Basic Research at the Department of Defense

Dr. Bindu Nair
Director for Basic Research
Office of the Under Secretary for Research and Engineering
Department of Defense

How does DoD define Basic Research?

DoD policy states that basic research is the

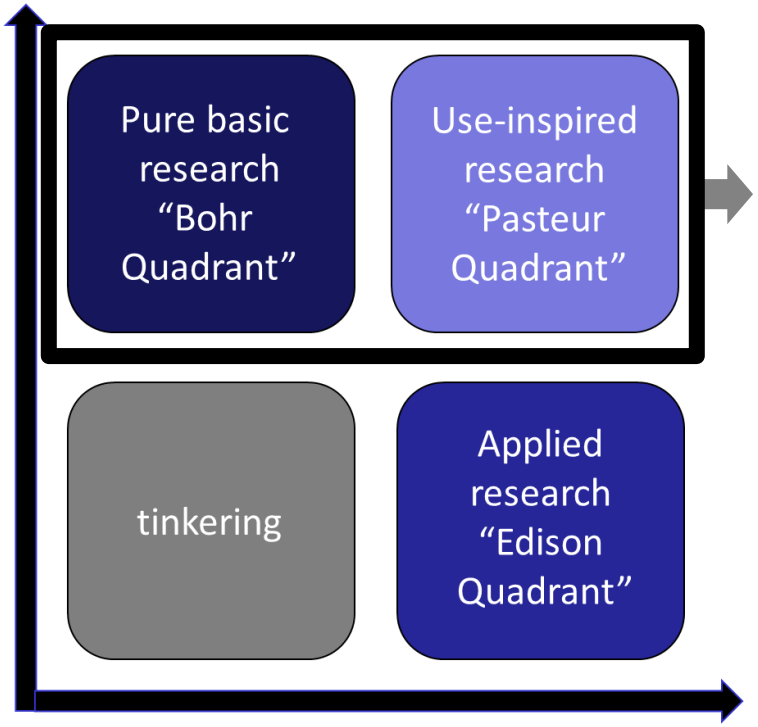
"systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts…"

How does DoD define Basic Research?

- 6.7 Operational Systems Development
- 6.6 RDT&E Management Support
- 6.5 System Development Demonstration
- 6.4 Advanced Component Development Prototypes
- 6.3 Advanced Technology Development
- 6.2 Applied Research
- **6.1 Basic Research**

