Funding for Software Engineering Research

Sol Greenspan

National Science Foundation

Directorate for

Computer & Information Science & Engineering (CISE)

Division of

Computing and Communication Foundations (CCF)

Outline

- What you should know about your science agency (NSF specifics but perhaps generalizable)
- SE-Related Funding Opportunities
  - Core SE and Interdisciplinary
- What makes a successful proposal
  - What to emphasize
  - What to avoid

Know How it Works!
Stakeholders

- US Citizens (via US Congress)
  - Give NSF appropriations from US government
  - Entrust NSF to conduct a peer review process
  - Want societal benefits for their tax dollars
  - Demands accountability for integrity of process
- Principal Investigators
  - Submit proposals
  - Serve as peer reviewers
- Program directors
  - Are your interface to NSF
  - Are federal employees or rotators (IPAs)
  - Have track records in their program areas
  - Form panels of experts to conduct review process

The Process *

- Annual solicitations with deadlines for Small, Medium, Large proposals (also some center-scale, also some emerging topics)
  - Other solicitations for emerging topics, also center-scale
  - Core and Cross-Cutting programs
  - Eligibility criteria and proposal limits
- Review process is mostly by panels, also some individual reviews
- Decisions usually within 6 months

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* Varies across NSF Longstanding Core programs; rules could change

