NSF Assistant Directors - Emerging Trends and Programs

Dawn Tilbury, Directorate for Engineering
Joanne Tornow, Directorate for Biological Sciences
Jim Kurose, Directorate for Computer & Information Science & Engineering
(Presented by Ken Calvert, Division Director, Computer & Network Systems)
Anne Kinney, Directorate for Mathematical and Physical Sciences
(Presented by Andrew Lovinger, Program Officer, Division of Materials Research)
NSF Champions Research and Education across all Fields of Science and Engineering

- Biological Sciences
- Engineering
- Mathematical & Physical Sciences
- Computer & Information Science & Engineering
- Geosciences (including Polar Programs)
- Integrative Activities
- Education & Human Resources
- Social, Behavioral & Economic Sciences
- International Science & Engineering
NSF Budget Context

Request

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Request (Million)</th>
<th>Enacted (Million)</th>
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<tbody>
<tr>
<td>FY 2017</td>
<td>$7,964</td>
<td>$7,472</td>
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<td>$7,767</td>
<td>$6,653</td>
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<td>FY 2019</td>
<td>$8,075</td>
<td>$7,472</td>
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<tr>
<td>FY 2020</td>
<td>$7,066</td>
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</table>
NSF by the Numbers

- 93% funds research, education and related activities
- $7.8B FY 2018 actual
- 48,000 proposals evaluated
- 2,000 NSF-funded institutions
- 12,000 awards funded
- 386,000 people NSF supported
- $1.2B STEM education
- $100M to seed public/private partnerships
- 236 NSF-funded Nobel Prize winners

Numbers shown are estimates based on FY 2018 activities.
<table>
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<th>NSF’s 10 Big Ideas</th>
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Convergence Accelerator

Accelerating Discovery through Convergence Research

- time-limited “tracks”: accelerating impactful convergence research in areas of national importance
- separate from directorates in leadership, budget, and programmatics (but relying on, and building on foundational disciplinary research, including Big Ideas)
- projects with clear goals, milestones, directed deliverables (e.g., 6-months)
- more intentional, more directed management; mission-driven evaluation
- initial tracks: in HDR, FW-HTF
- < 1% of NSF budget
NASEM Report Findings on Sexual Harassment

• Includes sexual coercion, unwanted sexual attention, and gender harassment
• Is common
• Disproportionately affects women of color and sexual- and gender-minority people
• Impacts targets, bystanders and the research enterprise
• Is most associated with male-dominated gender ratios and organization climates that tolerate it
Won’t be reduced by the legal system alone
NSF Steps to Stop Harassment

- Awardee organizations must report findings of harassment, sexual harassment or sexual assault
  - In effect October 21, 2018
- Secure online portal accepts harassment notifications
- nsf.gov/harassment
Directorate for Engineering
ENG by the Numbers: FY 2018

- **$978 M** research budget
- **13,092** proposals
- **692** panels
- **2,458** competitive awards
- **23,697** people supported
- **9,299** senior researchers
- **1,937** other professionals
- **484** postdoctoral associates
- **7,760** graduate students
- **4,217** undergraduate students

19% competitive award success rate
Shift to No Deadlines

• Unsolicited proposals to all core programs in four ENG divisions (CBET, CMMI, ECCS, and EEC) are accepted any time
  – Declined proposals face a 1-year moratorium before resubmission

• New flexibility to carefully craft proposals for significant contributions
A New Vision for Center-Based Engineering Research

2017:
• May: National Academies report
• Summer: Working group

2018:
• March: Solicitation for Planning Grants
• Sept.: 60 Planning grants awarded
• NSF 19-503: Solicitation for Gen-4 ERCs

2019:
• January: Pre-proposals due
• March: New solicitation for Planning Grants issued
Partnerships catalyze innovations

• NSF supports industry-relevant research and knowledge transfer
  – Grant Opportunities for Academic Liaison with Industry (GOALI)
  – Industry–University Cooperative Research Centers (IUCRC)
  – Innovation Corps (I-Corps)
  – SBIR/STTR

76 active IUCRCs
876 unique members
7:1 match of NSF $
Non-Academic Research Internships for Graduate Students (INTERN) Supplements

- Advances NSF-funded basic research through collaborations with industry, small businesses and national labs
  - 160 graduate students in FY 2018
  - DCL NSF 18-102 for FY 2019
“Life innovates, Biology integrates.”
“To enable discoveries for understanding life, advance the frontiers of biological knowledge, and provide a theoretical basis for prediction within complex, dynamic living systems through an integration of scientific disciplines.”
BIO by the Numbers FY 2018

- $755 M enacted FY 2018
- 4,767 proposals
- 77 panels
- 1,192 awards
- 13,764 people supported
- 3,665 senior researchers
- 1,350 other professionals
- 1,435 postdoctoral associates
- 2,691 graduate students
- 4,623 undergraduate students

