Inside the Federal Funding Machine

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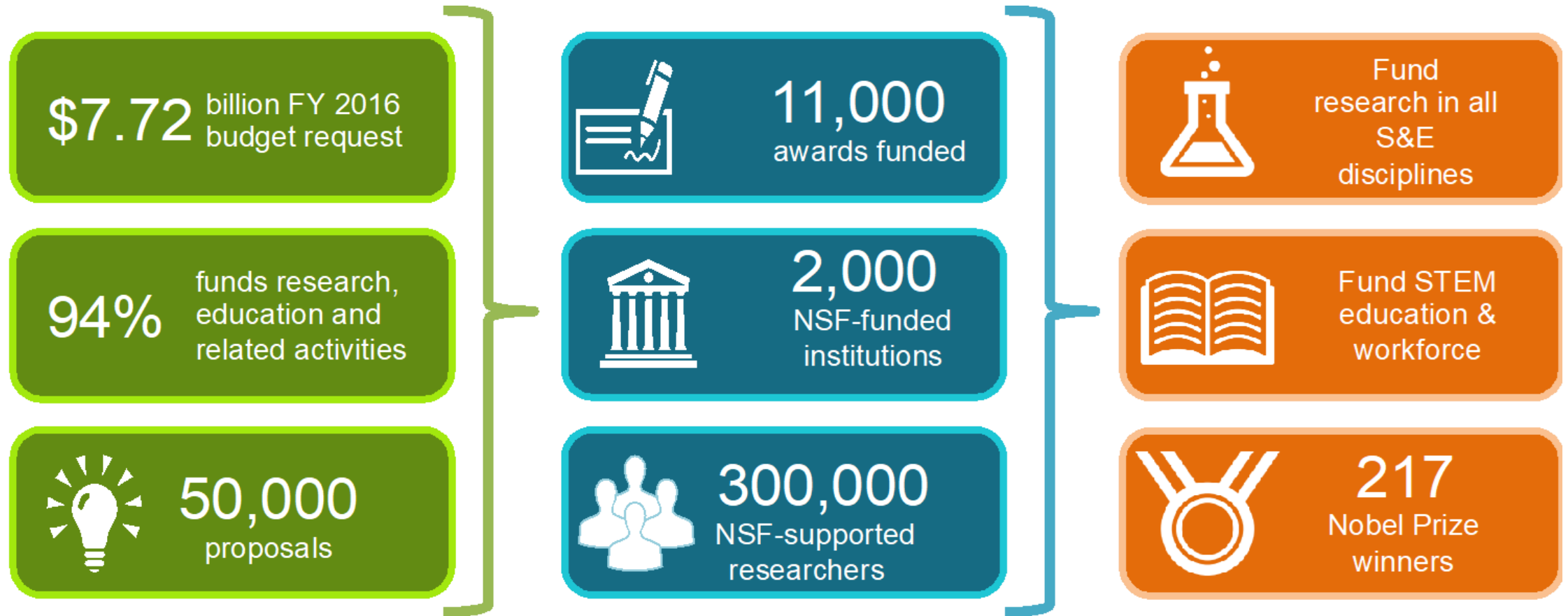# Me

- 4 years as NSF "rotator" via IPA Intergovernmental Personnel Act

- Prior work at another big Federal agency

- Industry experience in large scale networks and infrastructure

- Programs while at NSF: Cybersecurity & Privacy (SaTC), Networking (CC*), Scientific Cyberinfrastructure (CICI; DIBBS), HPC, Transition to Practice (TTP), Cyber Physical Systems (CPS), Citizen Science, Navigating the New Arctic, CyberSEES

- Visiting Fellow in CS

NSF by the Numbers

$7.72 billion FY 2016 budget request

94% funds research, education and related activities

50,000 proposals

11,000 awards funded

2,000 NSF-funded institutions

300,000 NSF-supported researchers

Fund research in all S&E disciplines

Fund STEM education & workforce

217 Nobel Prize winners

NSF "10 Big Ideas" (2016)
2019 - $30M into each Big Idea

RESEARCH IDEAS

HARNESSING THE DATA REVOLUTION

MATHEMATICAL, STATISTICAL, COMPUTATIONAL FOUNDATIONS — EDUCATION WORKFORCE — ANALYTICS — DATA SCIENCE — FUNDAMENTAL RESEARCH — MACHINE LEARNING — DOMAIN SCIENCE CHALLENGES — RESEARCH DATA CYBERINFRASTRUCTURE — MODELING — DATA MINING — INTERNET OF THINGS — STATISTICS — HUMAN-DATA INTERFACE

Harnessing Data for 21st Century Science and Engineering

Work at the Human-Technology Frontier: Shaping the Future
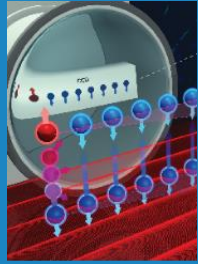
Navigating the New Arctic