Why DoD Funds Basic Research

Quest for fundamental understanding

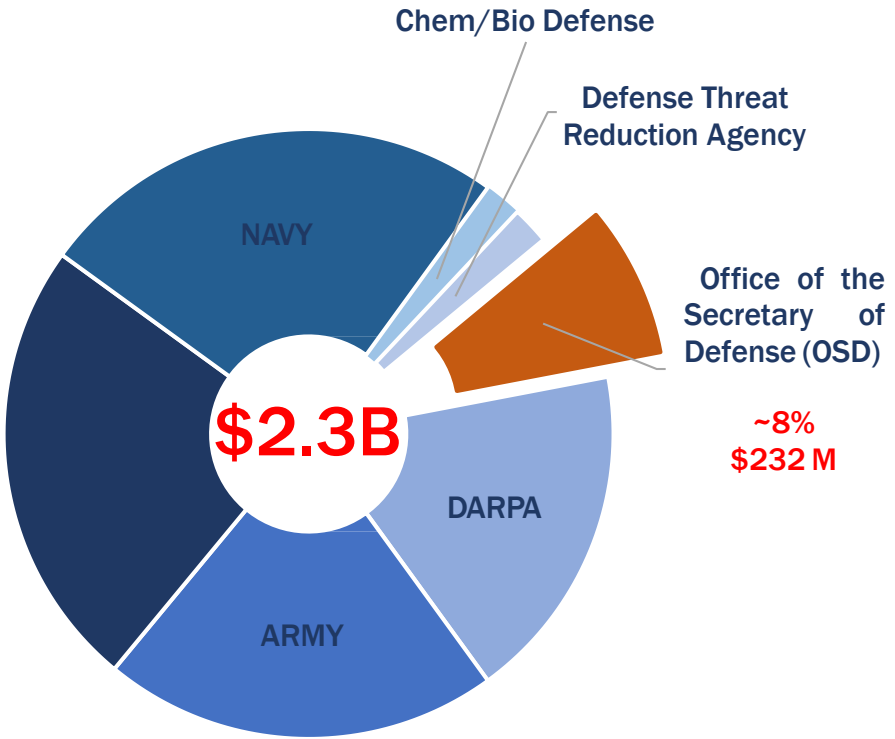


DoD 6.1 Basic Research

Donald Stokes: 'Pasteur's Quadrant'

Funding across the DoD Basic Research Enterprise

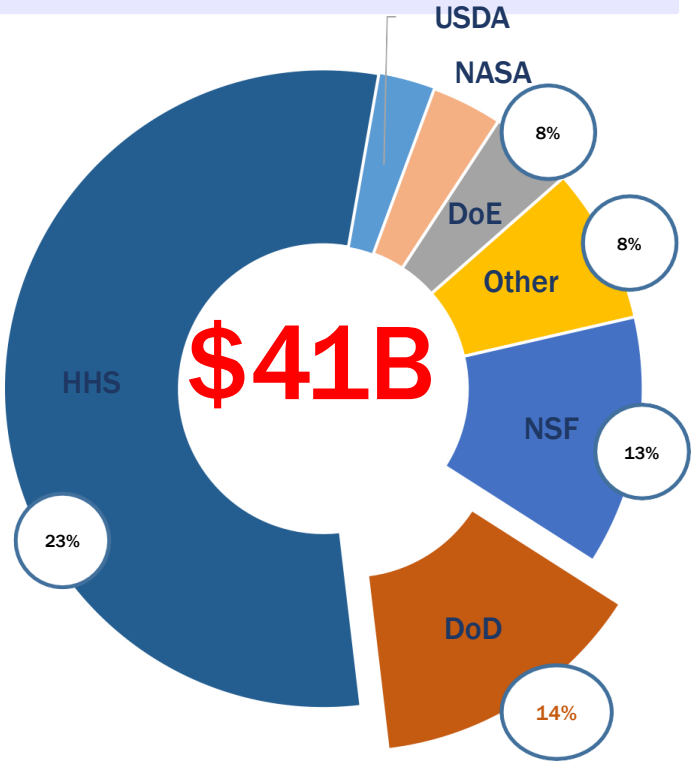
- Over <u>two-thirds</u> of funds to extramural programs
- Major funder of basic research in math, physics, and engineering
- *3rd largest* funder of basic research to universities



