# Transforming Women's Health through Engineering

**Susan Margulies, Assistant Director for Engineering**
**U.S. National Science Foundation**
**October 8, 2024**

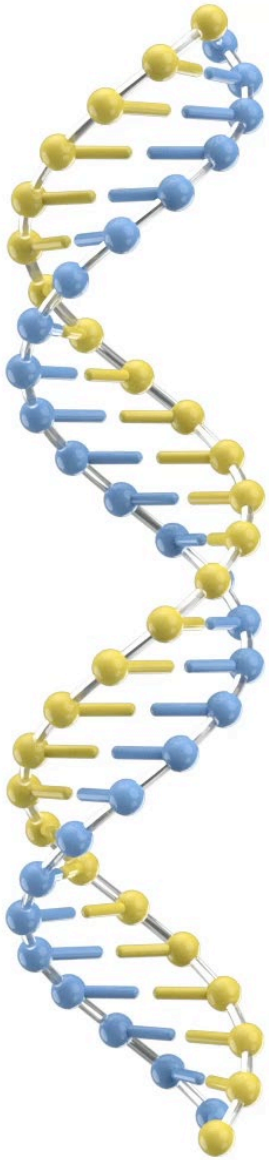
Meeting of the NIH Advisory Committee on Research on Women's Health (ACRWH)

# NSF Mission


To promote the progress of science, to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes