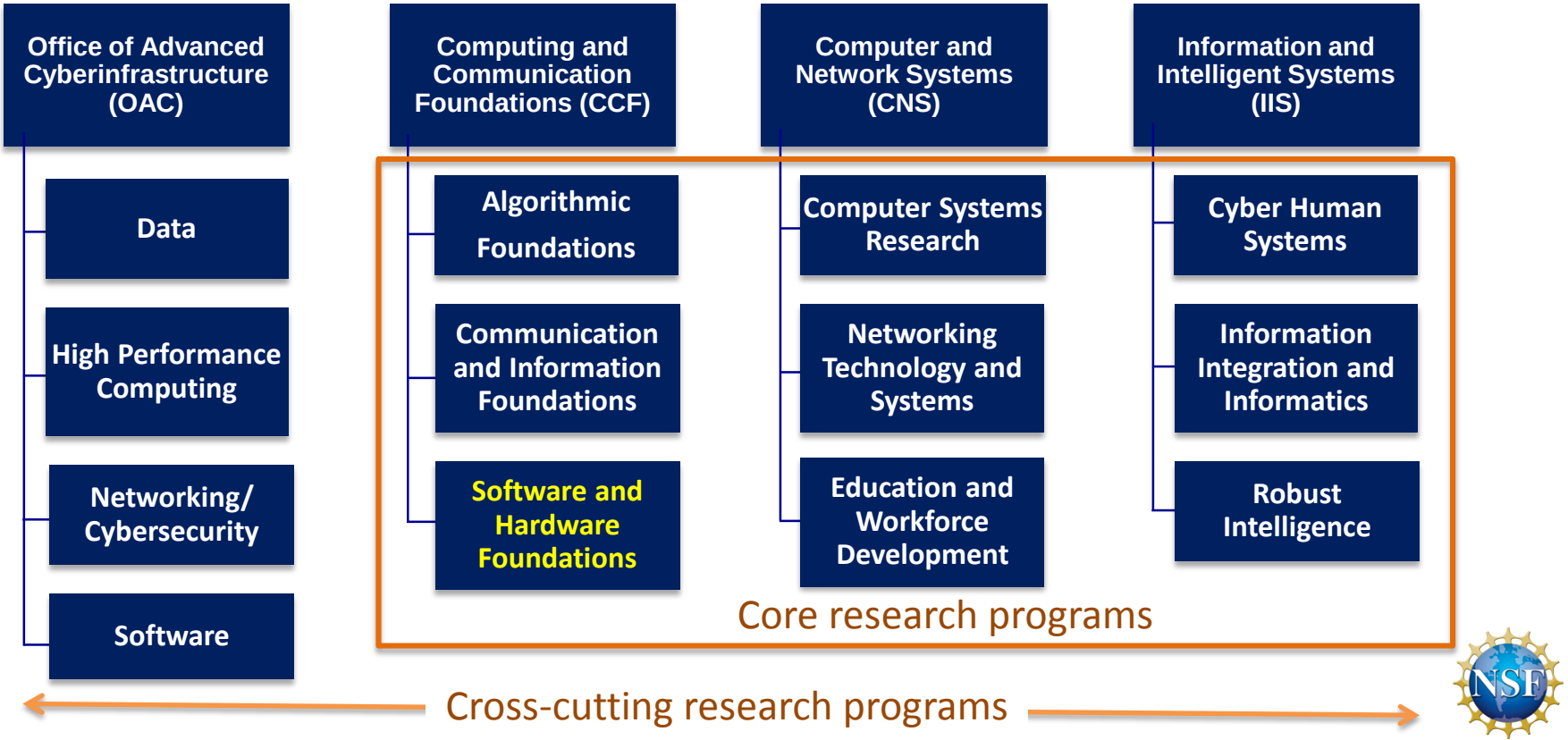
SE-Related Funding Opportunities

- Core programs in each Division of CISE Directorate
- Cross-Cutting programs run by CISE Directorate
- NSF-wide programs
- Programs elsewhere in NSF

CISE Research Investments

Exploring the frontiers of computing

- Strong commitment to core/fundamental research – the heart of what we do.
- Cast a broad net & let the best ideas surface.
- Engage with our community to develop new research directions.



Core SE-Related Programs in CISE

- Computing and Communication Foundations (CCF)
  - Software and Hardware Foundations (SHF)
    - Primary program for SE – FM, PL, testing/analysis, requirements, design, architecture, new paradigms, etc.
- Information and Intelligent Systems (IIS)
  - Cyber-Human Systems (CHS)
    - HCI, CSCW, other social-technical
- Computer and Network Systems (CNS)
  - Computer Systems Research (CSR)
  - Cyberphysical Systems (CPS)
- Office of Advanced Cyberinfrastructure (OAC)

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Cross-Cutting Programs drawing on SE

- Secure and Trustworthy Cyberspace (SaTC)
  (Lead is CISE/CNS; includes CISE, SBE, Math, ENG, EHR)
  - Vulnerability analysis/testing, malware defenses
  - Secure software development, designed-in security, language-based approaches
  - Intrusion detection, forensics, etc.
  - And more
- Cyberinfrastructure for Sustained Scientific Innovation (CSSI)
  Data and Software (Lead is CISE/ACI, involves all of NSF)
  - SE for computational science
    - Elements – software capabilities
    - Frameworks –common software infrastructure
    - CI community hubs

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Other examples of non-Core Programs

- Formal methods in the Field
  - First year of proposals are currently under review
- Scalable Parallelism in the Extreme (SPX)
  - CCF and CNS and OAC divisions
- Smart and Connected Health (SCH)
  - Run out of IIS division
  - Includes CISE, SBE, ENG directorates and several institutes of NIH

CISE Activities for Early-Career Faculty

Faculty Early Career Development (CAREER) Program

Integrating research and education efforts

One of NSF's most prestigious awards for faculty beginning their independent careers who exemplify the role of teacher-scholars.

CISE Research Initiation Initiative (CRII)

Jumpstarting research independence

Open to faculty in first years of an independent academic position to recruit and mentor undergraduate and graduate students, enabling a subsequent stream of discoveries and innovations. First awards in FY15.

Proposal Writing Workshops, Aspiring PI Meetings, and Early-career Workshops

Strengthening research and education activities through community

Introduces early-career faculty to NSF, merit review process, and peers and senior researchers in their field.

Successful Proposals

- A proposal is not a paper
  - Not “Why publish it?” rather “Why invest in it?”
- Intellectual Merit and Broader Impacts
- Science is a self-conscious, reflective activity
  - Explain the research challenges
  - Explain the scientific approach/methodology, e.g.:
    - Discovery through data collection and analysis
    - Prototype building to demonstrate a capability or improve a process
    - Theory formation, explanatory/predictive models, validation through experimentation
    - Prove a theorem and explain consequences

A Successful Proposal

- Solves an important problem
  - Why is the problem important to the field?
- Advances the field
  - How is the work situated in the field?
- Requires a high level of scientific knowledge and expertise
  - What are the research challenges and scientific methods?
- Is part of a vision
  - The vision may be long-range, but the project is only (say) three years long.
  - What are the short-term plans, and how do they contribute to the bigger picture?
- Produces long-lasting principles and artifacts
  - What is the likelihood that it will be considered important in 10 years?
- Benefits society
  - Do something you believe in. Be explicit about the benefits.