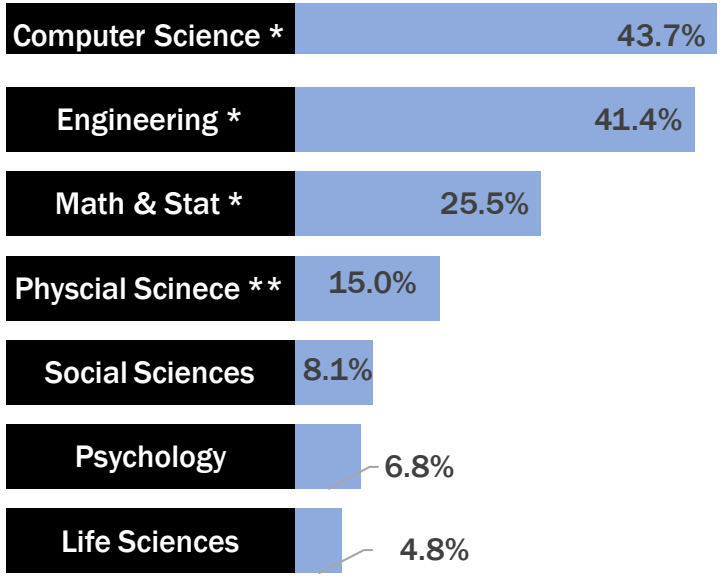
Defense Health Program < 0.5%

Academic R&D Funds by Agency

Research Budget by Federal Agencies



Top Areas *funded by DoD out of entire $41B budget*



*1st largest funder
** 3rd largest funder

Source: NSF, National Center for S&E Statistics, special tabulations (2018) of Higher Education R&D Development Survey (HERD).

Basic Research Investments Across DoD

Pre-doctoral Fellowships
- NDSEG
- Minerva Training Grants

Research Funding to University Laboratories
- VBFF
- Minerva projects
- MURI
- Single-Investigator Awards
- Young Instigator Program

Expanding the Research Base
- DEPSCoR
- HBCU/MI

Equipment and Facility Funding
- DURIP

Transition to DoD
- Minerva transition to Professional Military Schools
- LUCI
- UARCS

Technology Transfer
- I-Corps

Service Programs green | **OSD Programs purple** | **Cross- Service Programs orange**

Ongoing Programs

Vannevar Bush Faculty Fellowship

Defense Department's largest single-investigator program:
5-year fellowship with up to $3M for research with potentially extraordinary outcomes

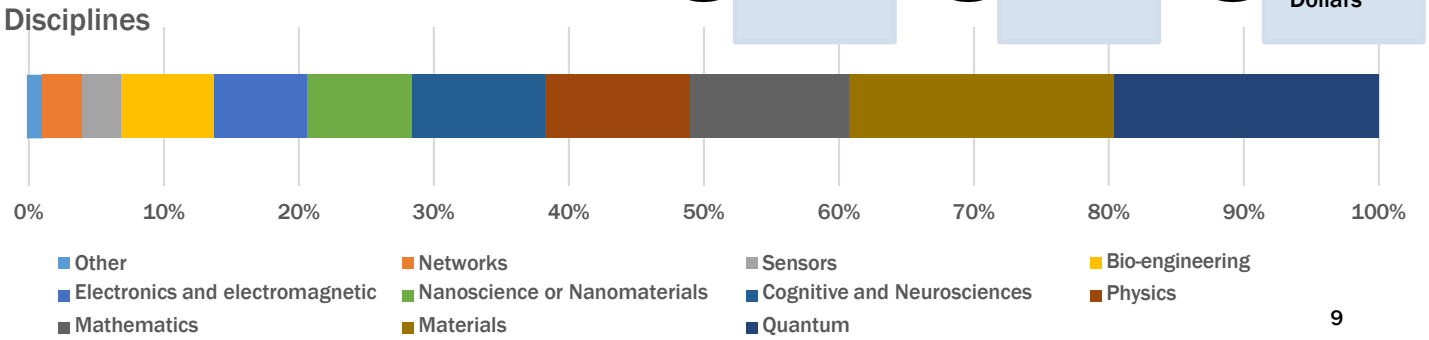
Program Goals:

- VBFF supports transformative, high-risk, basic research
- Attract distinguished, productive, and creative candidates and sustain career-long association between Fellows and DoD
- Establish a group of experts that can study and advise DoD on emerging scientific and technical challenges

103 Awards

42 Universities

$310M Award Dollars



Vannevar Bush Faculty Fellowship

VBFF Fellow make transformative discoveries and transform their careers

Julia Greer VBFF Fellow (2016)
Topic: Materials

Supported 3 Graduates
And 1 Postdoc

+12 High Impact Publications ~2.5 years

Publications Citing VBFF

1. Nano Letters 2020 20 (5), 3513-3520
2. *PNAS*; 2020 Vol. 117; No. 11
3. Nature 2019 573 (7773). pp. 205-213
4. *Advanced Materials*; 2019. Vol. 31; No. 33
5. *PNAS 2019*; Vol. 116; No. 14
6. *ACS Photonics*; Vol. 6; No. 2
7. *Advanced Functional Materials*; Vol. 29; No. 5
8. *Nature Communications*; Vol. 10
9. *Advanced Engineering Materials*; Vol. 20; No. 9
10. *Nano Letters*; Vol. 18; No. 8
11. Nature *Communications 2018*; Vol. 9
12. *Acta Materialia*; Vol. 140

