunity - analysis of the tremendous complexity of natural microbial systems in more complete terms. Genome sequencing has revealed totally unexpected genetic plasticity within and among named microbial species, and horizontal DNA transfer is now recognized to be a major force in the shaping of their genomes and fostering biochemical innovation. Therefore, before we can understand and predict the patterns in nature, we first need to know what those patterns are. Intensive microbial genomic/biodiversity surveys, covering the full range of environmental conditions and geological/evolutionary histories, will be required to determine the patterns that exist. This is a prerequisite to developing hypotheses to explain these patterns and linking patterns to processes at scales ranging from micrometers to global levels. **Recommendations:** 1. Support research funding opportunities to advance ecogenomics, to sample and sequence microbial genomes representing the breadth of natural microbial biodiversity, and to sample and sequence multiple genomes within well-defined species clusters. 2. Support research funding opportunities for the expansion of culture collections that include a central, well-ordered facility for the maintenance of type strains and their associated data. 3. Develop integrated universal databases that include genomic, phenotypic, habitat and geographical information. 4. Development of new technologies for measuring the activity of microorganisms in the environment, for cultivating currently uncultivable species, and for rapid determination of key physiological traits and activities. 5. Develop Genome Resource Centers to advance microbial genomic science, including a user-oriented approach for sharing microarray technologies, data analysis, and proteomic analysis. 6. Support funding opportunities for the training of students, including such disciplines as ecology, evolution, genomics, bioinformatics and computational sciences, to hone skills in emerging and rapidly changing fields. **Availability:** http://www.asmusa.org/acasrc/aca1.htm

Evolutionary Immunobiology: New Approaches, New Paradigms	**Findings:** The focus of the workshop was to elucidate the current status of the field of comparative (i.e. non-human and non-primate) and evolutionary immunobiology, to delineate the future directions that research should take (i.e. gaps in the relevant knowledge base), and to identify constraints to filling in these knowledge gaps. Reports presented at the workshop highlighted the important functional, evolutionary, and developmental interplay between innate and adaptive immune defense mechanisms throughout biology. Workshop presentations also noted the importance of the knowledge base in the field of comparative immunobiology to our fundamental understanding of evolution, animal interaction with the environment and with other species, in addition to system ecology, agriculture, aquaculture, and human ecology. Not unimportant is also the relevance of fundamental knowledge in this research area to new challenges of combating eco-, bio-, and agro-terrorism. The focus of the workshop was to elucidate the current status of the field of comparative (i.e. non-human and non-primate) and evolutionary immunobiology, to delineate the future directions that research should take (i.e. gaps in the relevant knowledge base), and to identify constraints to filling in these knowledge gaps. Reports presented at the workshop highlighted the important functional, evolutionary, and developmental interplay between innate and adaptive immune defense mechanisms throughout biology. Workshop presentations also noted the importance of the knowledge base in the field of comparative immunobiology to our fundamental understanding of evolution, animal interaction with the environment and with other species, in addition to system ecology, agriculture, aquaculture, and human ecology. Not unimportant is also the relevance of fundamental knowledge in this research area to new challenges of combating eco-, bio-, and agro-terrorism. **Recommendations:** 1. Application of functional genomics to evolutionary immunobiology requires the development of new mathematical modeling approaches. 2. Gaps in our immunobiology knowledge base include the identification of understudied groups. 3. Development and application of powerful genomic tools such as Bacterial Artificial Chromosome (BAC) libraries and Expressed Sequence Tag (EST) databases. 4. Development of novel bioinformatic tools, and the standardization of database annotation. 5. Development of genetically defined stocks of animals and cell lines including monoclonals.

Evolutionary Synthesis Center	**Findings:** Evolution has long served to unify the study of biology. Today, evolution has taken on an even greater role, as it serves to inform and direct data acquisition, analysis and interpretation across the life sciences. This transformation comes in part from an explosion of raw data, from sources as far ranging as whole genome sequences and phylogenetics to long-term behavior studies and functional morphology. Such data and metadata can only be interpreted using advanced mathematical and statistical approaches built on evolutionary concepts. Their implementation depends on highly developed database management and analysis tools. As formerly disparate fields of biological research converge, evolutionary biology is providing the common language. Evolutionary biology is poised to serve as the focal point for the synthesis and interpretation of these massive and growing data sets. Evolutionary biology can, and should, play a similarly central role in addressing a suite of critical national concerns. For example, evolutionary biology has a pivotal role to play in combating the evolution of infectious disease, for controlling the spread of invasive species, in understanding the emergence and spread of antibiotic resistance, for managing biodiversity, and in the application of population genetic tools to trace lineages of bioterrorism agents. To accomplish this mission, however, requires the coordination and communication among a diversity of scientists, government agencies, policy makers, health scientists, epidemiologists and others. **Recommendations:** Create an Evolutionary Synthesis Center to serve the needs of the evolutionary community by providing mechanisms to foster synthetic, collaborative, cross-disciplinary studies. **Availability:** http://frog.biology.yale.edu/esc/