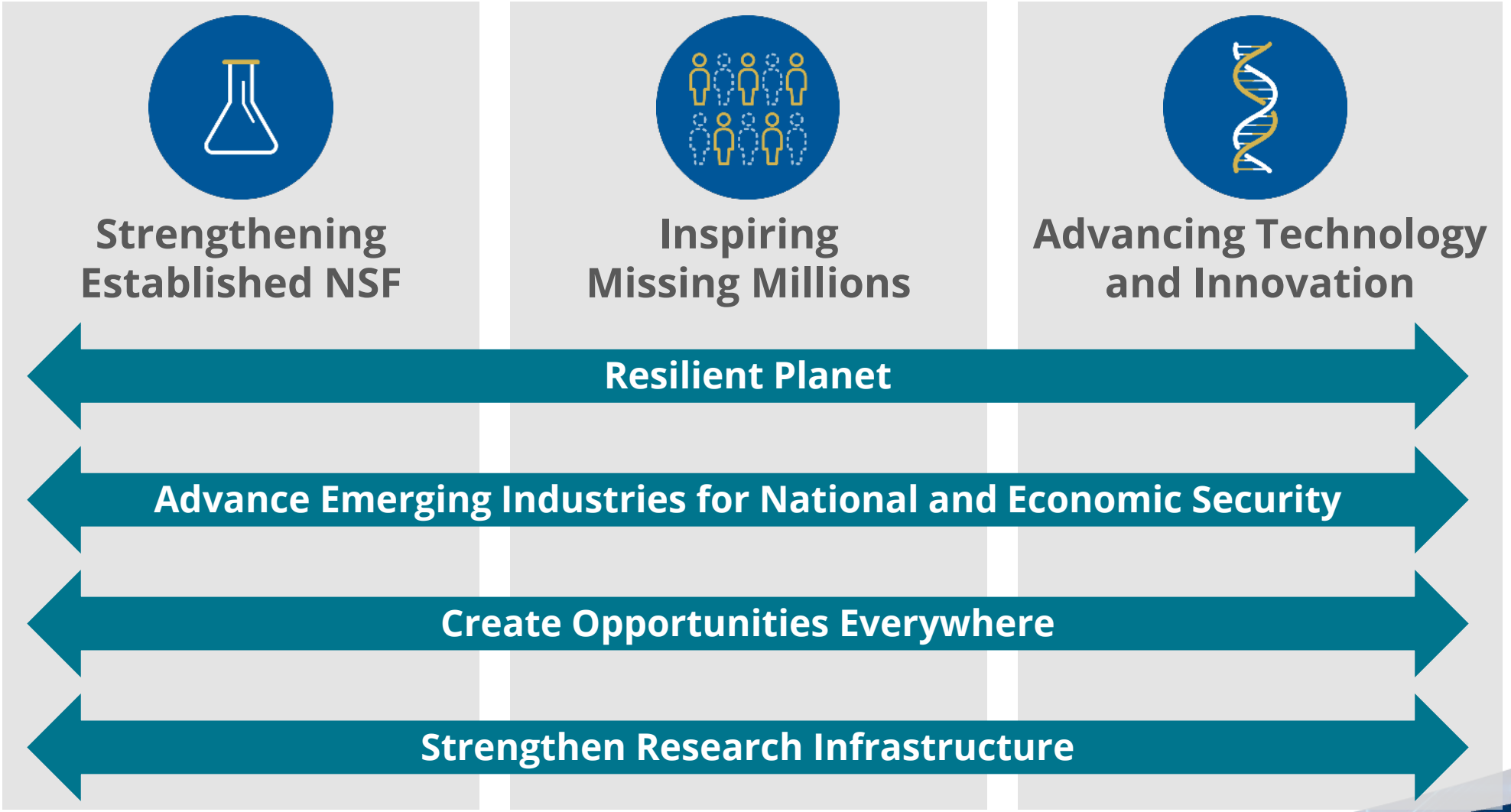
# NSF Research Investments

**CURIOSITY-DRIVEN, DISCOVERY-BASED EXPLORATIONS**



**USE-INSPIRED, SOLUTIONS-FOCUSED INNOVATIONS**

# NSF's Major Priorities



# NSF By The Numbers

NSF is an $9.06 billion independent federal agency created by Congress in 1950 to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense. NSF's vital role is to support basic research and researchers who create knowledge that transforms the future.

DID YOU KNOW?

NSF has funded the work of **262** Nobel Prize winners over 75 years.

**$9.06B**

**FY 2024 Total Enacted**

**93%**

**Funds research, education and related activities**

**11K**

**Awards**

**1.9K**

**Institutions**

**353K**

**People**

**Data represents FY 2023 Actuals unless otherwise indicated*

# White House R&D Priorities for FY 2025

- Advance trustworthy artificial intelligence (AI) technology
- Lead the world in maintaining global security and stability
- Meet the climate crisis by reimagining our infrastructures, renewing our relationship with nature, and securing environmental justice.
- Achieve better health outcomes for every person
- Reduce barriers and inequities
- Bolster R&D and industrial innovation that will build economic competitiveness from the bottom up and middle out
- Strengthen, advance, and use America's unparalleled research to achieve our Nation's great aspirations

# NSF Engineering Goals and Priorities

# NSF Engineering

**MISSION**

To transform our world for a better tomorrow by driving discovery, inspiring innovation, enriching education, and accelerating access

**VISION**

NSF Engineering will be a global leader in identifying and catalyzing fundamental engineering research, innovation, and education.

