



Stimulating Innovation within the Academic Community

Thomas W. Peterson

Assistant Director for Engineering, NSF

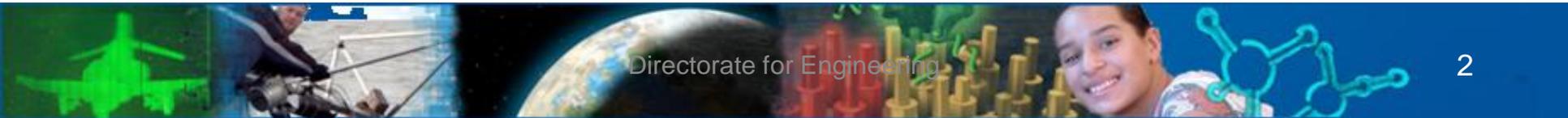
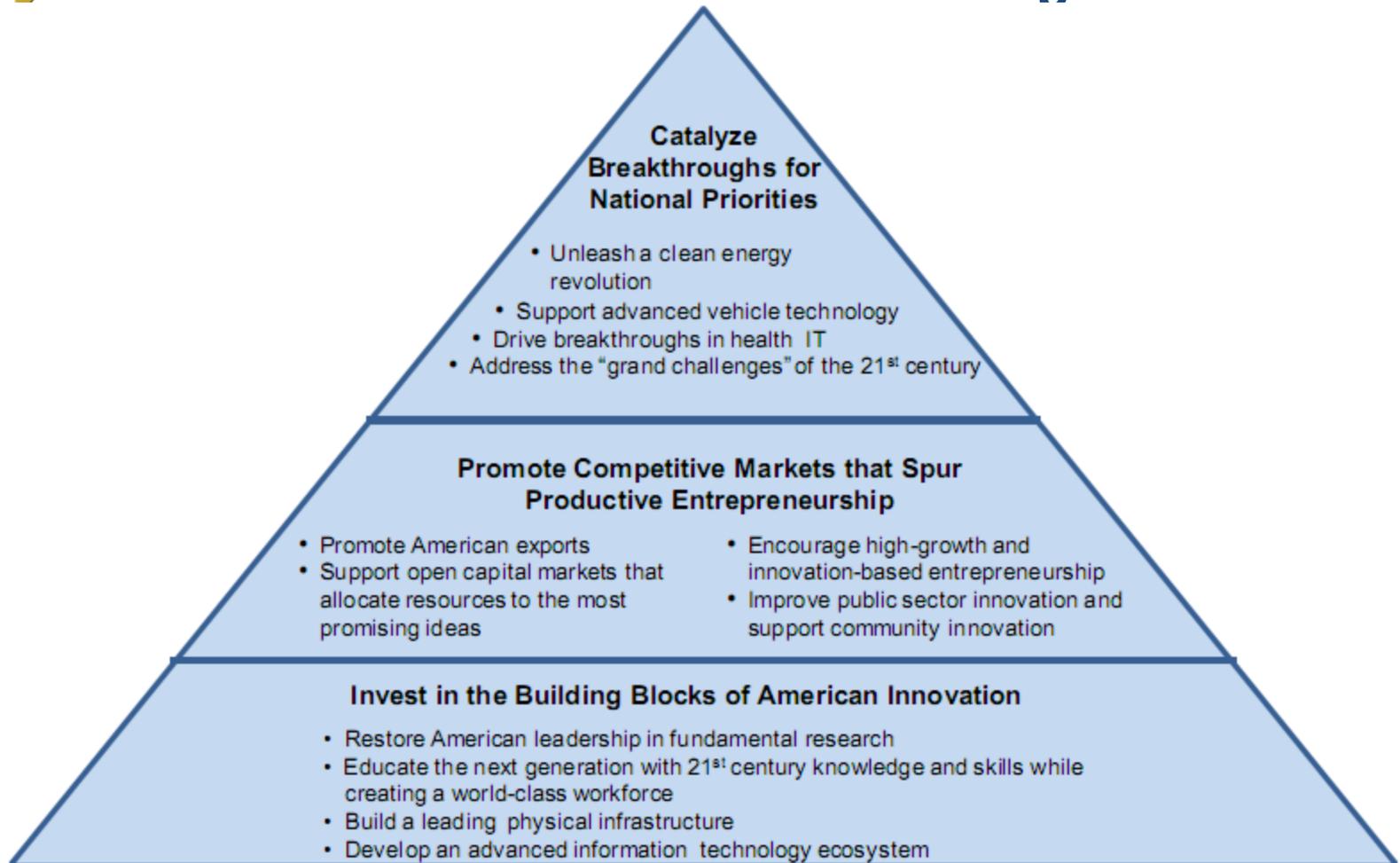
16 May, 2011





Innovation for Growth

From the President's Innovation Agenda 2009

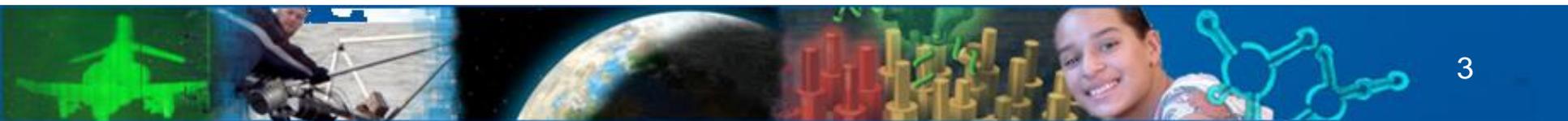




What is needed

Minimum Requirements

- A talented workforce
- Good ideas
- Mechanisms to facilitate Innovation

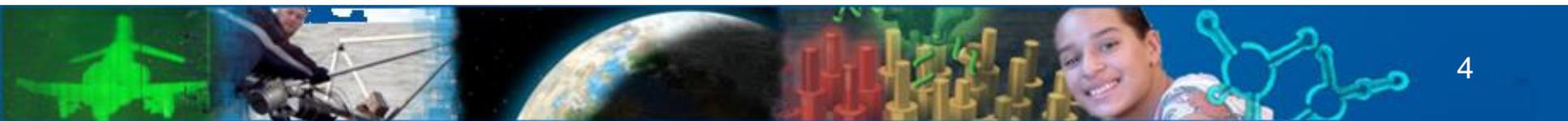




The Challenge

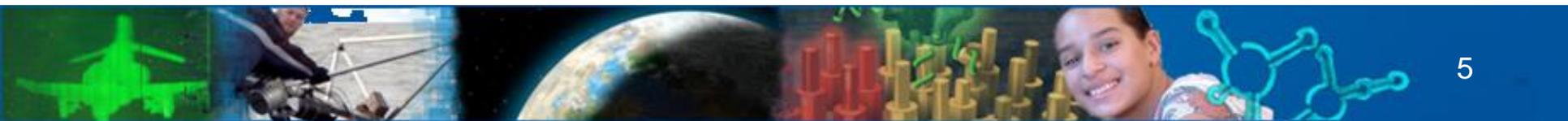
What are the Challenges?