	Directorate for Computer & Information Sciences & Engineering (CISE)
National Science Foundation Information Technology Research, Innovation and E-Government	**Scope:** This workshop was intended to examine broadly issues of E-Government, and to recommend related topics requiring academic research contributions, as well as identifying areas where standard commercial technology would be preferable. **Findings:** Government requirements can differ from those found in the commercial world, with government being a “demand leader”. Targeted research in computer science along with technology transfer can help in domains such as ubiquity, trustworthiness, information heterogeneity and semantic interoperability and building large-scale systems. **Availability:** http://www.cstb.org/web/pub_egovernment

National Science Foundation Research Challenges in Digital Archiving: Towards a National Infrastructure for Long-Term Preservation of Digital Information	**Scope:** This workshop developed a research agenda in this topic area. Digital archiving over periods of decades is of particular importance to government missions, where government agencies are stewards of official material. **Findings:** The National Science Foundation, the Library of Congress, and other government agencies should undertake a massive research effort to improve the state of knowledge and practice for long-term preservation of digital information. Important new research opportunities have arisen in storage and processing capacities, interoperability among heterogeneous systems, automation of intake and preservation management processes, and complex metadata and semantic representation. Related important issues exist in economic and business models, policies to encourage sustainable digital preservation, and economic, social, and legal impediments to digital archiving. All these research needs are propelled by the increasing amount of information that is "born digital". **Availability:** http://www.si.umich.edu/digarch
Developing a Basic Research Program for Digital Government: Information, Organizations and Governance	**Scope:** As information and communications technologies become ubiquitous, it becomes more important to understand just how these technologies impact governance and government agencies broadly speaking. This workshop developed a social science and information science research agenda for this area. **Findings:** High priority research must encompass critical elements of government performance, including effectiveness, efficiency, accountability, access, responsiveness to citizens, federalism, and capacity for learning and innovation. Empirical research on users of digital government is important given wide speculation and predictions regarding digital democracy and citizenship in an information society. The process of change requires research to focus specifically on the transformative processes that lie between inputs and outcomes. Included would be the antecedents and consequences of specific change processes, catalysts and incentives for change, models of emergence and network development from complexity theory, as well as extension and application of current theories of co-evolution, technology adoption, technology transfer, knowledge diffusion, and innovation. **Availability:** http://www.ksg.harvard.edu/digitalcenter; see http://www.ksg.harvard.edu/digitalcenter/reports/Workshop%20Report%2011_4.pdf for report.

National Science Foundation Workshop on Unexpected Events	**Scope:** This workshop developed a broad research agenda in crisis management and emergency response, particularly with respect to low-probability, high-impact events where societal response systems either do not exist or are overwhelmed. **Findings:** R&D drivers at the instant of disaster include: creating ad hoc organizations, quickly assembling sensor and communication networks, immediately putting in place reliable planning and execution processes, creating resource and personnel pools that integrate contributions from different agencies, organizations and communities, across sectors and jurisdictions, and transparently integrating information from multiple sources in a secure manner that allows data to be authenticated and validated. Research is needed in several areas: 1. Infrastructure and Its Protection (Monitoring technologies, transportation infrastructure, infrastructure performance and response outcomes) 2. Risk Analysis (taxonomy, decision-theoretic data analysis, cascading causal mechanisms, decentralized decision-making) 3. Organizational Response, Support and Integration (formation, structure, operation, multi-agent collaboration, distributed resource allocation, pedagogical agents) 4. Information Management (collection, fusion and validation, presentation, access, exploitation, tailoring, metadata representation) 5. Communication Resilience (sensor networks, rule-based systems security, communications infrastructure to support emergency response, grid technologies, heterogeneous and ad hoc wireless infrastructure) **Availability:** http://www.isi.edu/crue
Cybersecurity Today and Tomorrow: Pay Now or Pay Later	**Scope:** The Computer Science and Telecommunications Board (CSTB) of the National Research Council (NRC) has examined various dimensions of computer and network security and vulnerability in several prior reports. This brief report revisited those in the wake of terrorism events of September 11, 2001. The reports examined were: (1) *Computers at Risk*, 1991;[1] (2) *Cryptography's Role in Securing the Information Society*, 1996;[2] (3) *For the Record: Protecting Electronic Health Information*, 1997;[3] and (4) *Trust in Cyberspace*, 1999,[4] (5) *Continued Review of the Tax Systems Modernization of the Internal Revenue Service*, 1996;[5] (6) *Realizing the Potential of C4I*, 1999;[6] and (7) *Embedded, Everywhere*, 2001[7]. **Findings:** The unfortunate reality is that relative to the magnitude of the threat, our ability and willingness to deal with threats have, on balance, changed for the worse, making many of the analyses, findings, and recommendations of these reports all the more relevant, timely, and applicable today. This document presents the enduring findings and recommendations from that body of work. **Recommendations:** The report recommends that government should provide adequate support for research and development on information systems security. Research and development on information systems security should be construed broadly to include R&D on defensive technology (including both underlying technologies and architectural issues), organizational and sociological dimensions of such security, forensic and recovery tools, and best policies and practices. Given the failure of the market to address security challenges adequately, government support for such research is especially important. **Availability:** http://www.nap.edu/catalog/10274.html