Amy
NDSEG Fellow
2019

Research Highlight: Novel Tunable Metamaterials

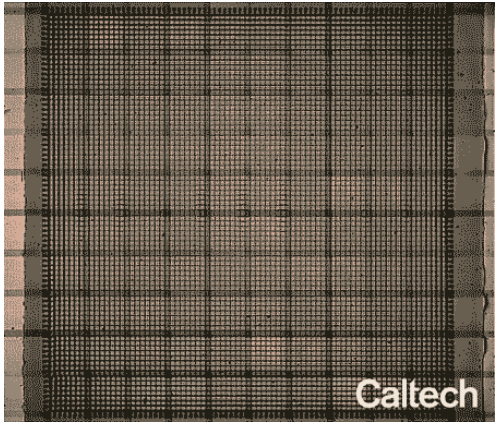


Image: A nanoarchitected metamaterial deforming to create the Caltech icon

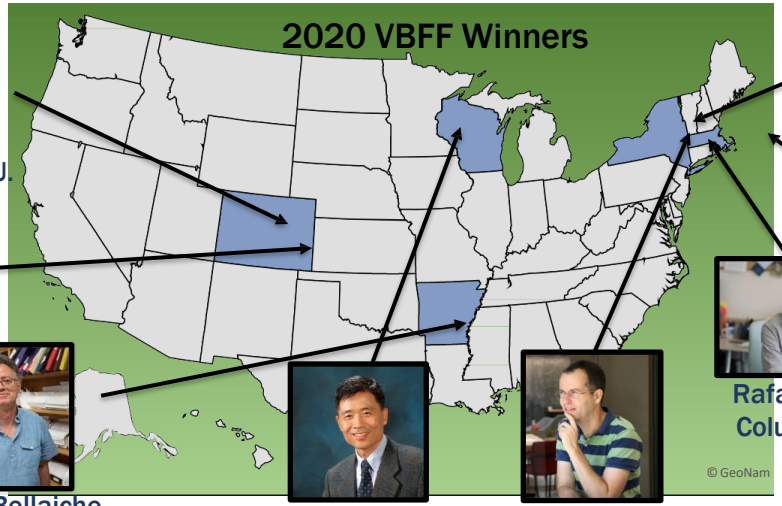
Applications: Next-generation energy storage and bio-implantable micro-devices

Awards: AAAFM Heeger Award

Vannevar Bush Faculty Fellowship

Defense Department's largest single-investigator program:
5-year fellowship with up to $3M for research with potentially extraordinary outcomes

Jorge Rocca
Colorado State U.



Eric Vanden-Eijnden
Courant Institute

Konrad Lehnert
JILA

Khalil Ahmed
Boston U.

Rafael Yuste
Columbia U.

Laurent Bellaiche
U. of Arkansas

Chang-Beom Eom
U. of Wisconsin

Elchanan Mossel
MIT

FOA posted by ONR	White papers due	Full proposals due	Selection of 2020 Class
Early Summer	Later Summer	Winter	Spring
	~15%	~25%	

Informational webinar, project descriptions available on website

https://https://basicresearch.defense.gov/Programs/Vannevar-Bush-Faculty-Fellowship/