- Workforce
- Research Investment
- Academic Culture
- Others.....





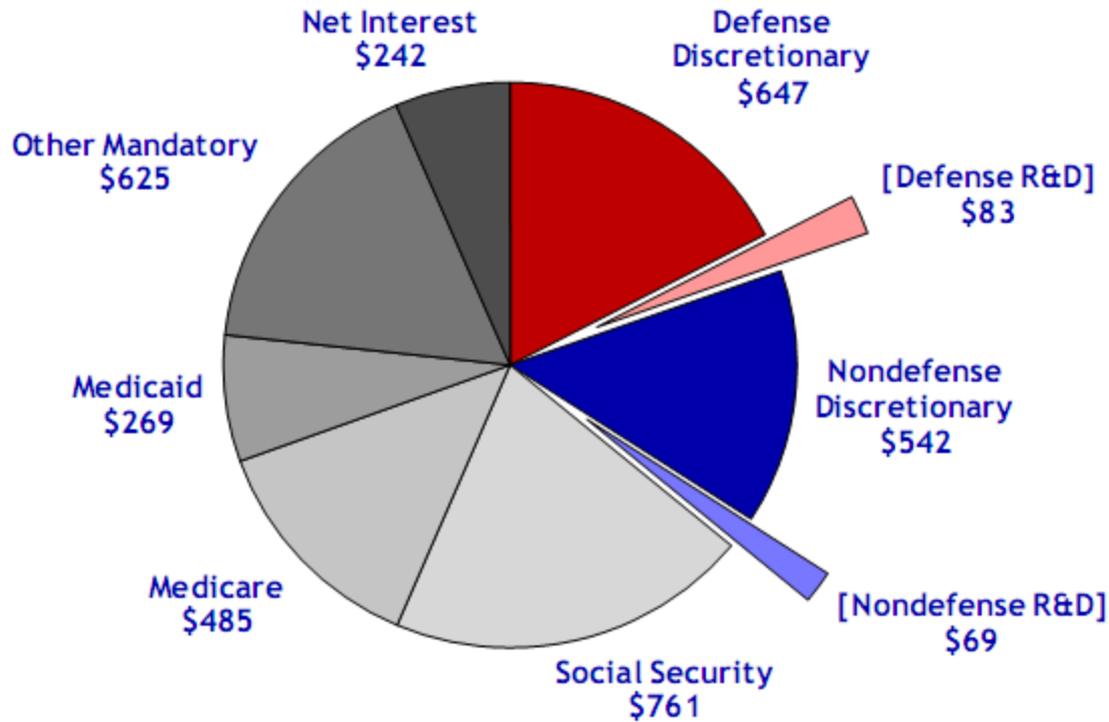
Challenges of Budget *Federal Investments in Innovation*



Composition of the Proposed FY 2012 Budget

Total Outlays = \$3.7 trillion

outlays in billions of dollars

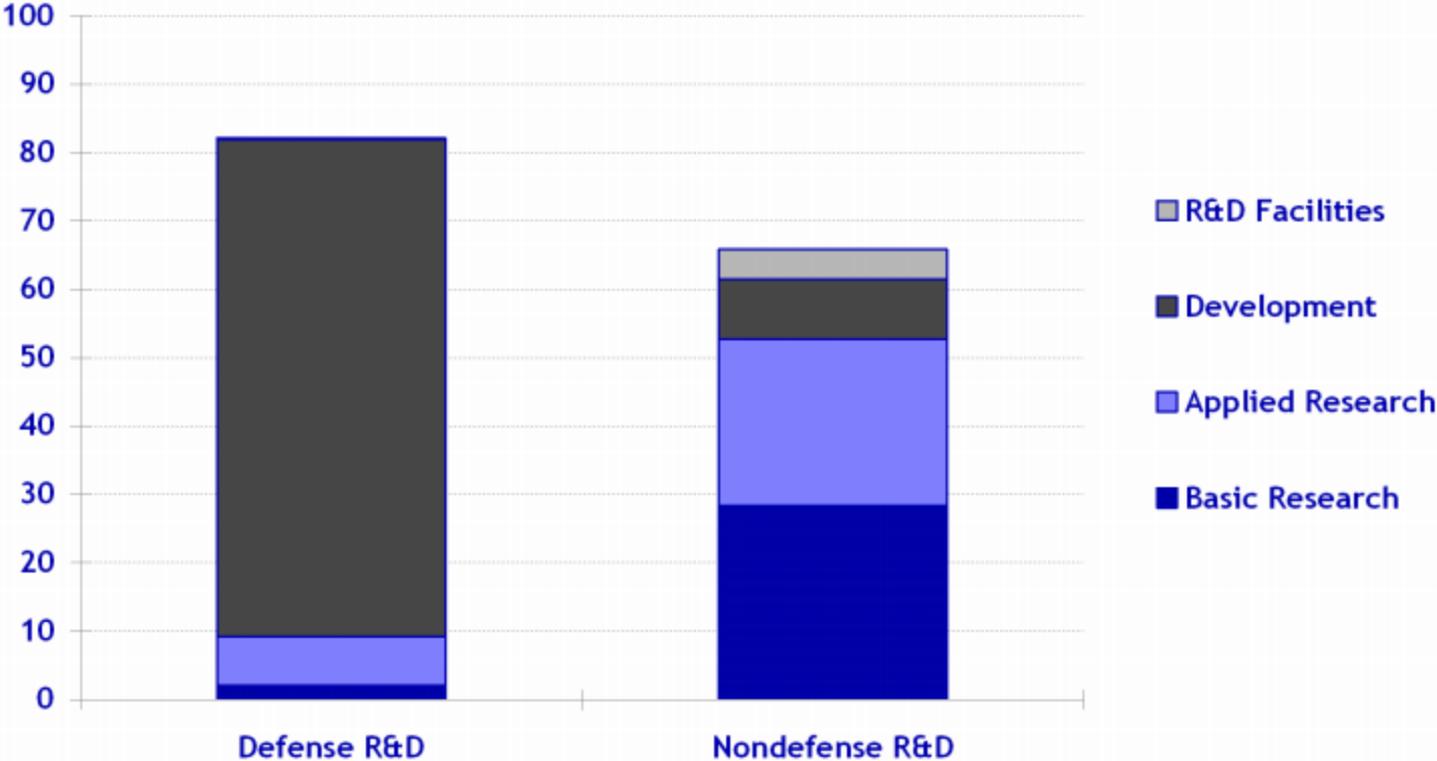


Source: *Budget of the United States Government FY 2012*.
 Projected unified deficit is \$1.1 trillion.
 © 2011 AAAS