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

The Quantum Leap: Leading the Next Quantum Revolution

Understanding the Rules of Life: Predicting Phenotype

PROCESS IDEAS

Mid-scale Research Infrastructure

NSF 2050: Seeding Innovation

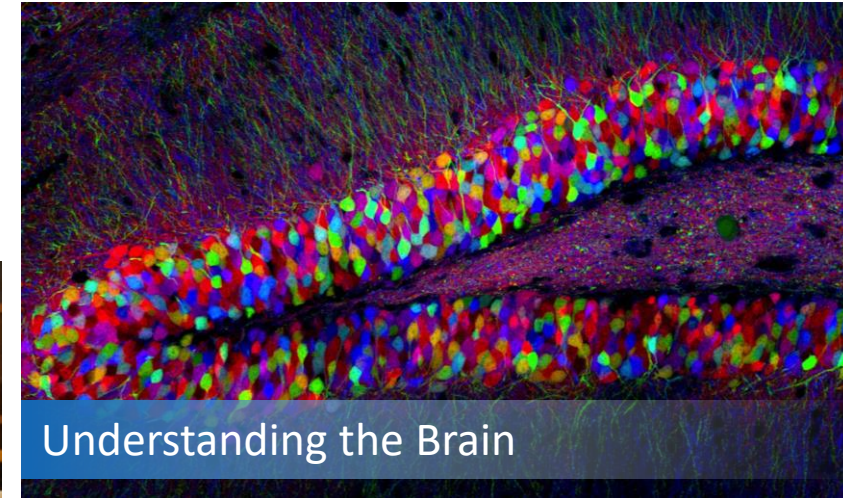NSF 2050
INTEGRATIVE FOUNDATIONAL FUND

Growing Convergent Research at NSF

NSF-INCLUDES: Enhancing Science and Engineering through Diversity

NSF Addresses National Priorities
through Support of Fundamental Research

Food/Energy/Water

INCLUDES

Understanding the Brain

….. requiring a highly capable, highly interoperable
Research Infrastructure

What Does a Program Director Do?

Program Director Role

Listen to a lot of people's ideas.

Read papers, emails, posters, white papers sent to us with a lot of ideas.

Go to academic, industry and government conferences and hear a lot of ideas even outside our area.

Talk to Industry leaders.

Sponsor, suggest workshops or Ideas Labs and hear more ideas.

Collaborate with peers at other Federal Funding Agencies and private funding sources (foundations or even providers like Google).

Craft new programs within NSF across Directorates and between Agencies.

Read formal proposals, run panels. Make funding decisions. Spend weeks afterward writing up awards, negotiating budgets with PI's and with other NSF if co-funding, talk to PI's who were declined.

Site Visits to see PI's, especially for large awards, to ensure the collaboration is on track.

Participate in programs other than your own on behalf of Division.
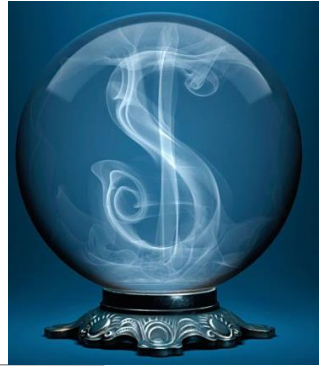
Arrange guest talks within NSF.

Attend Congressional briefings on our program or hear PI's testify on NSF funded technologies.

How are Award Decisions Made?

"The panel ranked this as Competitive – why wasn't it funded!"

Awards are part of a research Portfolio – should have breadth and depth: PI's, topics, institutions

Some ideas/topics are saturated with proposals or played out in novelty and BI

Panel scores are a Recommendation
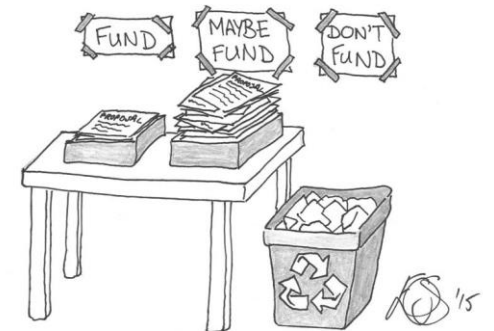
PD's own judgement based on experience
  ◦ Low Ranking/Low Competitive proposals are sometimes funded – may be nugget of an idea or a great BI

Agency and Directorate priorities

Budget constraints. Co-funding may help. Other agency or program (i.e., EPSCOR) funds helps.

Fine balance – early results, no results, significant results – no right answer!

Review panel categories.

Sample Program: Secure and Trustworthy Cyberspace (SaTC)