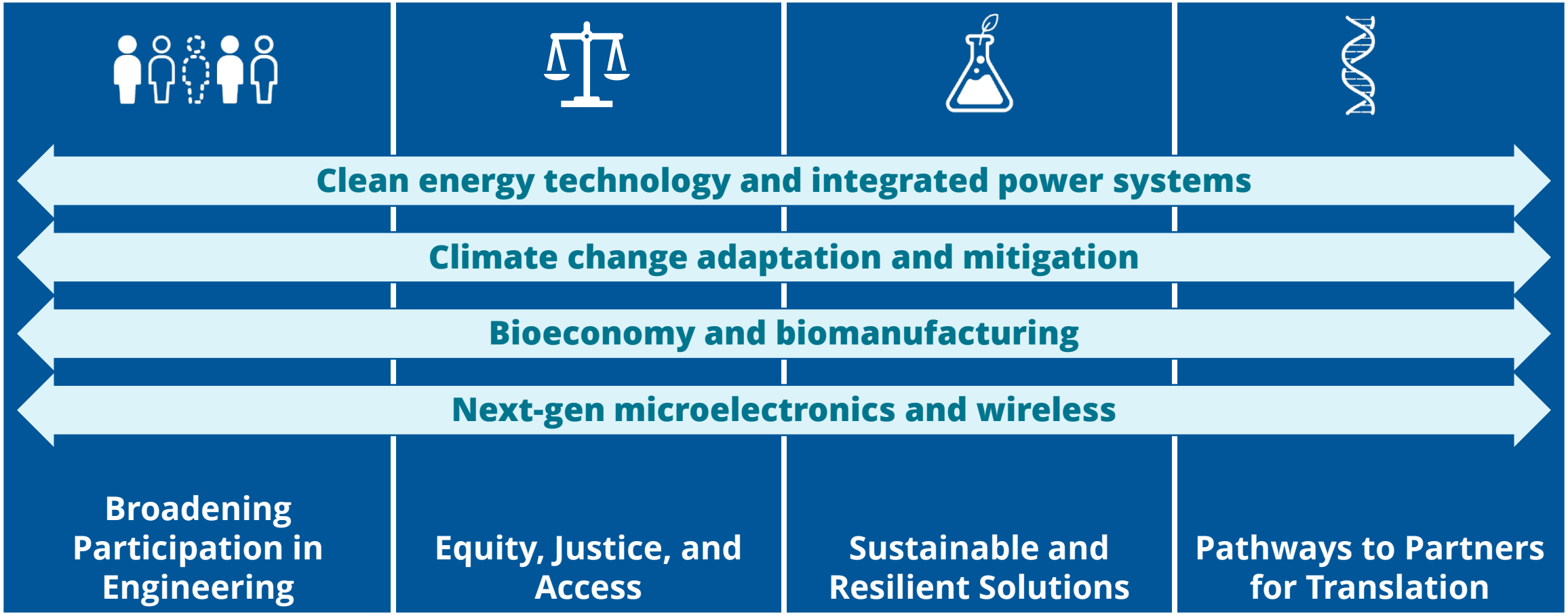
**GOALS**

**Propel**
**U.S. leadership in transformational engineering approaches to problems with societal impact**

**Expand**
**opportunities for people**

**Catalyze**
**purposeful partnerships**

# Investing in Cross-ENG Strategic Priorities



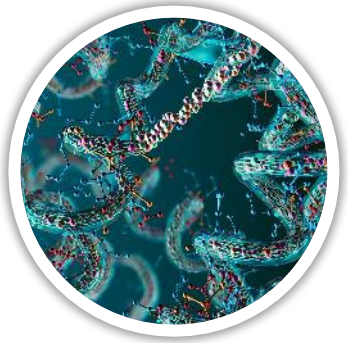

Coordinate — Collaborate — Co-fund

# Looking Back on Investments: A Track Record of Leadership in Transformational Engineering Impact in Medicine

# NSF: Where Discoveries Begin

**LED LIGHTING**

**mRNA VACCINES**



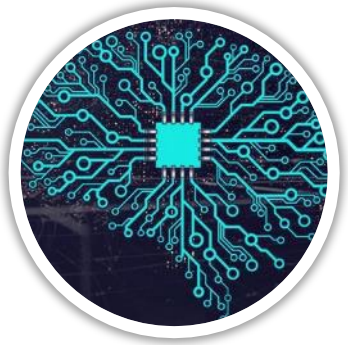
**DIRECTED EVOLUTION**

**TISSUE ENGINEERING**

**MAGNETIC RESONANCE IMAGING**

**DIGITAL TWIN MODELING**

**LASIK**

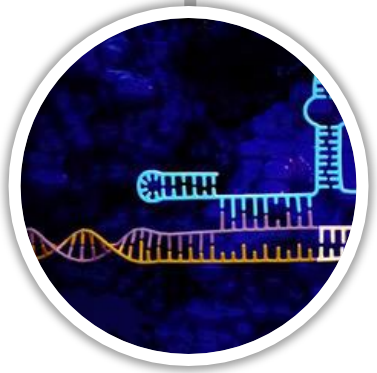


**ARTIFICIAL NEURAL NETWORKS**



*LED: Wikimedia; Directed evolution and Heart images: NSF - stock.adobe.com; LASIK: Jupiter; Neural network: mikemacmarketing (original); Liam Huang (cropped)*

# Biotechnology

| | 1980s<br>MOLECULAR BIOTECHNOLOGY | 1990s<br>TISSUE ENGINEERING | 2000s<br>SYNTHETIC BIOLOGY | 2010s<br>CELLULAR BIOMANUFACTURING | 2020s<br>BIOLOGICAL COMPUTING |
|---|---|---|---|---|---|
| **NSF INVESTMENTS** |  |  |  |  |  |
| **CURRENT IMPACTS** |  |  |  |  |  |
| | **PCR AND COVID TESTS** | **ARTIFICIAL SKIN** | **PRECISION GENOME EDITING AND CRISPR** | **REPRODUCIBLE PRODUCTION OF CANCER THERAPIES** | **DNA DATA STORAGE** |