Character of R&D, FY 2011

budget authority in billions of dollars

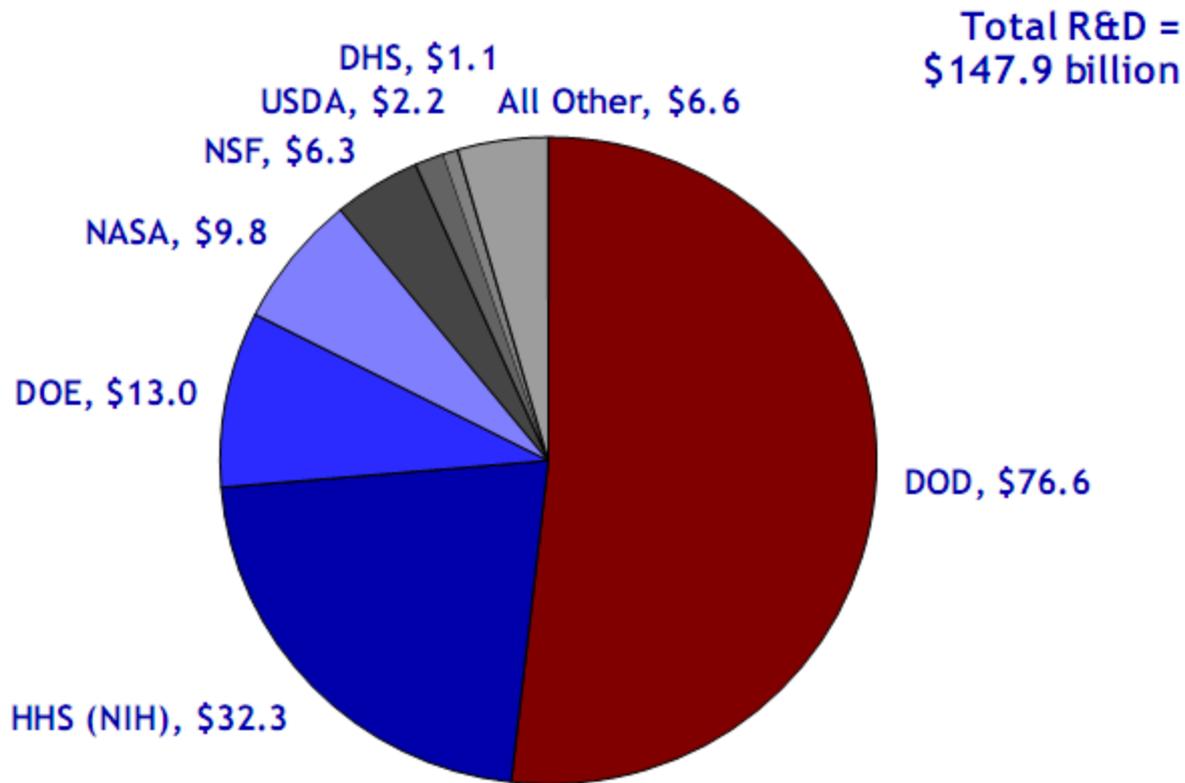


Source: OMB R&D data, agency budget justifications, and agency budget documents.
Defense R&D = DOD + DOE defense.
© 2010 AAAS



Total R&D by Agency, FY 2012

budget authority in billions of dollars



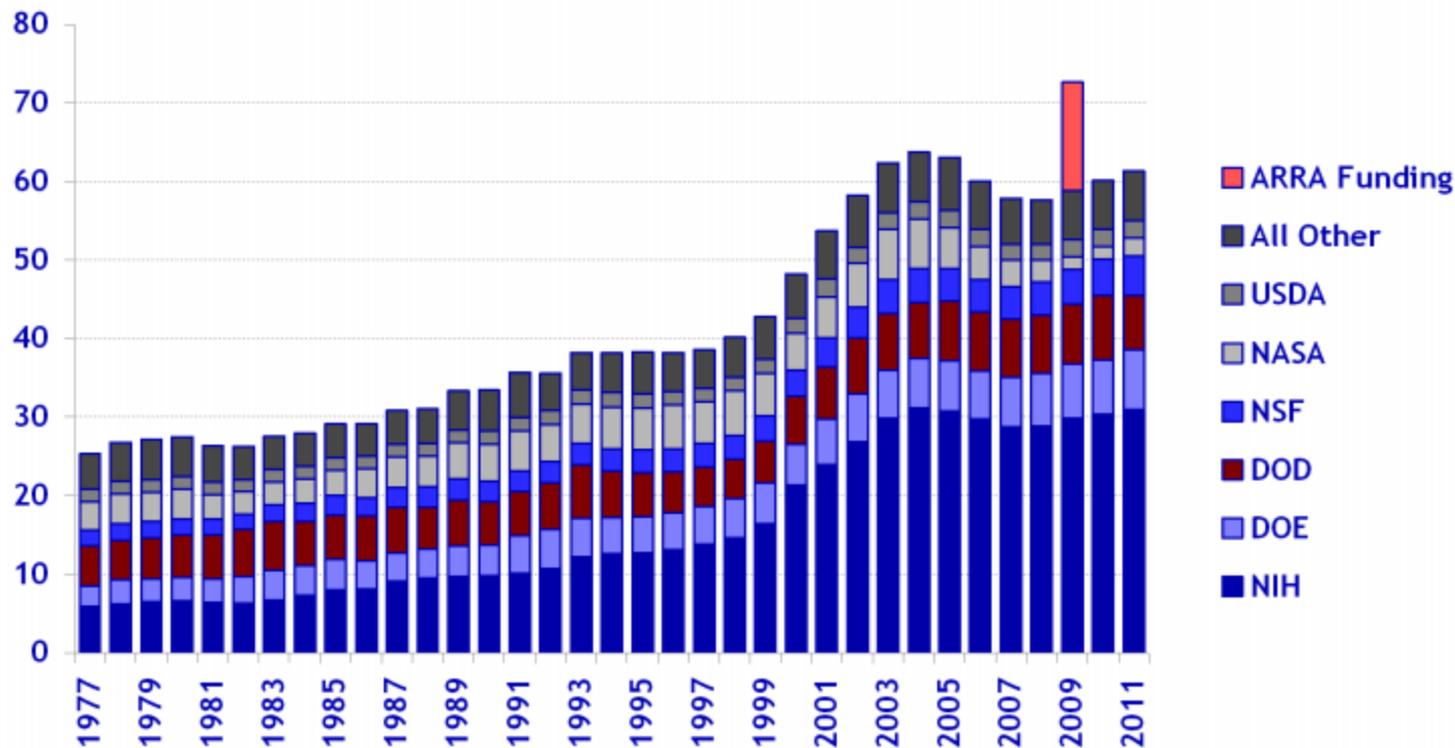
Source: OMB R&D data, agency budget justifications, and other agency documents.
R&D includes conduct of R&D and R&D facilities.