- Protect cyber-systems from *malicious behavior*, while *preserving privacy* and *promoting usability*
- NSF's largest Cross-Directorate program
- Support an interdisciplinary community of security and privacy researchers
- Funded by 5 Directorates
- Investments:
  ◦ ~$75M in grants annually (FY2008-18)
  ◦ ~200 new projects yearly
  ◦ ~900 currently active research grants
  ◦ Awards up to $10M
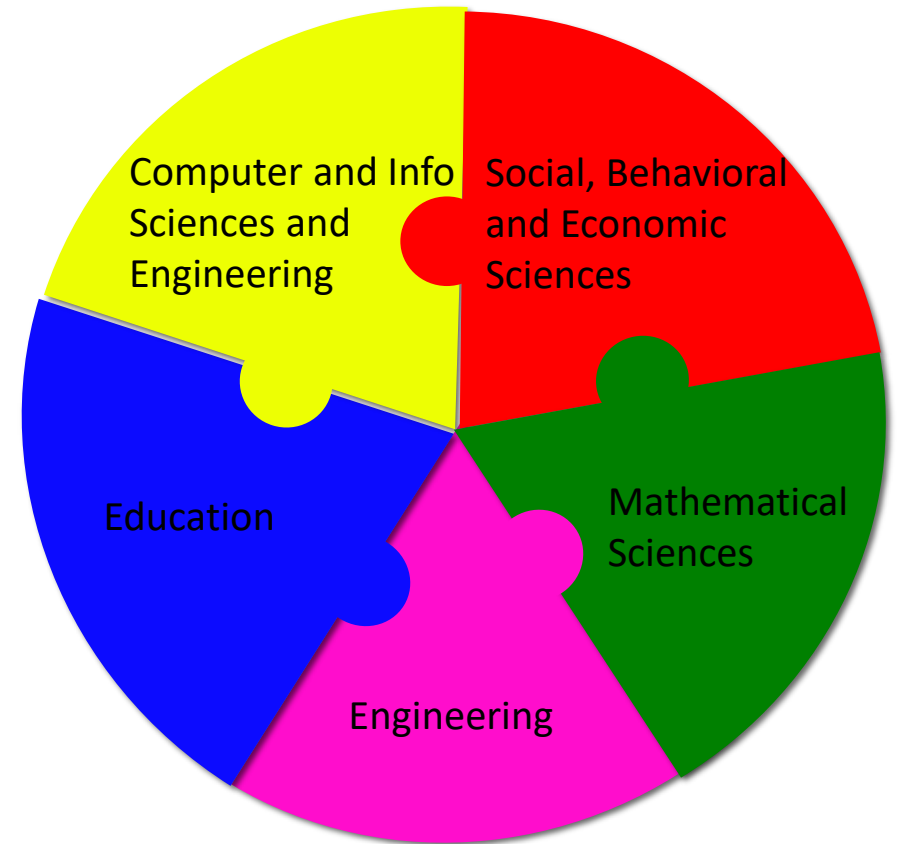
Back to the Big Picture...How are Programs Created?
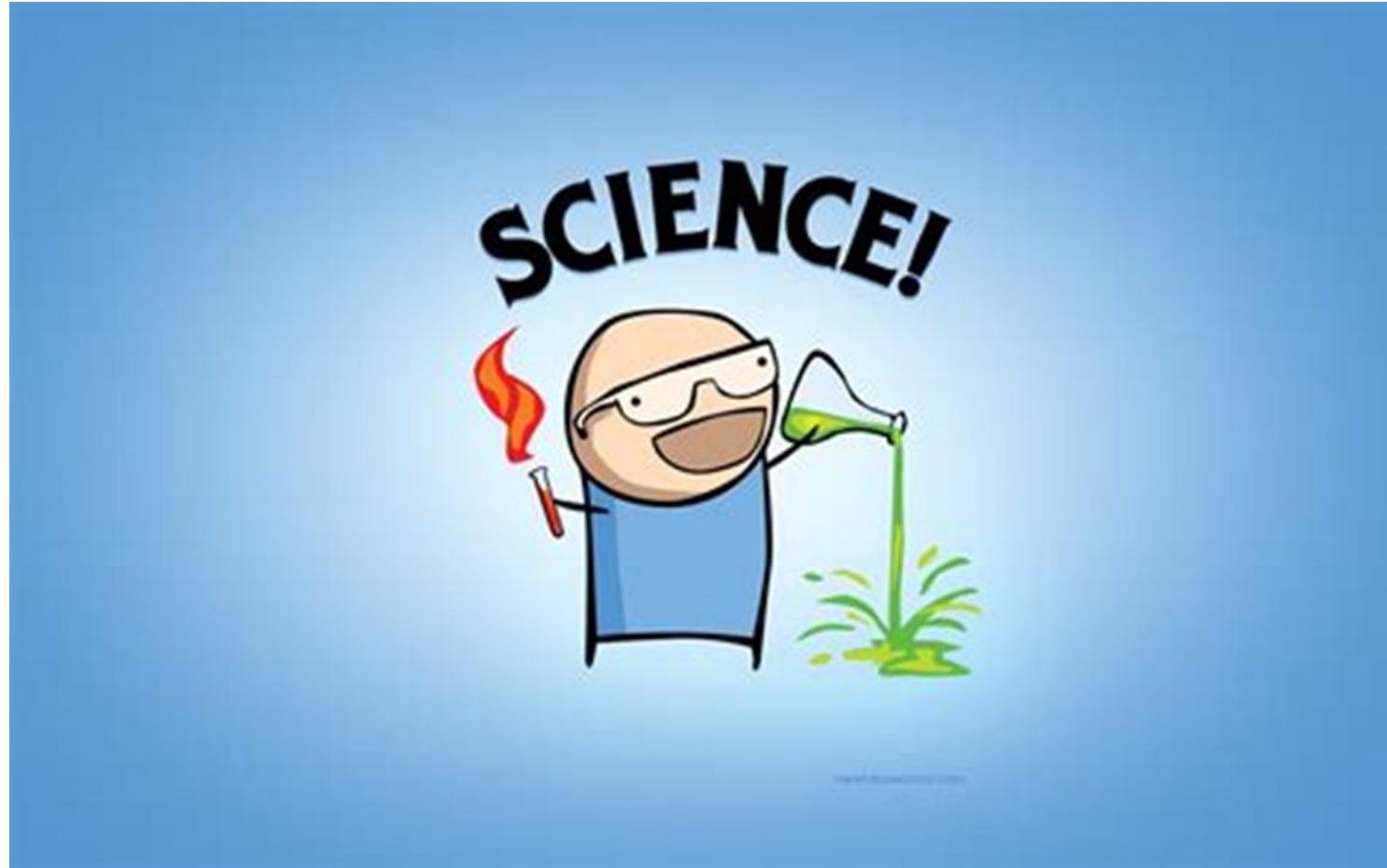
From the Top Down

OSTP leads interagency science and technology policy coordination

NSF Director is appointed by the President

Some NSF programs mandated by Congress

Understanding Government Strategy

Federal Strategies for R&D created jointly by multiple agencies. Typically every 5 years.