*Green microalgae: Phillip Savage, University of Michigan; MS stock images.*

# Looking Forward:
# Engineering Research Horizons

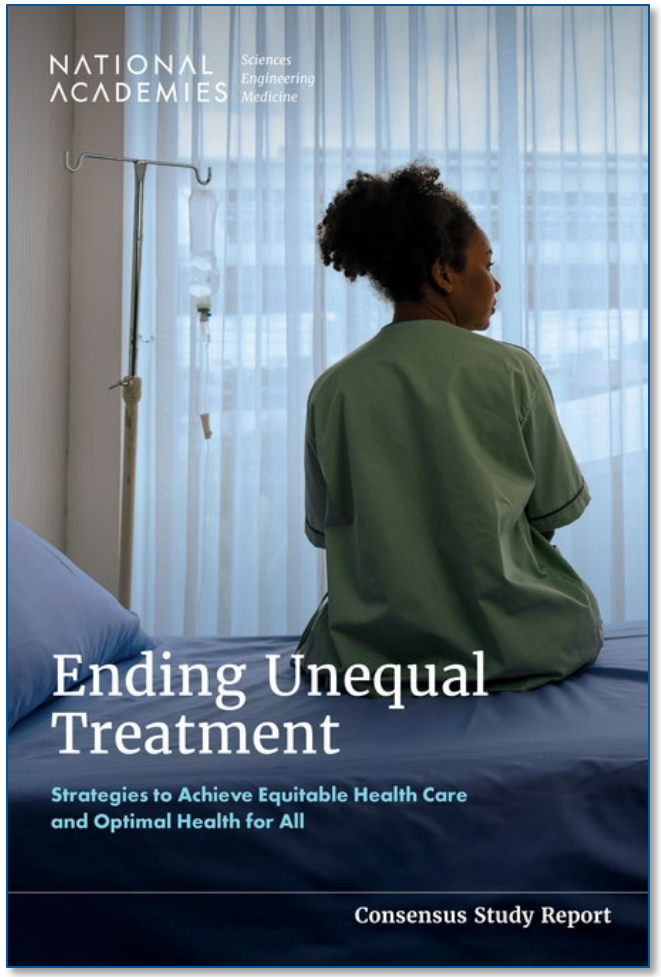
# Executive Order on Women's Health Research
## March 2024

- Integrate women's health across the federal research portfolio
- Prioritize investments in women's health research
- Galvanize new research on women's midlife health
- Assess unmet needs to support women's health research

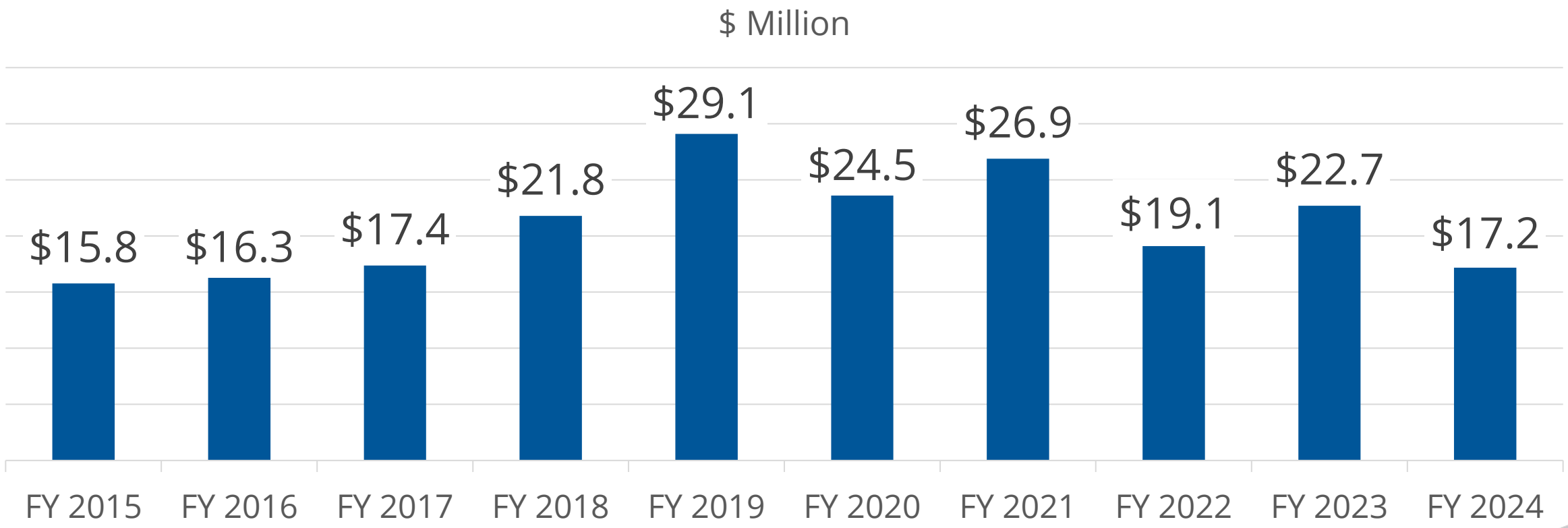
Agency Actions

- Prioritize and increase investments in women's health research
- Foster innovation and discovery in women's health
- Expand and leverage data collection and analysis related to women's health
- Strengthen coordination, infrastructure, and training to support women's health research
- Improve women's health across the lifespan