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Trends in Research by Agency

in billions of constant FY 2010 dollars



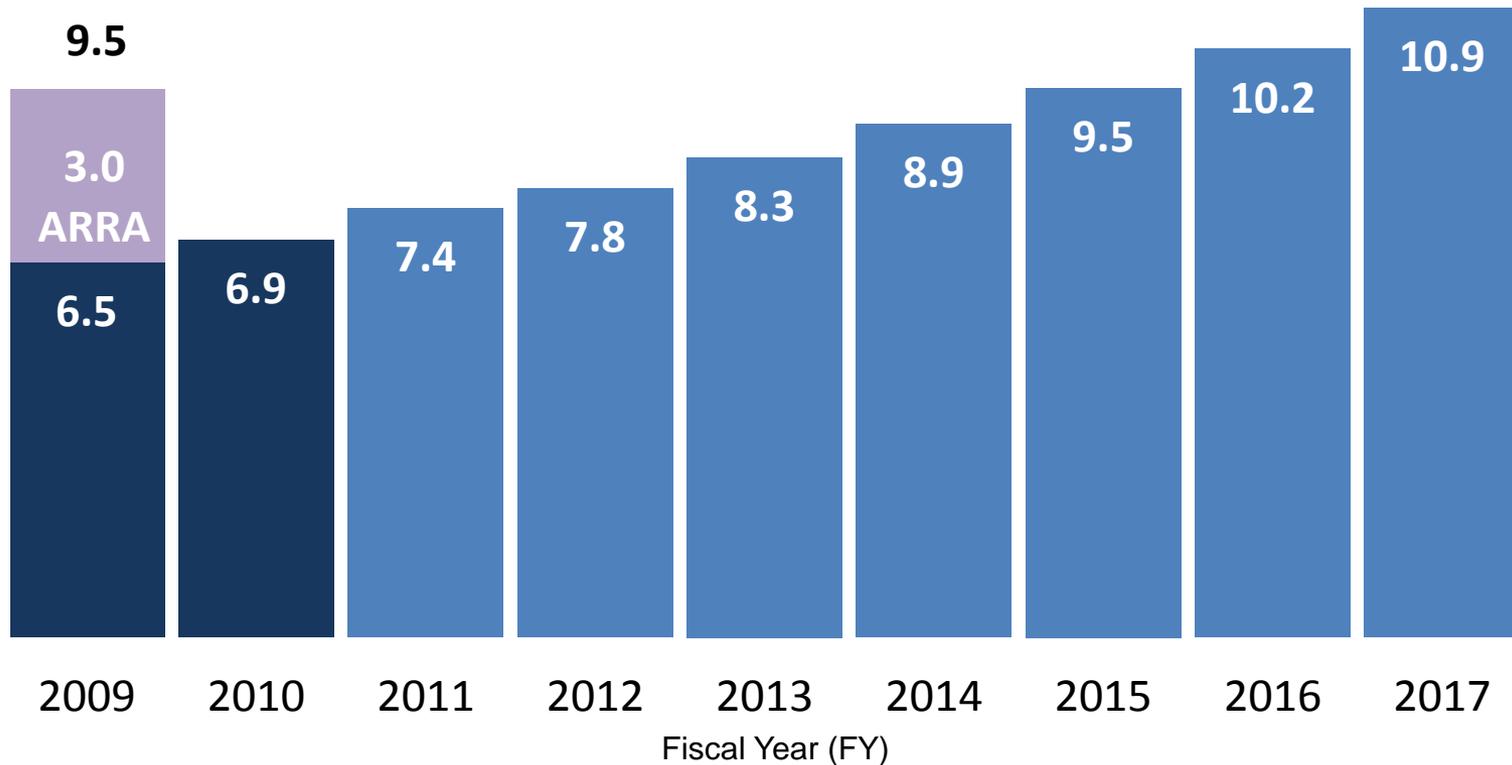
Source: AAAS Report: Research & Development series.
 FY 2010 and FY 2011 figures are latest estimates.
 Research includes basic research and applied research.
 1976-1994 figures are NSF data on obligations in the Federal Funds survey.
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President's Plan for Science and Innovation

Total NSF Funding
(dollars in billions)





How NSF Budgets have Fared

	FY09	FY10	FY11	FY12
NSF Proposed	6,854	7,045	7,424	7,767
NSF Approved	6,490	6,927	6,807	
NSF Actual	6,468	6,972		

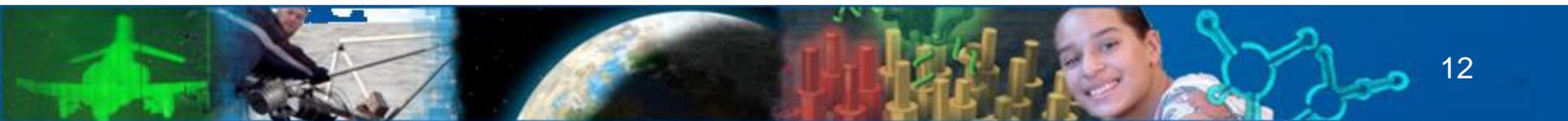




The Opportunity

What can we do with one one-hundredth of one percent (0.01%) of the federal budget?*