Examples at Federal Level across agencies:
- Federal Cybersecurity R&D Plan, AI R&D Plan, National Strategic Plan for Advanced Manufacturing, National Privacy Research Strategy, National Strategic Computing Initiative (NSCI)

Example of Agency-specific:
- Dept of Homeland Security (DHS) Science and Technology Directorate 2015-19 Strategic Plan

National Academies of Sciences, Engineering, Medicine Reports

Executive Orders
- National Strategic Computing Initiative (NSCI) – 2015 - to advance U.S. leadership in HPC

Coordinating Bodies
- Networking and IT R&D (NITRD) Program. Many meetings open to public to listen

National Strategy on Artificial Intelligence

PREPARING FOR THE FUTURE OF ARTIFICIAL INTELLIGENCE

Executive Office of the President
National Science and Technology Council
Committee on Technology

October 2016

THE NATIONAL ARTIFICIAL INTELLIGENCE RESEARCH AND DEVELOPMENT STRATEGIC PLAN

National Science and Technology Council
Networking and Information Technology Research and Development Subcommittee

October 2016

A diversity of computational resources support the nation's data- and computational-intensive science

2013 2014 2015 2016 2017 2018 2019 2020

Blue Waters/UIUC

Stampede/UT Austin

FUTURE DIRECTIONS FOR
NSF ADVANCED COMPUTING INFRASTRUCTURE
TO SUPPORT
U.S. SCIENCE AND ENGINEERING IN 2017-2020
FINAL REPORT - APRIL 2016

NATIONAL RESEARCH COUNCIL

Legend:
Large-scale computation
Long-tail and high-throughput
Data Intensive
Cloud

Science isn't Political...or is it?

2014 Lamar Smith (R–TX), Chair of the House Committee on Science, Space, and Technology, wanted to demonstrate how NSF is "wasting" taxpayer dollars on frivolous or low-priority projects, particularly in the social sciences.

Audited NSF decision making process. Reviewers names never disclosed!

From the Bottom Up

Community Input Informs Agencies :

Workshops

PI Meetings

Community Surveys and RFIs seeking input – these shape future programs and opportunities

National Academies Studies: Future HPC (2015); Evaluating Suitability of Commercial Clouds for NASA

RFI Responses: NSF RFI on Future Needs for Advanced Cyberinfrastructure to Support Science and Engineering Research (2017); Joint agency assessments of the NSCI Exascale RFI (2015); RFI on Midscale Infrastructure (2017)

Program Director Choice:

Create new program based on areas in which they feel more research is needed. Justify budget, scope and lifetime of the program.

Participation and Awareness

Advisory Committees at your favorite Agency. NSF's open to public via phone or in person

Federal Working Groups such as NIST Big Data WG – open to public via conference call

Workshops – many are open to all.

Community Surveys and RFIs seeking input – these shape future programs and opportunities
- ❖ National Academies Study: Future HPC
- ❖ NSF RFI on Future Needs for Advanced Cyberinfrastructure to Support Science and Engineering Research (2017)
- ❖ NSF and Joint agency assessments of the NSCI Exascale RFI (2015)

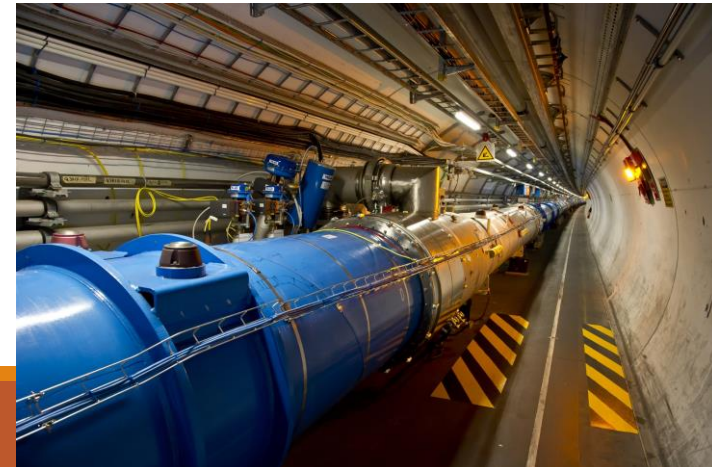# Some Programs Cross Agencies and Nations

High Energy Physics:

❖US – DoE and NSF

❖Europe – CERN

❖Discoveries both in Particle Physics and Advanced Computing

  ❖NSF funding from Physics

  ❖NSF funding from Office of Advanced Cyberinfrastructure – storage/network/compute cycles

  ❖University may fund storage and/or compute

International Networking: DoE, NSF, Partners

Proposal Nuts & Bolts

NSF Policy Changes (Jan 2016)

Significant Changes and Clarifications to the PAPPG:
http://www.nsf.gov/pubs/policydocs/pappguide/nsf16001/sigchanges.jsp

❖ Broader impacts. "**The Project Description must contain, as a separate section within the narrative, a section labeled "Broader Impacts"**. GPG II.C.2.d(i)

❖ Formatting changes in:

  ❖ Results from Prior NSF Support

  ❖ Biographical Sketches

  ❖ Current and Pending Support

❖ <u>Public Access</u> requirement will apply to peer-reviewed journal articles and juried conference papers resulting from awards made from proposals submitted after January 2016.

  ❖ NSF Public Access Repository (NSF-PAR), par.nsf.gov

  ❖ Voluntary deposit to NSF-PAR is possible.