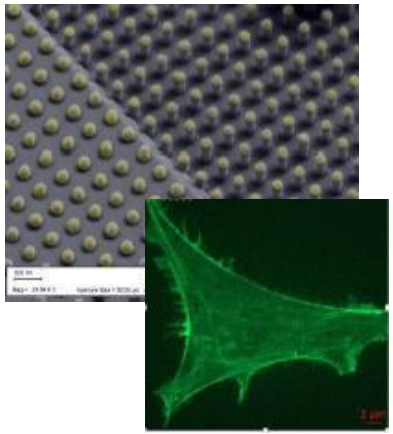
Laboratory University Collaboration Initiative

LUCI encourages collaboration to support high-risk basic science and build stronger relationships between universities and DoD labs

VBFF Fellow: Norbert Scherer, U. of Chicago
LUCI Fellow: Marc Raphael, U.S. Navy research Laboratory

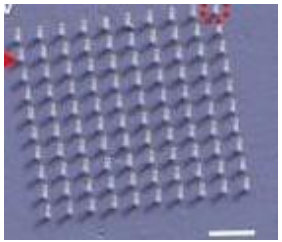
How Does Cellular Navigation Systems Enable Wound Healing?

Accomplishment: Fabricated multi-functional chips for eukaryotic and prokaryotic cell adhesion, division and migration experiments



Transition into Application

Nanoplasmonic Imaging Chip



Wound healing application: senses secretions at the injury site

U.S and Int'l Patents and Applications: 9,791,368, 2014-0093977 A1; US14039326, US15186742, WO2014052759A1, WO2014159847A1, WO2016205775A1

Awards of $600K awarded over 3 years

https://basicresearch.defense.gov/Pilots/Laboratory-University-Collaboration-Initiative/

Minerva Research Initiative

DoD's basic social sciences program to better understand the social and cultural forces shaping security

Program Goals:

- Connect social science insights and methods to improve decision-making
- Build fundamental understanding of social, cultural, and psychological forces that shape strategically important regions of the world
- Help DoD better understand and prepare for future challenges, particularly those prioritized in the National Defense Strategy.

Project average budget of $1.5 million lasting 3 to 4 years

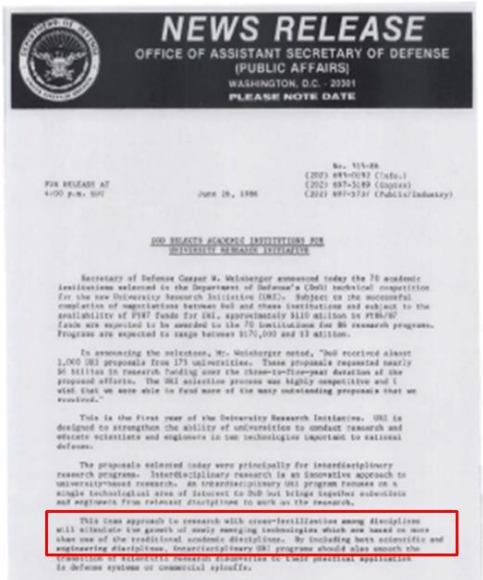
www.Minerva.defense.gov

Multidisciplinary University Research Initiative

Tri-service program that supports basic research teams intersecting with more than one traditional science and engineering discipline

Program Goals:

- Educate scientists and engineers in the interdisciplinary areas important to national defense
- Promote rapid technology transition directly to Service applications
- Complement other DoD programs that support university research through the single-investigator awards.
- MURI awards are 3-5 years, with teams funded up to $1.5M/year.



NEWS RELEASE

OFFICE OF ASSISTANT SECRETARY OF DEFENSE (PUBLIC AFFAIRS)

WASHINGTON, D.C. 20301

PLEASE NOTE DATE

FOR RELEASE AT 4:00 p.m. EST

June 26, 1986

DOD SELECTS ACADEMIC INSTITUTIONS FOR UNIVERSITY RESEARCH INITIATIVE

Secretary of Defense Caspar W. Weinberger announced today the 20 academic institutions selected in the Department of Defense's (DoD) technical competition for the new University Research Initiative (URI). Subject to the successful completion of negotiations between DoD and these institutions and subject to the availability of FY87 funds for URI, approximately $110 million in FY86/87 funds are expected to be awarded to the 20 institutions for 80 research programs. Programs are expected to range between $170,000 and $3 million.