25% Competitive award success rate

*Note: FY 2019 will likely look different following BIO’s shift to no deadlines*
Biological Research Across Scales

- Molecular & Cellular Biosciences (MCB)
- Integrative Organismal Systems (IOS)
- Environmental Biology (DEB)
- Biological Infrastructure (DBI)
BIO Science Drivers

- What are the origins and consequences of biodiversity, and how is it maintained?
- How did molecular and cellular structures, functions and processes evolve?
- How and why are organisms structured as they are?
- How and why do organisms function, interact and behave as they do?
- What infrastructure do we need to support scientific advances in these areas?
- How do we leverage and integrate large, -omics scale data sets to address
NSF’s 10 Big Ideas

Harnessing the Data Revolution

The Future of Work at the Human-Technology Frontier

Navigating the New Arctic

The Quantum Leap: Leading the Next Quantum Revolution

Understanding the Rules of Life:Predicting Phenotype

Windows on the Universe: The Era of Multi-messenger Astrophysics

Mid-scale Research Infrastructure

NSF 2026: Seeding Innovation

Growing Convergence Research at NSF

NSF INCLUDES: Enhancing STEM through Diversity and Inclusion
Opportunities for Engagement

Engineering Organisms
- Neurotechnology
- Synthetic Biology
- Chromatin and Epigenetic Engineering

Developing New Technologies
- Bioinspired Design
- Sensor Development
- Infrastructure Design and Development

Engineering the Environment
- Environmental Engineering
- Sustainability
Directorate for Computer & Information Science & Engineering

- Biological Sciences
- Engineering
- Mathematical & Physical Sciences
- Computer & Information Science & Engineering
- Geosciences (including Polar Programs)
- Integrative Activities
- Education & Human Resources
- Social, Behavioral & Economic Sciences
- International Science & Engineering
CISE Organization

CISE Directorate
Jim Kurose, AD
Erwin Gianchandani, DAD

Office of Advanced Cyberinfrastructure (OAC)
Manish Parashar, OD

Data
Leadership and Advanced Computing
Networking/Cybersecurity
Software
Learning and Workforce

Computing and Communication Foundations (CCF)
Rance Cleaveland, DD

Algorithmic Foundations
Communication and Information Foundations
Software and Hardware Foundations
Foundations of Emerging Technologies

Computer and Network Systems (CNS)
Ken Calvert, DD

Computer and Network Systems
Cyber-Physical Systems
Smart & Connected Communities
Education and Workforce Development

Information and Intelligent Systems (IIS)
Henry Kautz, DD

Cyber Human Systems
Information Integration and Informatics
Robust Intelligence

Strategic Engagements
Meghan Houghton
CISE by the Numbers: FY 2018

- $960 M FY 2018 research budget
- 9,151 proposals
- 397 Panels
- 1,819 awards
- 23% success rate
- 17,778 people supported
- 7,837 senior researchers
- 1,158 other professionals
- 455 postdoctoral associates
- 6,598 graduate students
- 2,741 undergraduate students
NSF’s 10 Big Ideas

1. Harnessing the Data Revolution
2. The Future of Work at the Human-Technology Frontier
3. Navigating the New Arctic
4. The Quantum Leap: Leading the Next Quantum Revolution
5. Understanding the Rules of Life: Predicting Phenotype
6. Windows on the Universe: The Era of Multi-messenger Astrophysics
7. Mid-scale Research Infrastructure
8. NSF 2026: Seeding Innovation
9. Growing Convergence Research at NSF
10. NSF INCLUDES: Enhancing STEM through Diversity and Inclusion
CISE programs address national priorities

AI and Big Data

Cybersecurity

Robotics & Manufacturing

Quantum Information Sciences

Advanced Cyberinfrastructure

Smart Communities

Computer Science Education

Advanced Wireless Research
CISE and Artificial Intelligence

Transformative science that holds promise for tremendous societal and economic benefit with potential to revolutionize how we discover, work, learn, and communicate

- CISE research programs in Information and Intelligent Systems division ($211M FY18)
- Cross-directorate programs:
  - NRI-2.0: Ubiquitous Collaborative Robots
  - Smart & Connected Communities
  - Smart and Connected Health
  - Collaborative Research in Computational Neuroscience

New in FY19:

- AI and Society (CISE, SBE, Partnership on AI)
- Real-Time Machine Learning (CISE, ENG, DARPA)
- CISE FEAT DCL: Fairness, Ethics, Accountability, and Transparency (NSF 19-016)
Cyber-Physical Systems (CPS) and Smart & Connected Communities (S&CC)

CPS: Core system science for complex cyber-physical systems upon which people can depend with high confidence.