Automated Compliance Checking

AUTOMATED PROPOSAL COMPLIANCE CHECKS PERFORMED BY SYSTEM AS OF JULY 24TH, 2015.*

COMPLIANCE CHECK	FUNDING OPPORTUNITY TYPE	ERROR / WARNING	FUNDING MECHANISM TYPE								
			RESEARCH	RAPID	EAGER	IDEAS LAB	CONFERENCE	EQUIPMENT	INTERNATIONAL TRAVEL	FACILITY/ CENTER	FELLOWSHIP
Proposal Section Exists Checks											
1. Project Summary is required.	GPG Program Description Program Announcement	ERROR	✔	✔	✔	✔	✔	✔	✔	✔	✔
	Program Solicitation	ERROR	✔	✔	✔	✔	✔	✔	✔	✔	✔
2. Project Description is required.	GPG Program Description Program Announcement	ERROR	✔	✔	✔	✔	✔	✔	✔		
	Program Solicitation	ERROR	✔	✔	✔	✔	✔	✔	✔	✔	✔
3. References Cited is required.	GPG Program Description Program Announcement	ERROR	✔	✔	✔	✔	N/A	✔	N/A		
	Program Solicitation	WARNING	✔	✔	✔	✔	N/A	✔	N/A	✔	✔
4. Biographical Sketch(es) is required.	GPG Program Description Program Announcement	ERROR	✔	✔	✔	✔	N/A	✔	N/A		
	Program Solicitation	WARNING	✔	✔	✔	✔	N/A	✔	N/A	✔	✔
5. Primary Budget is required.	GPG Program Description Program Announcement	ERROR	✔	✔	✔	✔	✔	✔	✔		
	Program Solicitation	ERROR	✔	✔	✔	✔	✔	✔	✔	✔	✔
6. Budget Justification for the Primary Organization is required.	GPG Program Description Program Announcement	ERROR	✔	✔	✔	✔	✔	✔	✔		
	Program Solicitation	WARNING	✔	✔	✔	✔	✔	✔	✔	✔	✔
7. Budget Justification for each Subrecipient Organization that exists is required.	GPG Program Description Program Announcement	ERROR	✔	✔	✔	✔	✔	✔	✔		
	Program Solicitation	WARNING	✔	✔	✔	✔	✔	✔	✔	✔	✔

http://www.nsf.gov/bfa/dias/policy/autocheck/compliancechecks_july15.pdf

Broader Impact

NSF now equally weighs IM and BI in reviews and must be commented on by PDs.

Be creative!

Programs with local museums, outreach to K-12 schools, participation in STEM days on campus, seminar series for general public

IIT is in Bronzeville – many opportunities for community interaction via schools, community groups, clubs

Citizen/Participatory Science –involve non-scientists in your work – crowdsource data for richer results

Involvement of undergrads in research

Use common social media platforms (e.g., Facebook, Twitter, etc.) to announce software releases, app releases, course offerings, tools, pubs, etc

Pay Attention to Little Things

If the word "must" (rather than "should") has been used, please note that this is a _requirement_.

Proposals that do not have required elements may be returned without review. This includes use of special characters, formatting, and organization of documents uploaded separately as well as collaboration plans, data management plans, and other elements required by solicitation or the Grant Proposal Guide.

5 p.m. submitter's local time for all submissions.

Page limits and margins matter. Could be returned without review.

Titles matter, especially externally:
◦ Nothing too controversial (ie climate change)
◦ Make it interesting

Data Management Plans (DMP) and Public Access

OSTP Memo (2013): directs Federal agencies to develop plans to make publicly available the direct results of federally funded scientific reseach

NSF Public Access Plan (2015) : Clear and open communication of research results is central to the progress of science

◦ Publications (traditional)

◦ Data (full range of research products)

◦ https://par.nsf.gov/

US Government-wide (Dec 2016): All subject Federal agencies have posted public access plans

Use of repositories are a part of the DMP, and are evaluated along with the rest of the DMP *as a part of the merit review process*

Substantive Letters of Collaboration

Do not submit Letters of Support!

Letter of Collaboration should be substantive

Don't have to use the recommended template. In fact, better not to.

If collaborating across disciplines, ensure it's a partnership and meaningful.

Thinking Big, Broadly and Across Disciplines

Scientific discovery is now multi-disciplinary/transdisciplinary

Example: safeguarding the life sciences entails data science, nanotechnology, materials, IT; Quantum entails Physics, Math, Chemistry, Materials, Computer Science, Social, Education

Substantive Collaborations

Cyberinfrastructure pulls it all together! Don't forget the Cyberinfrastructure!