Embedded Everywhere: A Research Agenda for Networked Systems of Embedded Computers, Computer Science and Telecommunications Board, National Research Council 236 pages, 2001.	**Scope:** A growing number of physical devices contain embedded computing and communications capabilities – e.g., aircraft, cars, telephones, and health monitoring devices. Networks comprising thousands or millions of such devices are expected to monitor and control complex domains such as battlefields, factories, warehouses, and environmental settings. Technology challenges arising from these developments include, power management, security, autonomous operation, self-organization, and performance requirements. To improve understanding of these issues and help guide future research endeavors, the Defense Advanced Research Projects Agency (DARPA) and the National Institute of Standards and Technology (NIST) asked the Computer Science and Telecommunications Board (CSTB) of the National Research Council (NRC) to conduct a study of networked systems of embedded computers (EmNets) that would examine the kinds of systems that might be developed and deployed in the future and identify areas in need of greater investigation. **Findings:** The Defense Advanced Research Projects Agency (DARPA), the National Institute of Standards and Technology (NIST), the National Science Foundation (NSF), and other federal agencies all have significant roles to play in the development of robust EmNets and EmNet-related research. **Recommendations:** Recommendations specific to NSF were o to continue to expand mechanisms for encouraging systems-oriented multi-investigator, collaborative, multidisciplinary research on EmNets. NSF can facilitate collaborative multidisciplinary research both through the programs it supports and through the use of a flexible process that encourages the incorporation of perspectives from a broad range of disciplines. o to develop programs that support graduate and undergraduate multi-disciplinary educational programs. NSF could take the lead in tackling institutional barriers to interdisciplinary and broad systems-based work. NSF has a history of encouraging interdisciplinary programs and could provide venues for such work to be explored as well as foster and fund joint graduate programs or joint curriculum endeavors. **Availability:** http://www.nap.edu/catalog/10193.html

New Visions for Software Design and Productivity: Research & Applications; Report on a workshop of the Interagency Working Group for Information Technology Research and Development (ITRD) Software Design and Productivity (SDP) Coordinating Group, Vanderbilt University, Nashville, TN, December 13 - 14, 2001.	**Scope:** The workshop provided a forum for scientists, engineers, and users to identify revolutionary thinking about software development techniques that could dramatically increase software productivity without compromising software quality. Workshop participants included 64 invited researchers from industry and academia and 14 government researchers. The goals of the workshop were to: • Bring together leading-edge researchers and practitioners • Encourage brainstorming and out-of-box thinking • Inform the Federal research agenda • Involve Federal agencies and research community The SDP workshop included panel discussions, breakout sessions, and plenary discussions. The panels and breakout sessions addressed the following four issues central to software design and productivity: 1. The Future of Software and Software Research 2. New Software Development Paradigms 3. Software for the Real World 4. Software for Large-scale Network-Centric Systems **Findings:** The reports major recommendation is: "If we want to maintain and increase the economic advantages of our IT prominence, we must increase our investment in understanding the relationship between emerging new application domains and IT technologies. More importantly, we must, aggressively seek out new methods and tools to explore emerging opportunities and extend our strategic advantage. End-user industry has neither the expertise nor the resources to make these changes themselves, and the dominant software industry may not have the resources or the interest in changing the status quo. Expanded government investment in IT is vital to accelerate this process. We believe that creating and maintaining a vibrant, active IT research community in the US is vital to our long-term economic and national security interests." **Availability:** http://www.isis.vanderbilt.edu/sdp/SDP_Wrkshp2-draft-7-26-02.d.pdf . Workshop Website is: http://www.itrd.gov/iwg/pca/sdp/sdp-workshop/vanderbilt/