S&CC: Scientific/engineering and socio-technical knowledge to improve quality of life within communities.
## CPS and S&CC Program Deadlines

<table>
<thead>
<tr>
<th>Cyber-Physical Systems (NSF 19-553)</th>
<th>Smart and Connected Communities (NSF 19-564)</th>
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</thead>
<tbody>
<tr>
<td><strong>Small</strong></td>
<td>Planning Grants</td>
</tr>
<tr>
<td>Deadline: April 1-12, 2019</td>
<td>Deadline: September 6, 2019</td>
</tr>
<tr>
<td>Budget: up to $500,000 and up to 3 years.</td>
<td>Budget: $150,000 and up to 1 year.</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td>Track 2</td>
</tr>
<tr>
<td>Deadline: April 1-12, 2019</td>
<td>Deadline: September 6, 2019</td>
</tr>
<tr>
<td>Budget: $500,001 to $1,200,000 and up to 3 years.</td>
<td>Budget: Less than $1,500,000 and up to 3 years.</td>
</tr>
<tr>
<td><strong>Frontier</strong></td>
<td>Track 1</td>
</tr>
<tr>
<td>Deadline: September 12, 2019</td>
<td>Deadline: September 6, 2019</td>
</tr>
<tr>
<td>Budget: 1,200,001 to $7,000,000 and 4 to 5 years.</td>
<td>Budget: Greater than $1,500,000 and up to 4 years.</td>
</tr>
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</table>
Directorate for Mathematical and Physical Sciences

Anne L. Kinney
Assistant Director
This is MPS. . .
MPS supports over 28,000 people…

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
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<tbody>
<tr>
<td>Undergraduate Students</td>
<td>6,248</td>
</tr>
<tr>
<td>Graduate Students</td>
<td>8,804</td>
</tr>
<tr>
<td>Postdoc Associates</td>
<td>1,988</td>
</tr>
<tr>
<td>Senior Researchers</td>
<td>8,236</td>
</tr>
<tr>
<td>Other Professionals</td>
<td>3,124</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>28,400</strong></td>
</tr>
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</table>

Support of Academic Basic Research

Mathematics: 64%
Physical Sciences: 45%

Data Source: FY 2017 Actuals
NSF’s 10 Big Ideas

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- NSF INCLUDES: Enhancing STEM through Diversity and Inclusion
- NSF 2026: Seeding Innovation
- Harnessing the Data Revolution
Departmental Affiliations of DMR and CHE Grantees

**Division of Chemistry**
- Chemical Engineering: 4%
- Biochem. & Biomed. Engr.: 4%
- Environm. Engineering: 2%
- Materials Sci. & Engr.: 2%
- Civil Engineering: 1%
- Electrical & Computer Engr.: 1%
- Nanoscience & Engineering: 1%

**Departmental Affiliations**
- Physics: 26%
- Chem./Chem.Eng: 7%
- Biomedical Engineering/Biochem./Bio: 7%
- Mechanical Eng: 7%
- Materials Eng./Science: 12%
- Elec. Eng./Comp Sci./Math: 6%
- Other Engineering and Science: 8%
- Centers, Institutes, Industry: 7%
- Unknown: 2%
- Centers, Institutes, Industry: 2%
- Other Engineering and Science: 6%
- Materials Eng./Science: 7%
- Mechanical Eng: 7%
- Biomedical Engineering/Biochem./Bio: 2%
- Chem./Chem.Eng: 2%
- Physics: 6%
NSF-DOE Sponsored
NASEM Materials Research Decadal Study

Broad Recommendations

• Increased coordination across all sectors – especially with industry
  • Mid-scale infrastructure
  • Sustainable materials
  • Computation and data science
  • High-throughput synthesis / characterization / processing
  • Quantum materials
  • Hybrid / composite materials
  • Advanced manufacturing

Issued
February 2019
Designing Materials to Revolutionize and Engineer our Future (DMREF)

NSF’s response to MGI

• Collaboration with federal laboratories and industry
• Coordination with federal agencies: AFOSR, NIST, DOE
• Strong focus on workforce development
• Central role of data in MGI

National Science Foundation
Directorate for Mathematical & Physical Sciences
  Division of Materials Research
  Division of Mathematical Sciences

Directorate for Engineering
  Division of Civil, Mechanical and Manufacturing Innovation
  Division of Electrical, Communications and Cyber Systems
  Division of Chemical, Bioengineering, Environmental and Transport Systems

Directorate for Computer & Information Science & Engineering
  Office of Advanced Cyberinfrastructure
  Division of Computing and Communication Foundations
  Division of Computer and Network Systems
  Division of Information & Intelligent Systems
Example Collaborations: MPS/CHE and ENG/CBET

Contaminants of Emerging Concern: Upcoming activities on problems associated with microplastics; encouraging polymer recycling and upcycling.


Innovations at the Nexus of Food-Water-Energy Systems (INFEWS): Understand and manage the interconnected food-energy-water system.

Co-sponsor NAS Board on Chemical Sciences and Technology Study on Separations Science: Separations for energy production, waste management, water treatment, chemical manufacturing and recovery of critical elements.