~$200M by 2020
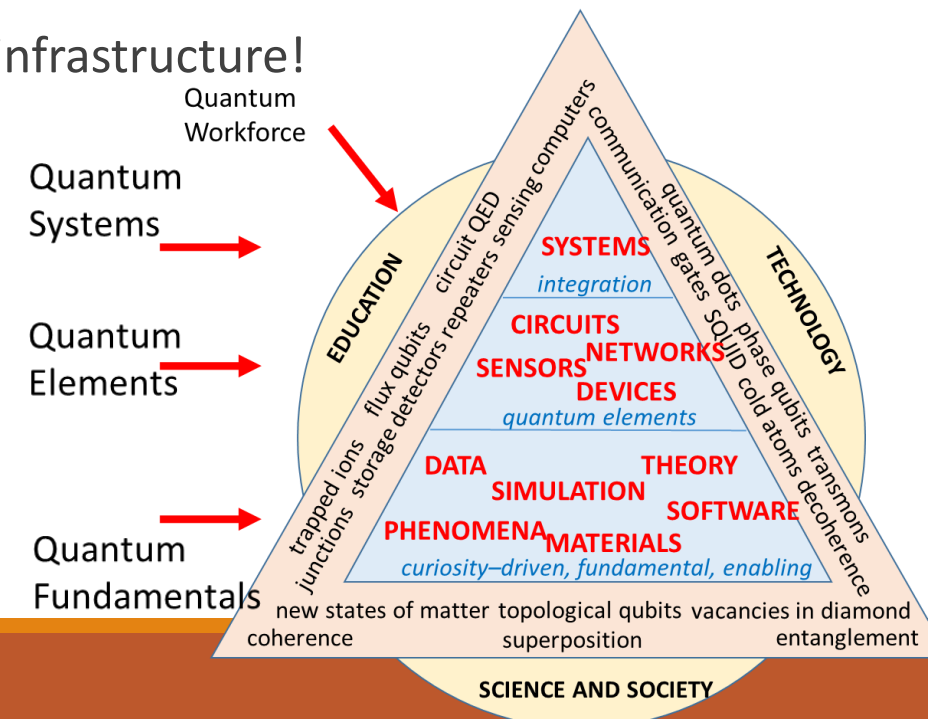
Data-Intensive Discovery Pathways

NSF Funds Cyberinfrastructure

Science applications have evolved from simple jobs to large complex workflows

Open Science Grid (OSG) – vital for LHC/physics data processing. ~1Billion hours of computing/yr moving 200+PB

High Performance Computing (HPC) – Petascale size supercomputers

Networking (including people) – from campus to global – $100M over past 6 years
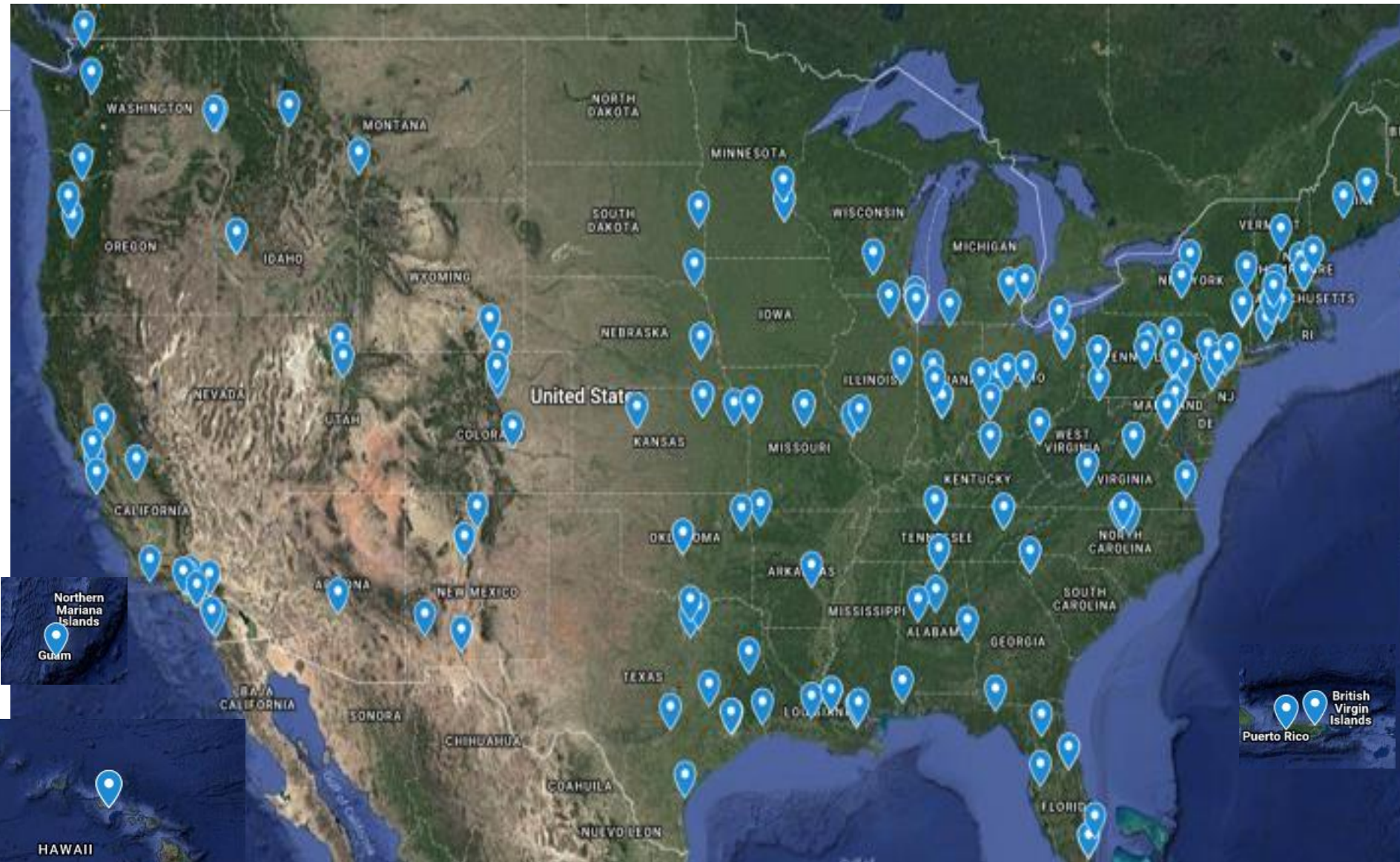
Network measurement – PerfSonar

Scientific Software

Data

Storage

"Pacific Research Platform" $5M

Campus Cyberinfrastructure (CC*) Program awards 2012-2017: ~225 awards

I/UCRC (Industry–University Cooperative Research Centers)

Public-Private Collaboration: Jointly funded by NSF, academia and Industry.

