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

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Request (Million)</th>
<th>Enacted (Million)</th>
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<tr>
<td>FY 2017</td>
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| FY 2017     | $7,964            | $7,472           |
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| FY 2019     | $7,066            | $8,075           |
| FY 2020     | $7,472            | $7,472           |

- Request
- Enacted
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.
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 affections 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

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
ENG by the Numbers: FY 2018

$978 M research budget

13,092 proposals

2,458 competitive awards

19% competitive award success rate

23,697 people supported

9,299 senior researchers

1,937 other professionals

484 postdoctoral associates

7,760 graduate students

4,217 undergraduate students

692 panels
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
Directorate for Biological Sciences

“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
- 25% competitive award success rate
- 3,665 senior researchers
- 1,350 other professionals
- 1,435 postdoctoral associates
- 2,691 graduate students
- 4,623 undergraduate students

*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

[Diagram showing the flow from molecules to ecosystems and biosphere]
CISE by the Numbers: FY 2018

- $960 M FY 2018 research budget
- 9,151 proposals
- 397 Panels
- 1,819 awards
- 17,778 people supported
- 23% success rate
- 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
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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<tbody>
<tr>
<td><strong>Small</strong></td>
<td><strong>Planning Grants</strong></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><strong>Track 2</strong></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><strong>Track 1</strong></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>
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Directorate for Mathematical and Physical Sciences

Anne L. Kinney
Assistant Director
This is MPS.

Science at the Scales of the Universe

MPS Divisions:
Chemistry (CHE)
Materials Res. (DMR)
Physics (PHY)
Astronomy (AST)
Math. Sciences (DMS)
MPS supports over 28,000 people…

Support of Academic Basic Research

Mathematics : 64%
Physical Sciences : 45%
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%
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
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
Example Collaborations: MPS/CHE and ENG/CBET

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

**DCL: Rules of Life (RoL):**
Design and Engineering of Synthetic Cells and Cell Components (DESYN-C³):
Design-Build-Test-Learn cycles to create a synthetic cell.

**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.