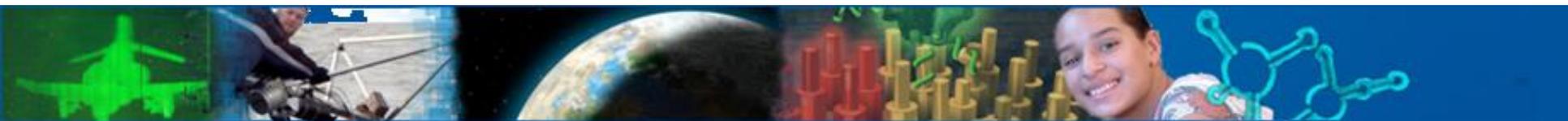
***NSF ENG Investment in Innovation**





NSF: Support for Innovation

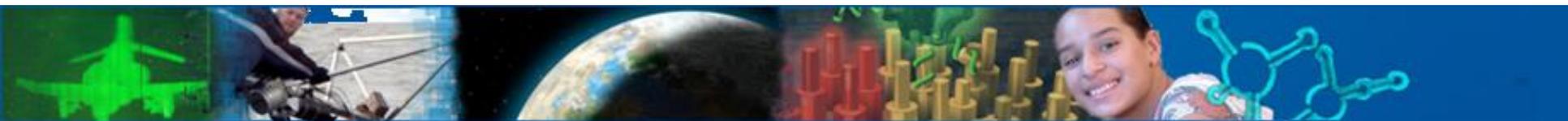
- Support basic research in ALL fields of science and engineering.
- Fund high-risk research; can sometimes lead to unexpected results!
- Many discoveries and products we now rely upon began with NSF support.





Characteristics of the Innovation Ecosystem

- University research is key, often driven by industrial needs.
- Faculty are involved along the innovation continuum, working with industry at all stages.
- A focus on translational research smoothes the handoff of technology from universities to industry—resulting in rapid, efficient innovation.





The Innovation Ecosystem

- ENG invests in innovation research through support for
 - Research centers
 - Engineers of the future
 - Partnerships



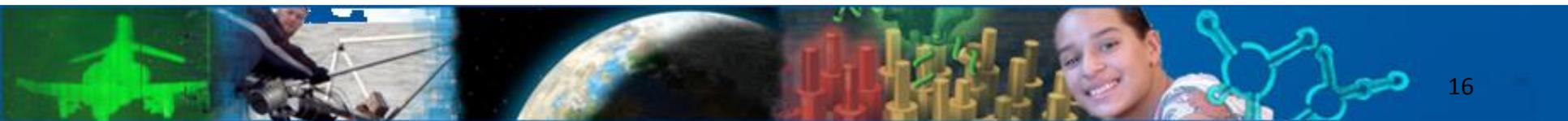
Student researchers sample contaminated sediment. *Credit: Karl Rockne, Univ. of Illinois at Chicago*





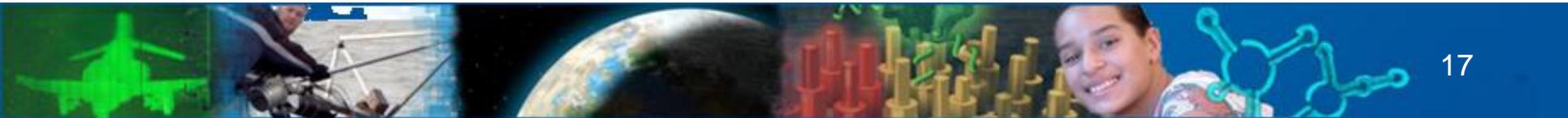
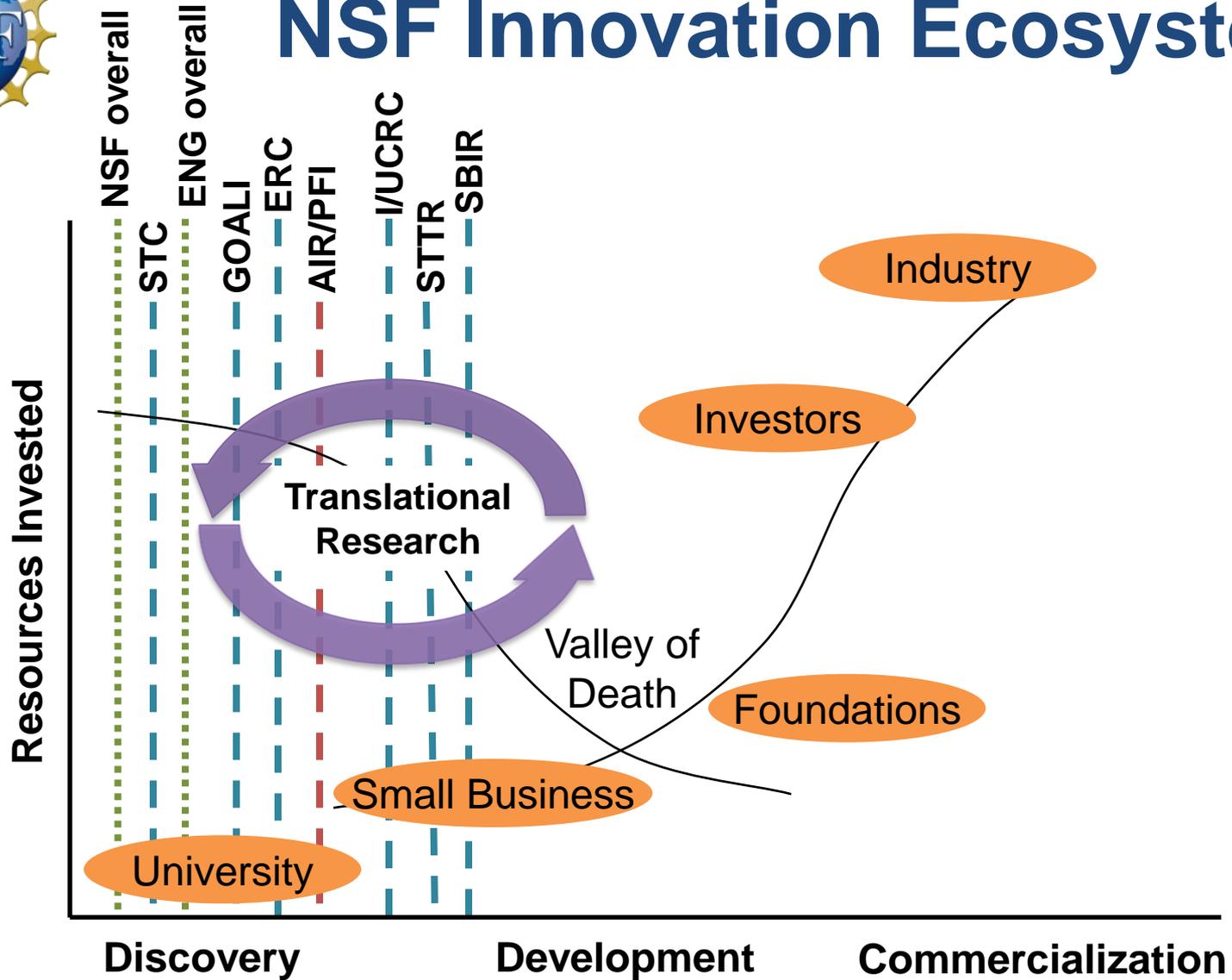
NSF Programs for Translational Research