Expanding the innovation capacity of our nation's competitive workforce through partnerships between industries and universities

Seed funding by NSF but primarily supported by industry Center members, with NSF taking a supporting role in the development and evolution of the Center.

Each Center conducts preliminary, precompetitive research of interest to both the industry members and the Center faculty and grad students

Periodic DCLs signal NSF's interest in various areas: IoT, Cybersecurity, Brain

Centers don't overlap in focus areas

IUCRC Preliminary Proposals due **April 19 2019**

Small Business Innovation (SBIR), STTR and Innovation Corps (iCorps)

11 Federal Agencies have an SBIR office: NSF, DoE, NIH, NIST, NASA, DoD, DHS, etc

Fund early-stage innovation ideas that are still too high risk for venture capital firms

Authorized by Congress

NSF SBIR is out of Industrial and Innovation Partnership Office (IIP). Averages $250K/award

https://seedfund.nsf.gov/

In Chicago, iCorps hosts cohorts at U Chicago iCorps site.

7 weeks curriculum: Learn to identify valuable product opportunities that can emerge from academic research, and gain skills in entrepreneurship through training in customer discovery and guidance from established entrepreneurs.

Transition to Practice

- Supports later stage activities in research and development lifecycle such as prototyping and experimental deployment

- Review Criteria:
  - Impact on deployed environment
  - Feasibility, utility, and interoperability in operation
  - Project plan including goals, milestones, demonstration and evaluation
  - Tangible metrics to evaluate effectiveness of capabilities developed

- Successful example of NSF TTP: Bro IDS system (now Corelight, with $25M Series B funding) had 10 years of NSF funding for basic research on networked IDS

- DHS has a robust TTP program.

- **Spring 2019 event – TTP Matchmaking in Chicago!**

Types of Grants

Standard, Annual Programs – "Core" Research

Equipment – Major Research Instrumentation (MRI) – across NSF Directorates

Education – REU Sites, Graduate Research Fellowship

International Collaborations – NSF funds US side/International partner funds their side

Joint with Industry
- Intel
- VMWare on Software Defined Infrastructure
- Platforms for Advanced Wireless Research (PAWR) – matching funds by industry
- Cloud vendors

DARPA

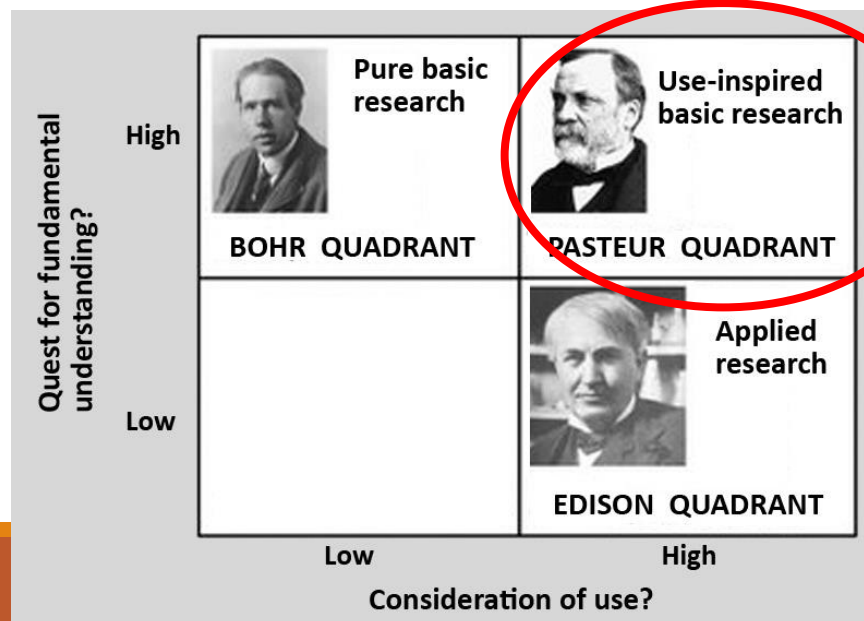DARPA PD's are all rotators/temporary except for support staff

PD's are hired knowing what project they'll create once at DARPA. A lot of autonomy.

Goal: solve real-world problems. Emerging user need that existing technologies cannot address.

Brings together industry and academia to work on projects of relatively short duration.

Very large in scale.

DARPA investments
Private investments declining here

DHS

Federal R&D Process

·Planning
- Identify requirements
- Develop program plan and allocate resources
- Communicate plans and priorities to technical community

·Solicitation
- Posting Solicitations
- Solicitation Process – White Papers
- Submitting proposals

·Contract
- Different programs demand different contract vehicles
- Flexibility used to match mission

·Execution
- Programs tailored to meet unique conditions of objectives
- Active interaction with performers

Homeland Security

Cross Agency Collaborations

NSF/DHS/MCTI (Brazil) cybersecurity program

NSF/BSF (Israel) cybersecurity research program

NSF/FAA on airline ecosystem

NSF/Dept of Transportation – For future Cyber Physical Systems

NSF-Netherlands privacy workshop

NSF almost never sends funds TO other agencies.

However, other Agencies can co-fund or send funds to PI via NSF process.