IDs – Not That Easy; Computer Science and Telecommunications Board, National Academy of Sciences (NAS)	**Scope:** This report assessed emerging approaches to user authentication in computing and communications systems with specific focus on implications for privacy. Although the study was begun in early 2001, the events of 9/11 prompted several proposals for national identity systems. This study group provided an interim report to raise awareness of the questions being addressed; it focused on a broad set of policy, procedural and technological issues. **Findings:** Policy questions that should be considered when developing identity systems include: identifying the purpose of the system, the scope of the population, and the scope of the data; determining who the users of the system will be (government, corporations, etc.); determining what the allowable uses of the system are, determining whether participation is mandatory or voluntary and whether participants know they are participating, and establishing legal structures to protect the integrity, privacy, and due process and enforce liabilities for misuse of the system. **Availability:** http://www.nap.edu
Broadband: Bringing Home the Bits; Computer Science and Telecommunications Board, NAS	**Scope:** The report examined the technologies, economics, policies and strategies associated with the broadband challenge: providing high-speed connectivity to end users in homes, businesses and other settings; it offered recommendations for fostering broadband deployment and use. **Findings:** There are two issues central to deployment: local access performance to support innovative applications is needed, and services and applications to justify investment. The Telecommunications Act of 1996 is central to current policy; the report concludes that present policy is "unsuited in several respects to the new era of broadband services." **Recommendations**: The report makes several recommendations that are summarized here. o Government should prioritize widespread deployment and defer new regulation in the early stages. Government should enhance monitoring of deployment, investment, use patterns and market outcomes to provide a firmer foundation for future action. o Regulation should be structured to emphasize facilities-based competition and encourage new entrants. Unbundling of services is not the preferred strategy, but when used should be at higher service levels. o Governments, including local levels, should take active steps to promote deployment and facilities based competition. o Research and experimentation should be supported that would foster the emergence of new competitors, increase understanding of economic, social, and regulatory factors, and spur the development of new content and applications. **Availability:** http://www.nap.edu

NSF CISE Grand Challenges in e-Science Workshop Report; January 2002	**Scope:** This report addresses network requirements to support e-science, or large-scale science that studies very complex micro to macro-scale problems over time and space. Support for e-science networks is part of the overall Cyber-infrastructure vision to support IT enabled opportunities in science and engineering. **Findings:** Current production networks (Internet2's Abilene, WorldCom's vBNS+, and the FedNets such as Esnet) do not provide known and knowable characteristics that are needed by e-science. Research networks are not designed to be reliable or persistent. Experimental networks that are robust enough to support application-dictated development of middleware, software toolkits, etc., are needed to bridge the gap between research and production networks. International Experimental networks are needed. **Recommendations:** NSF should develop and experimental networking program to promote cyber-infrastructure; these projects should be at least 5 years in duration and be multi-disciplinary. **Availability:** http://www.evl.uic.edu/activity/NSF/index.html
NSF Advanced Networking Infrastructure and Research (ANIR) Workshop on Experimental Infostructure Networks	**Scope:** This meeting brought together industry, government and academic leaders to seek recommendations for advanced research and education networks; specifically for Experimental Networks as differentiated from Research or Production Networks. **Findings:** The workshop concluded that an application focus for Experimental Networks is of utmost importance to address vertical integration (from network to middleware to application to user interface) over multiple application requirements. Industry looks to NSF for its essential role in supporting high-risk research and providing validation of new concepts. Industry should participate in the research; this research leads to new market opportunities that are too high risk for industry or venture capitalists to undertake. **Recommendations:** NSF should establish an experimental network program to support 5-7 projects at a total annual investment of $10M per year. Multi-institutional and company awards were recommended. The program should fund delivered end-to-end connection of all resources needed **Availability:** http://www.calit2.net/events/2002/nsf/index.html