- Science and Technology Centers (STC)
- Engineering Research Centers (ERC)
- Materials Research Science and Engineering Centers (MRSEC)
- Grant Opportunities for Academic Liaison with Industry (GOALI)
- Industry/University Cooperative Research Centers (I/UCRC)
- Partnerships for Innovation (PFI)
- Small Business Technology Transfer (STTR)
- Small Business Innovation Research (SBIR)
- Nanoscale Science and Engineering Center (NSEC)
- Nanoscale Interdisciplinary Research Teams (NIRT)
- Emerging Frontiers of Research and Innovation (EFRI)
- Other ENG programs





NSF Innovation Ecosystem





NSF's Centers Foster Innovation

NSF supports more than 100 centers in seven interdisciplinary program areas that facilitate innovation.





Research Centers

**\$81 M for
ERCs**

- **Engineering Research Centers (ERCs)**
 - The first class of nano ERCs will transition the nano-devices created at graduating Nanoscale Science and Engineering Centers (NSECs) to the systems level and commercialization
- **Science and Technology Centers (STCs)**
 - CBET will support the Center on Emergent Behaviors of Integrated Cellular Systems
 - ECCS will support the Center for Energy Efficient Electronics Science

**\$10 M for
STCs**

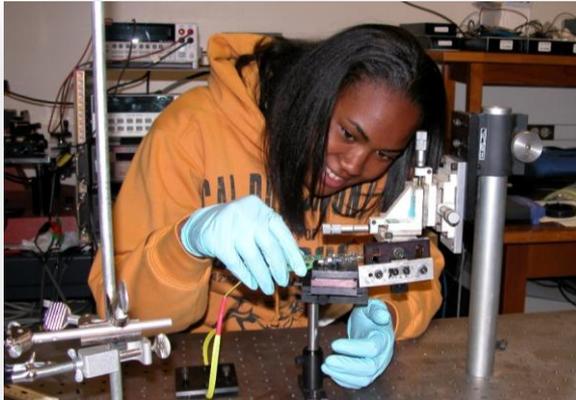




Engineers of the Future

- The directorate emphasizes support for
 - CAREER awards
 - Activities that promote the entry and retention of veterans and other non-traditional students in engineering programs

**\$53 M for
CAREER**



REU student Brittney Perry at work.
Credit: Biomimetic MicroElectronic Systems ERC, USC



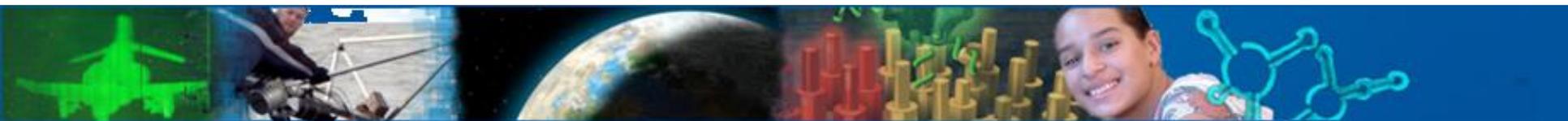
Spc. Timothy Roy, 44th Expeditionary Signal Battalion, performs maintenance on computer servers and routers at Camp Echo, Iraq, in 2008.
Credit: Spc. Evan D. Marcy; Courtesy of U.S. Army





New NSF Innovation Partnerships and Investments

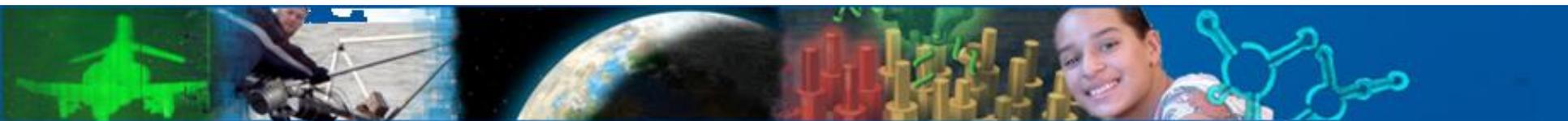
- Partnership with DoC in I6 Challenge Grants
- Partnership with DoC in Innovation Forum Program (Washington DC, LA, Atlanta, Boston, Ann Arbor)
- New Partnerships for Innovation (PFI)
- New Accelerating Innovation Research (AIR)





AIR and PFI

- Single Investigator and Small groups of Faculty - AIR (\$4M)
- Partnerships of Large Research Groups – AIR (\$8M)
- Institutional Partnerships – PFI (\$7M)





Accelerating Innovation Research (AIR)

\$20 M

- AIR creates partnerships for innovation involving universities and institutions to increase the economic and social impacts of basic research through
 - Engaging faculty and students across all disciplines in innovation and entrepreneurship
 - Increasing the impacts of promising university discoveries through commercialization, industry alliances, and start-up formation
 - Developing regional communities





Science, Engineering, and Education for Sustainability (SEES) and Clean Energy

- ENG will invest in research and education for technologies that mitigate against, and adapt to, environmental change that threatens sustainability.
 - Sustainable Energy Pathways
- ENG will support smart grid technologies, solar energy technologies, biofuels and bioenergy, wind energy generation, and renewable energy storage.
 - BioMaPS

**\$162 M/
\$173 M**



Solar array. *Credit: NREL*

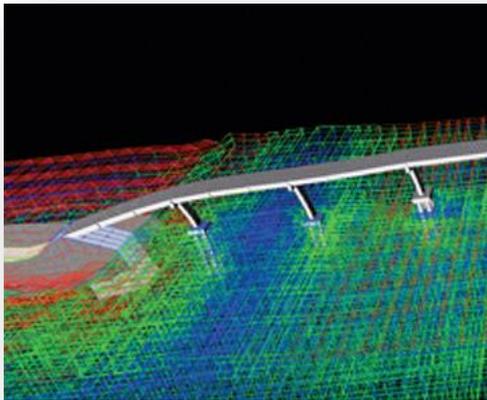




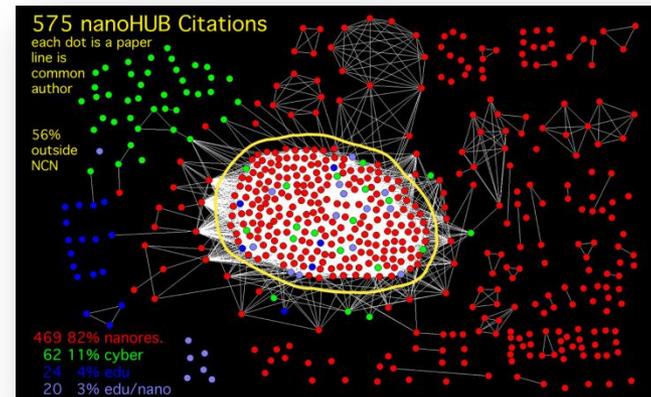
Cyber Infrastructure for the 21st Century (CIF21)