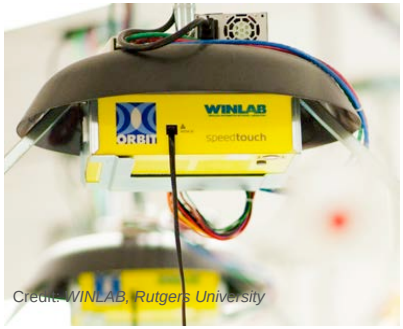
Have a Vision

- Astronomy: What/who is out there? Map the universe. Understand/predict phenomena.
- Biology: What are we made of? How does it all work? Map the gene. Study/predict ecosystem evolution.
- Physics: What is matter made of? What holds everything together?
- A.I. – how can a machine perform specific tasks better than a human? (Invoke for “perform SE tasks…”)
- Software Engineering: ???

Have a Vision

- Software Engineering:
  - We are moving toward a world where we will be programming (nearly) everything everywhere (by) everyone.
  - How can humans (individually or as a group) program a machine (or an environment) to automate everything?
    - Turn intentions into code?
    - With the least effort?
    - With the most (requirements) satisfaction?
    - While knowing what reliability guarantees are achievable and achieved
    - With SE infrastructure and services as part of the “plumbing”

SE and CS are at the center of an ongoing societal transformation



Credits: WINLAB, Rutgers University

Advanced Wireless Research


Image Credit: CCC and SIGACT CATCS

Big Data & Artificial Intelligence


Image Credit: Calvin, University of Texas, Austin

Computer Science Education

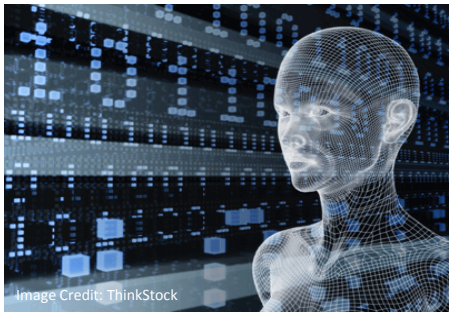


Image Credit: ThinkStock

Cybersecurity


Image Credit: Eliza Grinnell/Harvard SEAS

Manufacturing, Robotics, & Smart Systems


Image Credit: Texas Advanced Computing Center

Advanced Cyberinfrastructure


Image Credit: US Ignite

Smart Cities & Communities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Understanding the Brain