	Directorate for Education and Human Resources (EHR)
State Systemic Initiatives (SSI) Impact Study	**Scope:** An impact study of systemic reform efforts in three SSIs (Louisiana, Montana and Colorado) and one non-SSI state (Illinois) **Findings:** The theoretical model as conceived by the study team was insufficient for explaining the relationships among school characteristics and student achievement. However, the most important results of the study were that schools with high contact with SSIs were more likely to have conditions supportive of standards based approaches to science and mathematics than matched schools with little SSI contact. Schools with high contact with SSIs were more likely to have conditions supportive of standards based approaches to science and mathematics than matched schools in a comparison state. There appeared to be more differences between high and low SSI contact schools in the use of standards based instructional practices for science classes than mathematics classes. The study also concluded that schools were able to reform parts of the systems but coordinating and affecting all aspects of the reform system is extremely challenging. **Availability:** Available from EHR Directorate, NSF
Raising Standards and Achievement in Urban Schools: Case Stories from CPMSAs in Hamilton County/ Chattanooga and Newport News Public Schools	**Scope:** An evaluative study of 6 Comprehensive Partnerships for Mathematics and Science Achievement (CPMSA) funded between 1993 and 1994. **Findings:** The CPMSAs funded in 1993 and 1994 have demonstrated success in improving the mathematics and science educational infrastructure and student outcomes in medium sized cities. Average high school student enrollment in gate-keeping and higher-level mathematics courses increased over 41%, and average science enrollments increased 33%. By 1997-98, the 8th grade enrollment rates in Algebra I or higher were equal to or higher than the national average. The report also highlighted the achievements of two CPMSA sites: Hamilton County/Chattanooga, TN and Newport News, VA. Hamilton County/Chattanooga CPMSA focused on the implementation of new mathematics and science curricula, partnerships with universities and science-based institutions, and policy changes. Policy changes included the elimination of student tracking and basic-level mathematics and science courses, the adoption of a common core of requirements for high school graduation, and the requirement that all teachers participate in professional development. Newport News Public Schools created its standards-based mathematics and science curricula; instruction and assessment were then aligned to the new curricula. Strengthened professional development programs, convergence of resources, and partnerships were also focus of the program. Participation disparities and achievement gaps between African American and white students received particular emphasis with the creation of several student support programs. **Availability:** Available from EHR Directorate, NSF and the full report can be downloaded at www.systemic.com/CPMSA and www.sistudyforum.org

	Directorate for Engineering (ENG)
The World Technology Evaluation Center (WTEC) Worldwide Study on Tissue Engineering Research	**Scope:** This report is a comparative review of tissue engineering research and development activities in the United States, Japan, and Western Europe conducted by a panel of leading U.S. experts in the field. It covers biomaterials, cells, biomolecules, non-medical applications, engineering design, informatics, and legal and regulatory issues associated with tissue engineering research and applications. **Findings:** The panel's conclusions are based on a literature review, a U.S. review workshop held at NIH in June of 2000, and a series of site visits to leading tissue engineering research centers in Japan and Western Europe. A summary of the June 2000 workshop is included as an appendix, as are site reports from each of the panel's overseas visits. Key recommendation: Establish an interagency tissue engineering (TE) competition, with emphasis on biological aspects of TE. Implementation of this recommendation is under consideration by the Multi-Agency Tissue Engineering Science Working Group. An executive summary is included conveying the panel's overall conclusions. **Availability:** The complete report is available on the web at http://www.wtec.org/loyola/te/final/te_final.pdf
The World Technology Evaluation Center (WTEC) Molecular Modeling Study	**Scope:** This report reviews the development and applications of molecular and materials modeling in Europe and Japan in comparison to those in the United States. Topics covered include computational quantum chemistry, molecular simulations by molecular dynamics and Monte Carlo methods, mesoscale modeling of material domains, molecular-structure/macroscale property correlations like Organism/Chemical Structure/Bioactivity Relationships (QSAR) and Quantitative Structure Activity Relationships (QSPR), and related information technologies like informatics and special-purpose molecular-modeling computers. **Findings:** The United States leads this field in many scientific areas. However, Canada has particular strengths in density functional theory (DFT) methods and homogeneous catalysis; Europe in heterogeneous catalysis, mesoscale, and materials modeling; and Japan in materials modeling and special-purpose computing. Major government-industry initiatives are underway in Europe and Japan, notably in multi-scale materials modeling and in development of chemistry-capable *ab-initio* molecular dynamics codes. In European and U.S. assessments of nanotechnology, it was also concluded that to advance the field most quickly—and competitively—the need is acute for applying new and existing methods of molecularly based modeling. Additional findings are outlined in the panel's executive summary. **Availability:** The complete report is available on the web at http://www.wtech.org/loyola/molmodel/mm_final.pdf