\$9 M

- The ENG investment will focus on
 - Data-enabled science
 - New computational infrastructure
 - Access/connections to cyberinfrastructure facilities



Pacific Earthquake Research Center, UC Berkeley



NanoHUB Citation Map in the Scientific Literature, Purdue University





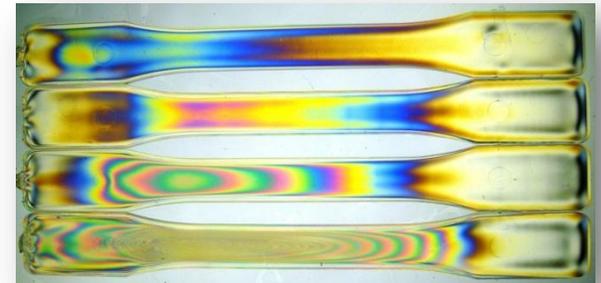
Advanced Manufacturing

\$65 M

- ENG will invest in transformative manufacturing technologies, including
 - Multi-scale modeling for simulation-based design and manufacturing across the supply chain
 - Nanomanufacturing
 - Innovative materials and manufacturing processes
 - Energy manufacturing
 - Complex engineering systems design and manufacturing
 - Science and Engineering Beyond Moore's Law (SEBML)
 - BioMaPS

A novel, dynamic injection molding process controls molecular orientation.

Credit: John P. Coulter, Lehigh Univ.

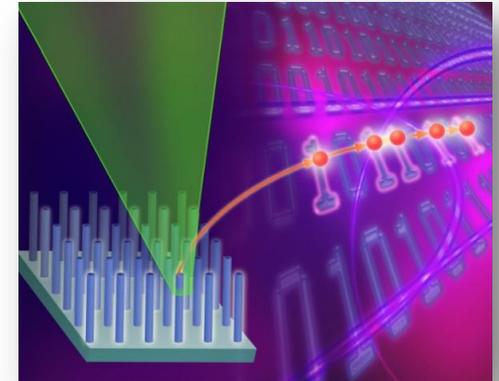




Science and Engineering Beyond Moore's Law (SEBML)

- ENG will support investigations into:
 - Devices, systems and architecture
 - Multi-scale modeling and simulation research
 - Quantum information science and engineering
 - Design of efficient and sustainable manufacturing equipment, processes, and facilities

\$29 M



A diamond nanowire matrix with defects called nitrogen vacancies. When stimulated with green light, these defects emit one red photon at a time.
Credit: Zina Deretsky, NSF





Enhancing Access to the Radio Spectrum (EARS)

- The ENG investment will support research on
 - more efficient radio spectrum use
 - energy-conserving device technologies

\$4 M

UNITED STATES FREQUENCY ALLOCATIONS THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

■ AERIAL TELEVISION BROADCASTING SERVICE	■ AERIAL TELEVISION BROADCASTING SERVICE	■ AERIAL TELEVISION BROADCASTING SERVICE
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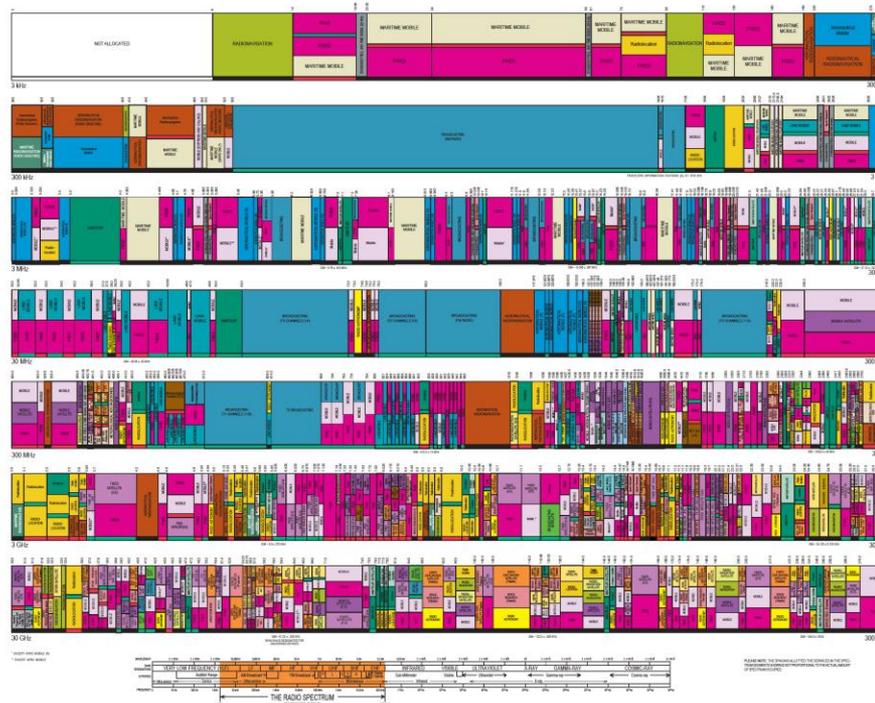
ACTIVITY CODE

■ GOVERNMENT EXCLUSIVE	■ GOVERNMENT EXCLUSIVE (SATELLITE)
■ NON-GOVERNMENT EXCLUSIVE	

ALLOCATION USAGE DESIGNATION

PRIMARY	SECONDARY	RESERVED
Priority	Secondary	Reserved

U.S. DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Office of Spectrum Management
October 2013



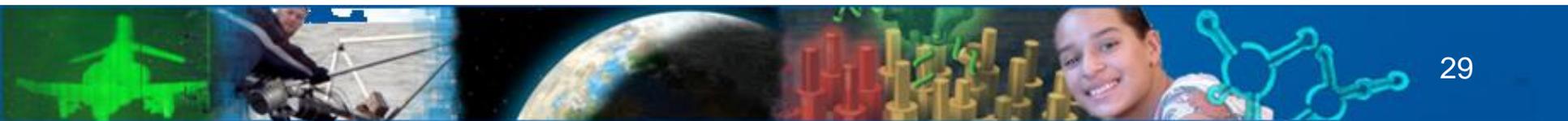
U.S. radio frequency allocations.
Credit: U.S. Department of Commerce