Stay Connected

- Subscribe to get NSF updates by email at www.nsf.gov.
- Subscribe to receive special CISE announcements:
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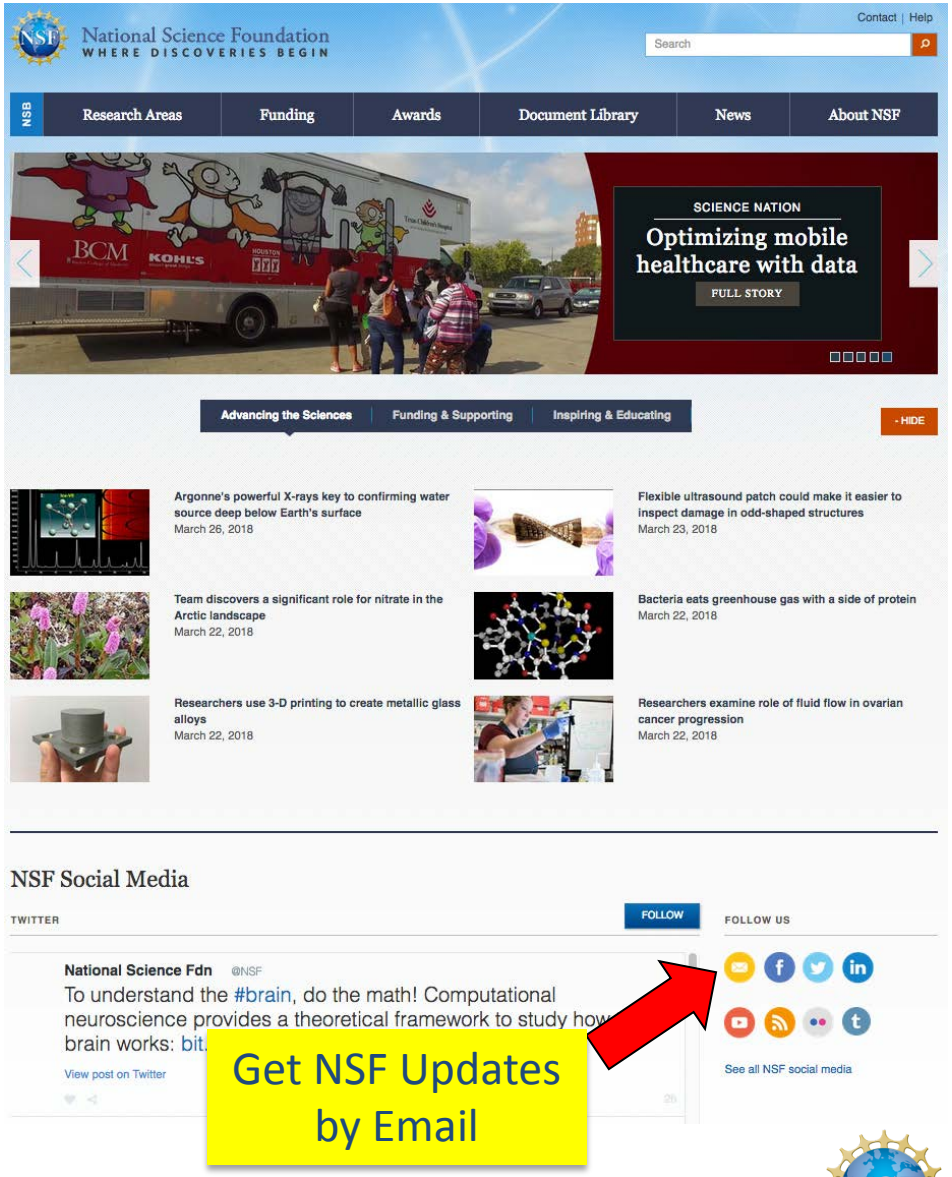
- Visit the CISE website often: http://www.nsf.gov/CISE
- Talk to Program Directors: http://www.nsf.gov/staff/staff_list.jsp?org=CISE&from_org=CISE.
- Follow CISE on Twitter @NSF_CISE.



Final Words

- Learn how your agency works
- Submit your best ideas
- Know your institution's grants people and their process
- Attend a career day event
- Serve on a panel, as a reviewer
- Serve as an NSF program director (some day)
- Subscribe to cise-announce@listserv.nsf.gov
  - See https://www.nsf.gov/news/announcements.jsp?org=CISE

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National Science Foundation's Mission