In announcing the selections, Mr. Weinberger noted, "DoD received almost 1,000 URI proposals from 175 universities. These proposals requested nearly $6 billion in research funding over the three-to-five-year duration of the proposed efforts. The URI selection process was highly competitive and I wish that we were able to fund more of the many outstanding proposals that we received."

This is the first year of the University Research Initiative. URI is designed to strengthen the ability of universities to conduct research and educate scientists and engineers in the technologies important to national defense.

The proposals selected today were principally for interdisciplinary research programs. Interdisciplinary research is an innovative approach to university-based research. An interdisciplinary URI program focuses on a single technological area of interest to DoD but brings together scientists and engineers from relevant disciplines to work on the research.

This team approach to research with cross-fertilization among disciplines will stimulate the growth of newly emerging technologies which are based on more than one of the traditional academic disciplines. By including both scientific and engineering disciplines, interdisciplinary URI programs should also smooth the transition of scientific research discoveries to their practical application in defense systems or commercial spinoffs.

1986 Press Release: "This team approach in research with cross-facilitation among disciplines will stimulate the growth of newly emerging technologies....

Multidisciplinary University Research Initiative

Tri-service program that supports basic research teams intersecting with more than one traditional science and engineering discipline

***FY 2020 Budget*:**

$185 million for 26 research teams

Selected topics from most recent funding call:

Molecular Qubits for Synthetic Electronics, Anomalous Dipole Textures in Engineered Ferroelectric Materials, Fundamental Design Principles for Engineering, Orthogonal Mechanisms of Novel Reactivity in Aqueous Microdroplets

https://www.grants.gov/web/grants/search-grants.html?keywords=muri

National Defense Science and Engineering Graduate Fellowship

The NDSEG fellowship supports graduate students in science and engineering disciplines of military importance

Since its inception in 1989...