Wireless Innovation: Advancing wireless capabilities via research and testbeds

- Funded by spectrum auction revenues
 - \$1B over 5 years for NSF
- Components
 - Basic wireless research
 - Wireless testbeds
- Obama's promise to the nation
 - High-speed wireless coverage to 98% of Americans in 5 years

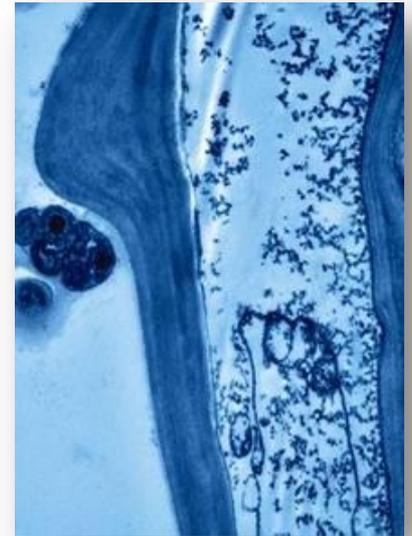




National Nanotechnology Initiative

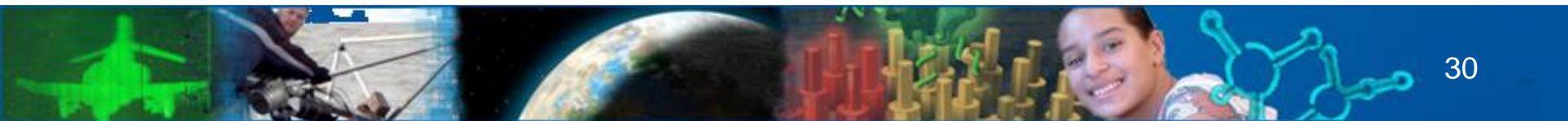
\$174 M

- The directorate will continue support for
 - nanomaterials and nanodevices
 - nanosystems
 - nanomanufacturing
 - environment, health, and safety
- ENG will direct additional funds towards three Signature Initiatives
 - Nanoelectronics for 2020 and Beyond
 - Sustainable Nanomanufacturing
 - Nanotechnology for Solar Energy Collection and Conversion



Uptake of C70 nanoparticles and their aggregation within a rice plant leaf cell.

Credit: JoAn Hudson, Sijie Lin, and Pu Chun Ke, Clemson University





National Robotics Initiative

\$13 M

- ENG will support
 - Assistive mechanisms for those with physical disabilities and/or cognitive impairments
 - Systems integration that enables ubiquitous, advanced robotics to be realized
 - Next-generation robotics for manufacturing, healthcare and rehabilitation, surveillance and security, education and training, and transportation

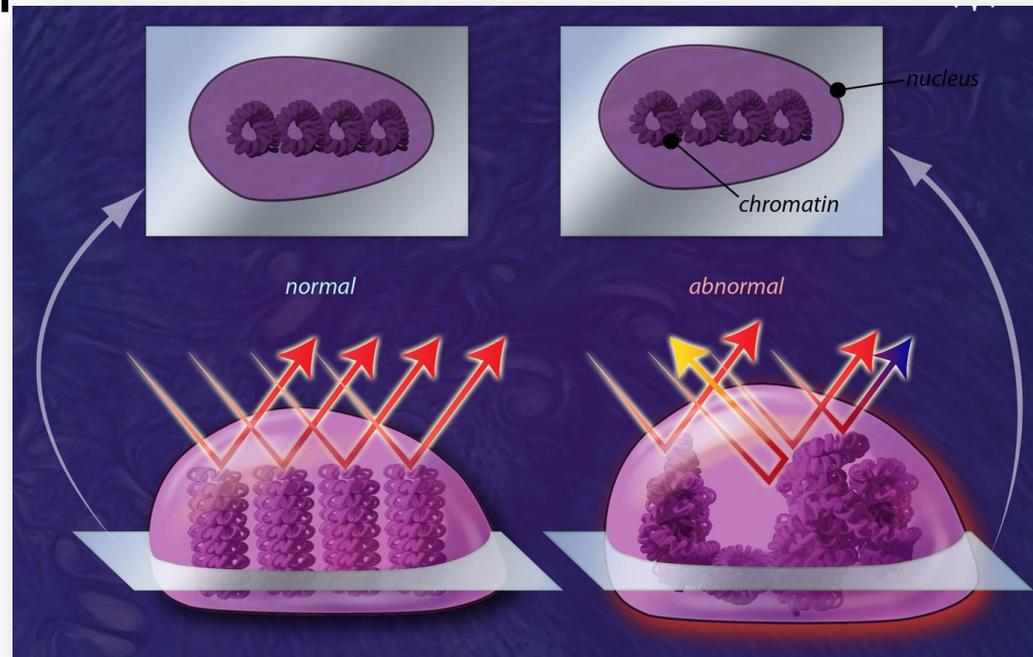




Potentially Transformative Research

- Emerging Frontiers of Research and Innovation
- Interdisciplinary research
- Disciplinary research

Nanoscale disturbances in cheek cells indicate the presence of lung cancer. A new technique called partial wave spectroscopic microscopy (PWS) zeroes in on nano-level disturbances. The development of PWS has been led by Vadim Backman of Northwestern University. *Credit: Zina Deretsky, NSF.*





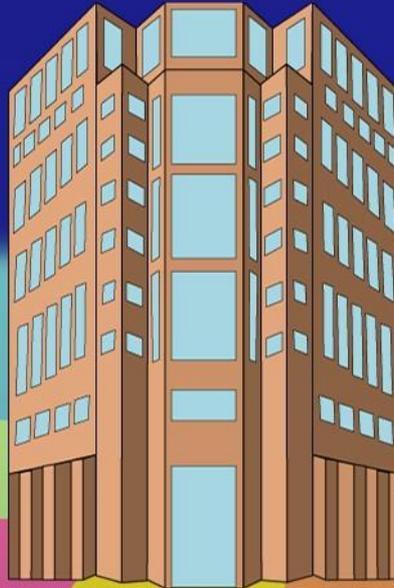
OneNSF



catalyze human capital development



improve
organizational
efficiency



create
networks and
infrastructure
for the nation



spark greater innovation
and opportunity for
scientific discoveries



support
fundamental
research in
all disciplines



address
multidisciplinary
challenges of
national/global significance



Questions