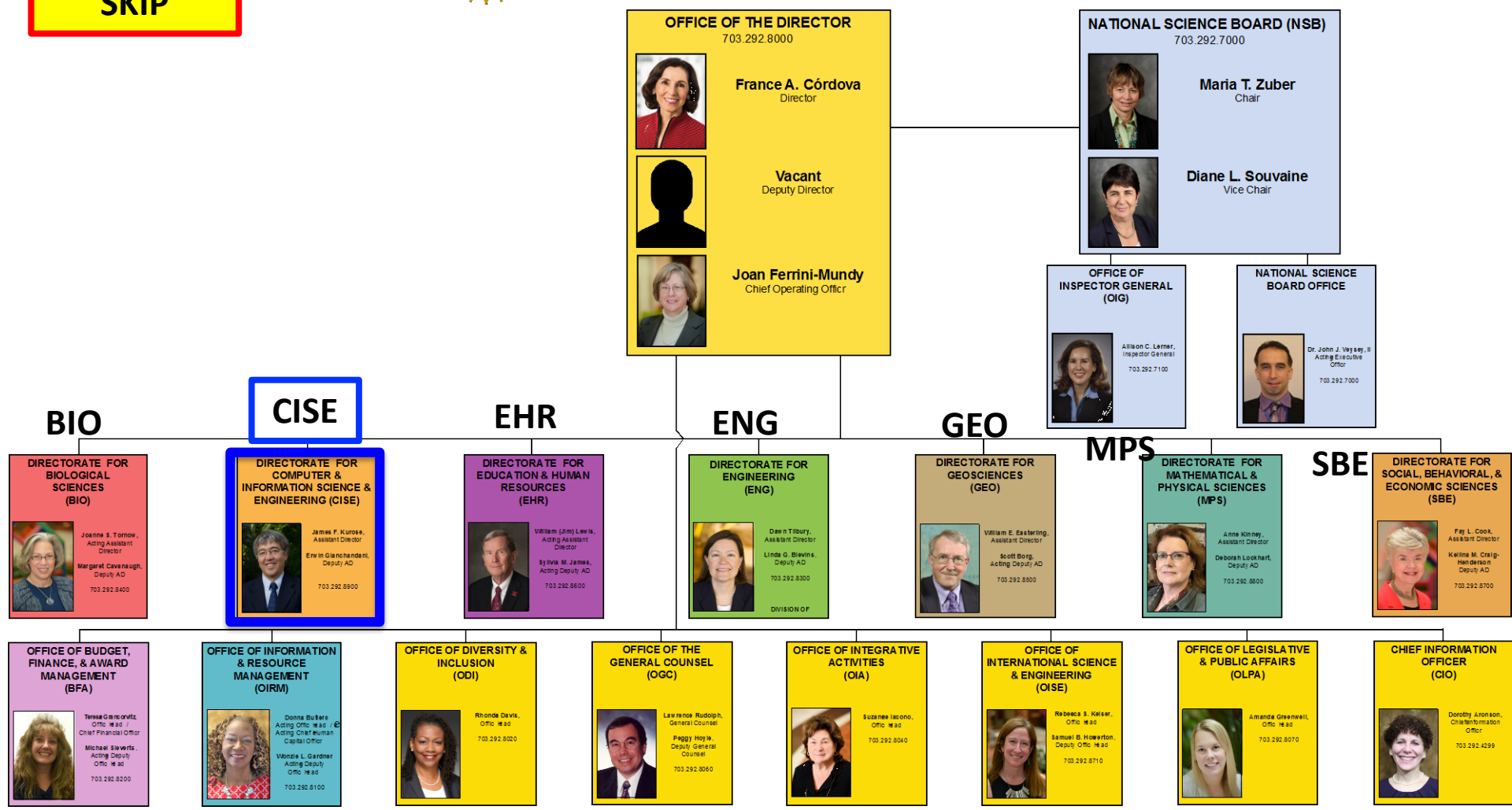
"To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense..."

End of Slides

NSF Supports All of Science & Engineering

SKIP

NATIONAL SCIENCE FOUNDATION



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GOLD STANDARD IN MERIT REVIEW

SKIP

Research proposals submitted to NSF are subjected to a rigorous merit review system – impartial, competitive, and transparent – ensuring that each proposal meets the highest standards of intellectual merit and broader impact on society. NSF's merit review process is widely regarded as the gold standard of scientific review and has been emulated in numerous countries around the world.

$7.3 billion NSF FY 2015 Budget Request

94% Funds research, education and related activities

INPUT

50,000
Proposals evaluated through competitive review process

38,000
Reviewers, including external experts and program staff

233,000
Total number of reviews, each proposal evaluated multiple times

OUTPUT

10,800
Competitive awards funded

1,922
U.S. colleges, universities, and other institutions receiving NSF funding

299,000
Estimated number of researchers, postdoctoral fellows, trainees, teachers and students NSF supports directly

IMPACT

47,800
Students supported by NSF Graduate Research Fellowships since 1952

210+
Number of Nobel Laureates supported by NSF

NSF-Supported Research
has spurred economic activity and improved the quality of life for all Americans

STEM Workforce Development
supports students, teachers and tools to enable the development of a diverse and highly qualified science and technology workforce