	Directorate for Geosciences (GEO)
Abrupt Climate Change: Inevitable Surprises	**Scope:** Undertake a comprehensive review of the science and potential impacts of abrupt climate change. **Findings:** Abrupt Climate Change: Inevitable Surprises looks at the current scientific evidence and theoretical understanding to describe what is currently known about abrupt climate change, including patterns and magnitudes, mechanisms, and probability of occurrence. It identifies critical knowledge gaps concerning the potential for future abrupt changes, including those aspects of change most important to society and economies, and outlines a research strategy to close those gaps. Based on the best and most current research available, this book surveys the history of climate change and makes a series of specific recommendations for the future. **Availability:** National Academy of Sciences www.nas.edu
An Integrated and Sustained Ocean Observing System for the United States	**Scope:** To examine the scientific significance, technical feasibility, and potential societal benefits of the ISP. **Findings:** This report summarizes (1) the rationale for an Integrated Ocean Observing System (The Problem), (2) the conceptual design of the System (Solving the Problem), (3) economic benefits of an integrated system, (4) first steps for implementation, and (5) the high priority actions and associated funding levels that should be implemented now. Based on established priorities and the cost-effectiveness of a systematic and step-wise approach to implementation, the following actions should be taken: • Accelerate the implementation of the U.S. commitment to the global ocean observing system for global climate change. • Initiate a Data Communications and Management system for the Integrated and Sustained Ocean Observing System (IOOS). • Enhance/expand existing Federal Elements (buoys, water level sites, etc.). • Initiate Regional Observing Systems as Proof of Concept trials. **Availability:** http://www.ocean.us.net/projects/papers/post/FINAL-ImpPlan-NORLC.pdf
The North American Carbon Program Plan (NACP): A Report of the Committee of the U.S. Carbon Cycle Science Steering Group	**Scope:** To develop A plan for carbon cycle research focused on measuring and understanding sources and sinks of carbon dioxide (CO_2), methane (CH_4), and carbon monoxide (CO) in North America and adjacent oceans. **Findings:** The plan outlines how to implement a principal recommendation of the U.S. Carbon Cycle Science Plan (1999). It was developed as a component of the U.S. Interagency Carbon Cycle Science Program and as a contribution to U.S. climate change research planning. **Availability:** University Consortium for Atmospheric Research http://www.esig.ucar.edu/nacp/index.html

	Directorate for Mathematical and Physical Sciences (MPS)
Nanotechnology – Tools and Instrumentation for Research and Manufacturing	**Scope:** The 4th joint NSF-European Community (EC) workshop on nanotechnology was held in Grenoble, France on 12-13 June 2002. The workshop was organized within the framework of cooperation between NSF and the European Commission in materials sciences and nanotechnology. Its aim was to foster international collaboration in research and education by identifying future cooperative activities and joint actions in the area of tools and instrumentation for nanoscale research and manufacturing. **Findings:** The workshop identified challenges and applications for instrumentation with potential for enabling breakthroughs in research and manufacturing related to nanotechnology. The necessary innovation will require increased effort from the private sector to complement the public effort. **Availability:** Office for Official Publications of the European Communities, L-2985 Luxembourg, and NSF Division of Materials Research web page, http://www.nsf.gov/mps/divisions/dmr/ (under Research Highlights).
Nanotechnology – Revolutionary Opportunities and Societal Implications	**Scope:** The 3rd joint NSF-EC workshop on Nanotechnology was held in Lecce, Italy on 31 January-1 February 2002. The workshop was organized within the framework of cooperation between NSF and the European Commission in materials sciences and nanotechnology. Workshop participants from the USA and Europe addressed the technical, educational and ethical implications of nanotechnology for both European and American society. **Findings:** The EC and US nanotechnology communities face common technical, educational and societal challenges that would benefit from increased collaborations. Specific recommendations are summarized in the Report. **Availability:** Office for Official Publications of the European Communities, L-2985 Luxembourg; and Division of Materials Research web page, http://www.nsf.gov/mps/divisions/dmr/ (under Research Highlights).
Proceedings of the Workshop on the Present Status and Future Developments of Solid State Chemistry and Materials	**Scope:** Define research opportunities in the field of solid-state chemistry and materials; identify the most important multidisciplinary areas for involvement by the solid-state chemistry and materials community; determine novel roles for the Solid State Chemistry and Materials community that will advance educational and training opportunities for future scientists, engineers, and technicians; develop new approaches that allow for the more effective and efficient conduct of research and educational activities. **Findings:** Numerous recommendations are listed for various sub-fields in this discipline. **Availability:** NSF web site http://www.nsf.gov/mps/dmr/ssc.pdf