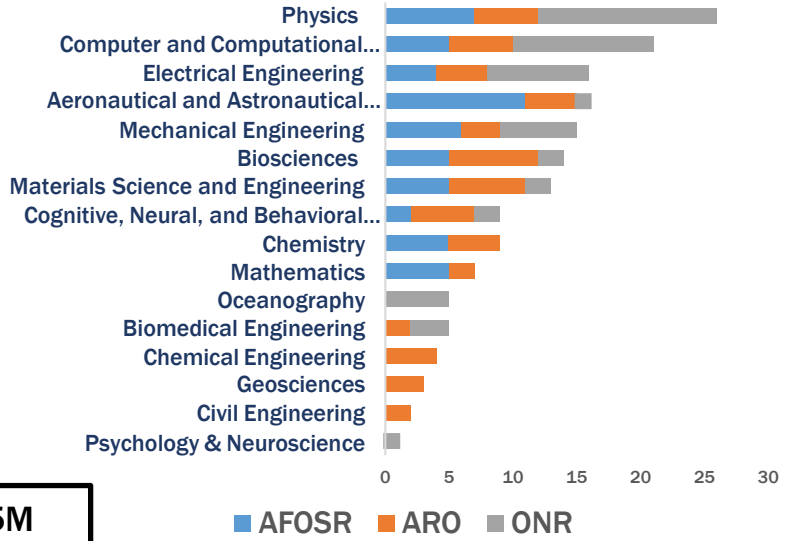
3,600 Fellowships Awarded

15 Disciplines Supported

FY 2019

166	65	$45M
Awards	Universities	Budget

FY 2019 NDSEG Fellows Disciplines

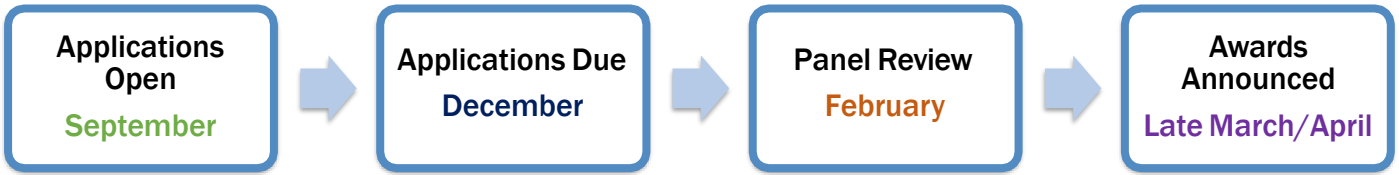


National Defense Science and Engineering Graduate Fellowship

The NDSEG fellowship supports graduate students in science and engineering disciplines of military importance

Funding for 3 years:

- Covers full tuition, mandatory fees, & health insurance cost up to $1200/year, travel costs up to $500 for the fellowship duration
- Fellows also receive a monthly stipend of $3200.



Informational webinar, project descriptions available on website

http://www.ndsegfellowships.org

Historically Black Colleges and Universities And Minority-Serving Institutions Program

DoD's HBCU/MI Science Program increases the research and educational capacity of HBCUs/MIs, and fosters workforce diversity and entry of underrepresented minorities into STEM disciplines.

Program Goals:

- Enhance participation of HBCUs/MIs in DoD research
  - 751 institutions across the nation
  - 24 institutions in New York
- Strengthen research and educational opportunities at HBCU/MI and increase number of minority graduates in STEM disciplines
- Build a more diverse pool of scientists and engineers to meet the future needs of defense-related programs

FY 2017: Prairie View A&M University, an HBCU in Texas, leads the $5M research Center of Excellence in Big Data Analytics.

PI: Dr. Lijun Qian
Prairie View A&M University

Co-PI: Dr. Barbara Chapman
Stony Brook University

Accomplishments:

- Center has graduated 33 scholars; developed courses in Deep Learning for Artificial Intelligence
- Leveraged research capabilities to secure an additional $3.6M in funding.
- Supports 56 students

https://basicresearch.defense.gov/Programs/HBCU-MI-Program/

Historically Black Colleges and Universities And Minority-Serving Institutions Program

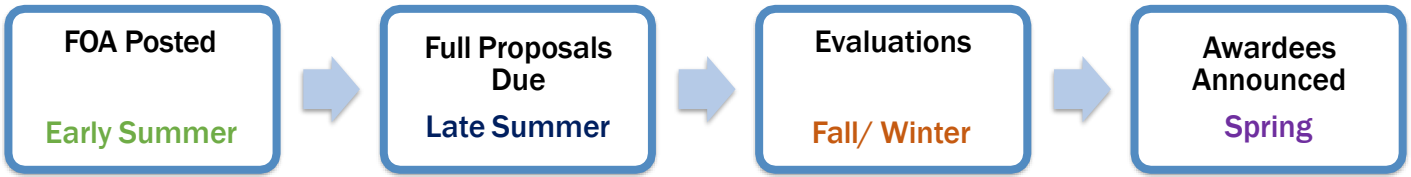
DoD HBCU/MI annual funding opportunities support research project grants, including student support (fully funded for 3 years) or equipment/instrumentation grants (fully funded for 1 year).

***FY 2020 Budget*:**

Budget ~ $24 million for ~ 104 awards to students and acquisition and research equipment

Current open funding opportunities for HBCUs/MIs support:

- **Acquisition of Equipment and Instrumentation (W911NF-20-S-0010)**
- **Research, development, testing, evaluation, and educational enhancements (W911NF-19-S-0013)**



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Beyond Funding Research

Basic Research Office Implements Policy

THANK YOU

http://basicresearch.defense.gov

@DoD_STIx