Be Cognizant of Big Initiatives

BRAIN Initiative (White House) – 2013
- ◦ Several Federal agencies establish programs
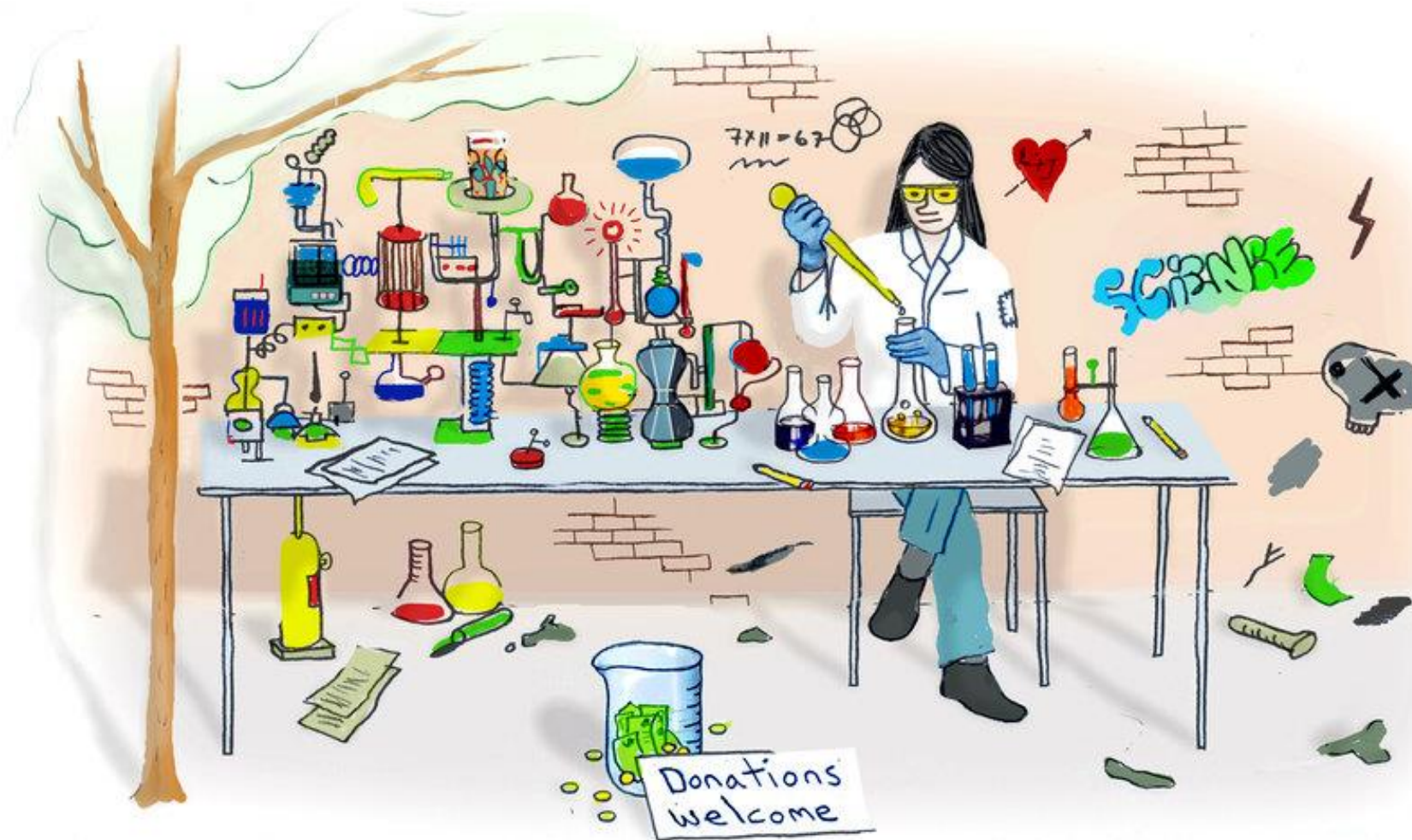
National Strategic Computing Initiative (NSCI)

DoE Exascale

Big Data Hubs

Quantum Computing and Cloud Computing trends in Industry

But I Need More Money!

Other NSF Funding Sources

CISE Research Initiation Initiative (CRII) Within first 3 years of tenure or research job.

Research Experience for Undergraduates (REU) Supplements

EAGER – Early Concept Grants for Exploratory Research – 2 years up to $300K. High risk-high reward projects. NO set due dates. Talk to a PD.

RAPID – Rapid Response Research – severe urgency, natural disasters (Hurricane Harvey, Ebola, etc)

Supplements – additional funding to the original grant to expand

International Office might co-sponsor

Workshops

Student travel to academic conferences

Tips for Success

Find a program to match your research not vice versa.

Think Interdisciplinary

Beware submitting the exact same proposal to multiple programs. PD's talk within and across Agencies.

Pay attention to DCLs.

ALWAYS approach PD with a one pager or idea before submission.

If you are at a conference, workshop or in VA, make an effort to talk to PDs.

Come to the table with funding ideas, especially co-funding. International partners? Other agencies? EPSCOR partners?

Final Tips

Serve on panels (NSF, DARPA, IARPA, NIH) even though it's time consuming.

Get as much feedback as possible internally. Contact PD prior to submission and if declined call to get feedback.

Write monthly/quarterly/annual reports on time. (Negotiate up front if the reporting is too onerous.) Update your PD during the year!

Join mailing list of your favorite Agency

Be flexible in negotiating budget. Be careful in spending it.

Attend webinars held by your favorite Agency

Read the solicitation very carefully! Include necessary documents!

Don't keep emailing/calling if your proposal is "under review"

The research grant application process.

Questions?