Statistics: Challenges and opportunities for the 21st Century	**Scope:** On May 6-8, 2002 a workshop was held at the NSF to identify the future challenges and opportunities for the statistics profession. The report that will be available in the early part of 2003 identifies major opportunities and challenges for the field of Statistics and formulates recommendations. The organizing committee of the workshop that is responsible in producing this report decided that the entire domain of statistics should be covered, both as a core science and in its scientific application areas, except for the health sciences, which is a very large and thriving specialty deserving of its own report. The report, in addition to discussing scientific opportunities and the challenges associated with those, discusses the role of education and training in statistics. **Findings:** Three high-priority opportunities are identified; analysis of massive data sets, modeling complex systems and understanding uncertainty. An in- depth discussion of each of these areas is provided in the report. Four major challenges were also identified; challenge of recognition, challenge of multidisciplinary activity, challenges in core research areas, and challenges in education and training. Five recommendations are made and discussed in the report: promote recognition of the unique identity of statistics, strengthen the core research areas; strengthen multidisciplinary research activities; develop new models for statistical education and accelerate the recruitment of the next generation of statisticians. **Availability:** At this point the report is 80% complete. The goal of the scientific committee of the report is to deliver the final report in early April of 2003. A preliminary version of the report will be put on http://www.stat.psu.edu for commentary by the Statistics profession early January of 2003.
Algebra, Number Theory, Combinatorics (ANTC) Workshop in Computation	**Scope:** The workshop was planned to bring together members of the ANTC community with extensive computing expertise to discuss future ways in which the community needs computing support. The participants are preparing a report, under the guidance of Brian Conrey, director of the American Institute of Mathematics (AIM). The report, due in November, will identify needs and opportunities of the ANTC community with respect to computing. **Findings:** Numerous recommendations and observations will appear in the report. **Availability:** To appear at the American Institute of Mathematics website http://www.aimath.org

Current and Emerging Research Opportunities in Probability	**Scope:** The report identifies the strengths of the discipline, both internally and in its applications. It describes some of the exciting areas of current research. While it does not quantify the needs of the community, it does demonstrate the need for a larger community trained in probability and probabilistic reasoning. It further points to the responsibilities of the funding agencies, the academic institutions, and the community itself, to meet the growing demands for the discipline. **Findings:** Probability is both a fundamental way of viewing the world, and a core mathematical discipline, alongside geometry, algebra, and analysis. In recent years, the evident power and utility of probabilistic reasoning as a distinctive method of scientific inquiry has led to an explosive growth in the importance of probability theory in scientific research. Central to statistics and commonplace in physics, genetics, and information theory for many decades, the probabilistic approach to science has more recently become indispensable in many other disciplines, including finance, geosciences, neuroscience, artificial intelligence and communication networks. **Availability:** The report is available at http://www.math.cornell.edu/~durrett/probrep/probrep.html
Making Sense of Complexity: Summary of the Workshop on Dynamical Modeling of Complex Biomedical Systems	**Scope:** This report documents the workshop "Dynamical Modeling of Complex Biomedical Systems" sponsored by the Board on Mathematical Sciences and Their Applications and the Board on Life Sciences of the National Research Council, April 26-28, 2001. The topics were chosen to provide a sampling of the rapidly emerging research at the interface of mathematical and biomedical sciences. Mathematicians, biomedical scientists, and statisticians discussed modeling aspects of cellular function, disease states, and neuroscience. **Findings:** When biomedical processes are modeled with mathematical and statistical concepts, the underlying structure of the biological processes can become clearer. Knowledge of that structure, and of the way its mathematical representation respond to change, allows one to formulate hypotheses that might not be apparent from the phenomenological descriptions. **Availability:** http://www7.nationalacademies.org/bms/BMSA_Publications.html

Report of the DOE/NSF High Energy Physics Advisory Panel (HEPAP) Subpanel on Long Range Planning for U.S. High-Energy Physics	**Scope:** The report develops a roadmap for the twenty-year future of U.S. elementary particle (high-energy) physics. The roadmap provides and overview of the field and an outline of the steps to reach the scientific goals. It is built on fully exploiting the investment in the Large Hadron Collider and the ongoing program. It recognizes that the field needs a balanced approach including forefront accelerators at the energy and luminosity frontiers, experiments in space, underground, and away from accelerators, and a strong university program. The roadmap will need to be periodically updated. **Findings:** The five recommendations are: that the U.S. take steps to remain a world leader in particle physics; a twenty-year roadmap for the field and a new mechanism to update the roadmap and set priorities across the program; that the highest priority be a high-energy, high-luminosity, electron-positron linear collider, wherever it is built in the world, and that the U.S. take a leadership position in forming the international collaboration needed to design, build, and operate such a machine; that the U.S. prepare to bid to host the linear collider as an international facility; and a vigorous long-term accelerator R&D effort within the program. **Availability:** http://doe-hep.hep.net/lrp_panel/
Opportunities in Nuclear Science: A Long-Range Plan for the Next Decade	**Scope:** The DOE/NSF Nuclear Science Advisory Committee has developed a long-range plan that provides a framework for the coordinated advancement of the field of nuclear science in the U.S. The plan includes descriptions of recent progress across the field, highlighting the discovery of neutrino oscillations. It makes recommendations that address funding issues facing the present nuclear science program and guide new investments for th future. **Findings:** The four recommendations are: increased funding for research and facility operations to exploit the opportunities for scientific discoveries made possible by recent U.S. investments; the Rare Isotope Accelerator as highest priority for major new construction; immediate construction of the world's deepest underground science laboratory; and an upgrade of the Continuous Electron Beam Accelerator Facility (CEBAF) at the Jefferson Laboratory to 12 GeV as soon as possible. **Availability:** http://www.sc.doe.gov/production/henp/np/nsac/LRP_5547_FINAL.pdf