Figures other than Budget Request represent FY 2013 actuals

Data Current as of 2014

CISE by the Numbers: FY 2017

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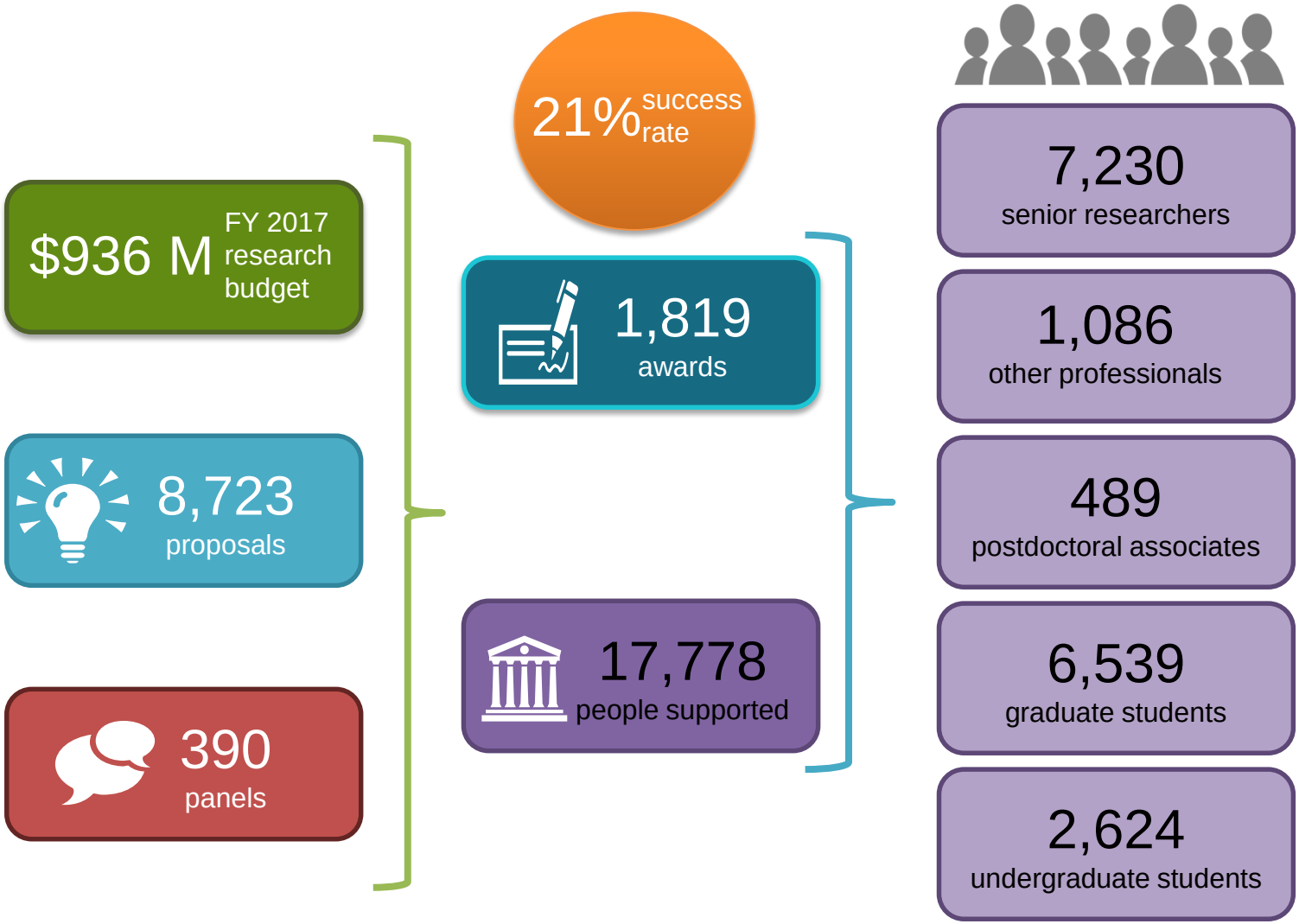

NSF Support of Academic Basic Research

(as a percentage of total federal support)