Connecting Quarks with the Cosmos: Eleven Science Questions for the New Century	**Scope:** This report from the National Research Council's "Committee on the Physics of the Universe" was commissioned jointly by NASA, NSF, and DOE, in recognition of the deep connections that exist between quarks and the cosmos. It identifies eleven science questions that focus on the interface between physics and astrophysics, connecting physics at the most microscopic scales to the properties of the universe and its contents on the largest physical scales. Further, it recommends research and research coordination needed to address the 11 science questions. **Findings:** The report recommends that NASA, NSF, and DOE work together to carry out an extensive program of experiments, including: measure polarization of the cosmic microwave background; determine properties of the dark matter; determine the neutrino masses, the constituents of dark matter, and the lifetime of the proton; use space to probe the basic laws of physics; determine the origin of the highest energy gamma rays, neutrinos, and cosmic rays; discern physical principles of extreme astrophysical environments through laboratory study of high-energy-density physics; and realize the scientific opportunities at the intersection of physics and astronomy. **Availability:** Prepublication copy is available at http://www7.nationalacademies.org/bpa/BPA_Reports.html
Computation as a Tool for Discovery in Physics	**Scope:** This report is the output of a workshop held at NSF to survey opportunities and challenges in computational physics, broadly construed. Presentations covered the state of the art of computation and opportunities and barriers to progress in various research fields with differing maturities in the use of computation. The workshop demonstrated a broad commonality of interests and needs across the spectrum of disciplines represented. **Findings:** The central finding of the committee is that NSF should create a new program in computational physics, which could serve as an exemplar of similar programs in other parts of NSF. They also recognized an urgent need for training the next generation of computational scientists and for integrating computational science into the standard curriculum in physics. The new program should increase attention to software development and pay particular attention to the mid-range hardware needs of university groups. **Availability:** NSF web site http://www.nsf.gov/pubs/2002/nsf02176/nsf02176_1.pdf
Atoms, Molecules, and Light: AMO Science Enabling the Future	**Scope:** This brochure from the National Research Council highlights selected forefront areas of atomic, molecular, and optical (AMO) science and identifies connections between AMO science and other scientific fields, emerging technologies, and national needs. **Findings:** The report is aimed at a broad audience and gives numerous, illustrated examples of AMO science impacting the economy, improving health, protecting the environment, enhancing national defense, and expanding the frontiers of AMO science. **Availability:** http://www.nap.edu/catalog/10516.html

	Directorate for Social, Behavioral and Economic Sciences
Risk Management and Decision Science Workshop	**Scope:** To assess the state of the science and to identify needs and opportunities for integrated research in risk analysis and decision science in a democratic society. **Findings:** This workshop's broad conclusion was that in an age of growing uncertainty and emerging risks, society requires new knowledge and tools to assess and manage risk. Specific findings were: (1) Scientists working in numerous disciplines have significantly advanced our capacity for risk analysis and decision making during recent decades; (2) Unnecessary divisions between risk analysts, decision scientists, and hazards researchers as well as more traditional disciplinary divisions have impeded scientific progress; (3) Advancing the basic science of risk analysis and decision making and increasing its practical utility requires a new focus on interdisciplinary and multidisciplinary research, including engineering, information sciences, natural sciences, and social sciences; and, (4) An NSF initiative can build upon a firm foundation by facilitating interdisciplinary and multidisciplinary research that will make significant advances in risk management-with a special emphasis on the distinctive challenges associated with managing risk in a democratic society. The workshop's unanimous conclusion was that the time is ripe for an initiative that will advance the risk and decision sciences so as to provide the knowledge and tools needed to reduce societal vulnerabilities, save lives, avoid societal disruptions, and reduce psychological and economic losses from extreme events and other threats.