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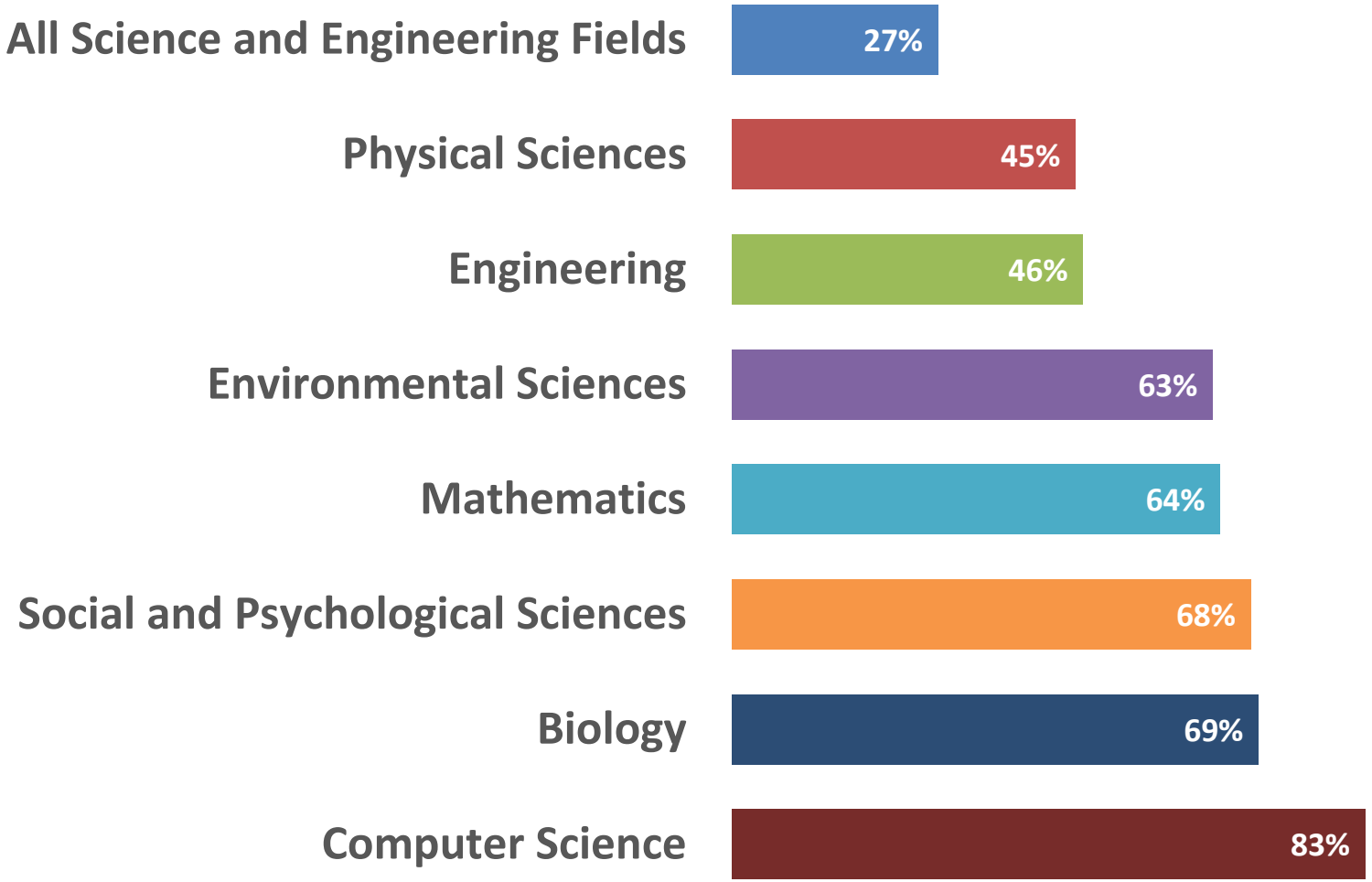

Source: NSF/NCSES, Survey of Federal Funds for Research & Development, FY 2015.

Cross-NSF Opportunities

SKIP

- CAREER – Early career development award
- CRII – research initiative awards to jumpstart research independence
- RUI – Research at (primarily) Undergraduate Institutions
- EAGER – groundbreaking new idea that merits immediate attention and isn't suitable for normal proposal process
- RAPID – rapid response to events
- Research Experiences for Undergraduates – REU Sites, REU Supplements
- Office of International Science and Engineering (OISE) – read their web site, CC me.