# Ending Unequal Treatment



# NSF Investments for Women's Health, FY 2015 – FY 2024



# Engineering Research Visioning Alliance

ERVA identifies and catalyzes engineering research horizons and priorities for the nation, with stakeholder input from academia, industry societies, investors, government agencies, and the public.

## June 2024 Visioning Event: Transforming Women's Health Outcomes through Engineering

- Prenatal to puberty
- Reproductive years related to pregnancy
- Reproductive years not related to pregnancy
- Pre-, peri-, and post-menopausal

Technology areas include AI/imaging; computer modeling; diagnostic technologies and devices; tissue engineering and microfluidics

# Conferences for Women's Health

## ElevateHER: Engineering Solutions for Women's Health

Texas A&M and Univ. of Maryland

August 1-2, 2024

- Biomaterials and tissue engineering
- Biomechanics and mechanobiology
- Devices, sensors and photonics
- Immuno-engineering

*NSF #2422973*

## Using AI to Better Understand Menopause

Columbia Univ. and Univ. of Colorado

September 4-5, 2024

- State-of-the-art computational approaches
- Intelligent interactive systems

*NSF #2435444 with NIH*

# NSF Funding Opportunities for Science and Engineering Research with Impact on Women's Health

NSF is committed to funding research on topics of relevance to women's mental and physical health, from the molecular to the ecosystem level (NSF 24-068)

- Mechanisms, detection,  diagnostics, monitoring, and management of health/disease across all phases of life, including Intersection of gender and other identities
- Genetic, epigenetic, biological, economic, societal and environmental determinants. Rehabilitation and support technologies
- Multi-scale models: computational, cells, tissues, organs, systems
- Individuals, populations, generations, geography

# Core Engineering Programs

- Biomechanics and Mechanobiology
- Biophotonics
- Biosensing
- Communications, Circuits, and Sensing Systems
- Engineering of Biomedical Systems
- Fluid Dynamics

**CAREER: Biomechanics and Mechanobiology of Uterine Growth and Remodeling During Pregnancy,** #2236961 led by University of Minnesota

*Image: MS stock*

# NSF Centers

## Engineering Research Centers (ERCs)

- ERC for Advanced Technologies for Preservation of Biological Systems
- ERC for Cellular Metamaterials
- ERC for Precise Advanced Technologies and Health Systems for Underserved Populations
- ERC for Precision Microbiome Engineering

## Industry-University Cooperative Research Centers (IUCRCs)

- Building Reliable Advances and Innovation in Neurotechnology (BRAIN) Center
- Center for Data-Driven Drug Development and Treatment Assessment (DATA)
- Center for Disruptive Musculoskeletal Innovations (CDMI)
- Center to Stream Healthcare in Place (C2SHIP)

# Smart Health and Biomedical Research in the Era of Artificial Intelligence and Advanced Data Science (SCH)

- For transformative advances in computer and information science, engineering, mathematics, statistics, behavioral and cognitive research to address pressing questions in the biomedical and public health communities.
- NSF-NIH joint program
- NSF 23-614 proposals due October 3, 2025

**Personalized Watch-based Fall Risk Analysis and Detection with Cross Modal Learning,** #2123749 and #2123521 led by Texas State and Illinois Institute of Technology

*Image: MS stock*

# NSF Support for Engineering Research Related to Women's Health

**Coordinated Advances in Reproductive Engineering for Health Research,**
#2053851 led by Virginia Tech

**Tissue Engineered Muscle in Microgravity as a Novel Platform to Study Sarcopenia,**
#1829534 led by Palo Alto Veterans Institute for Research



*Images: MS stock*

# Harnessing light and sound to improve biomedical imaging systems


## Muyinatu A. Lediju Bell

Johns Hopkins University


2024 Alan T. Waterman Awardee

# Education and Workforce Development

## Revolutionizing Engineering Departments

- Defining the Frontiers of Bioengineering Education at Illinois and Beyond, UIUC
- Transforming for inclusion: Fostering belonging and uniqueness in engineering education and practice, Georgia Tech

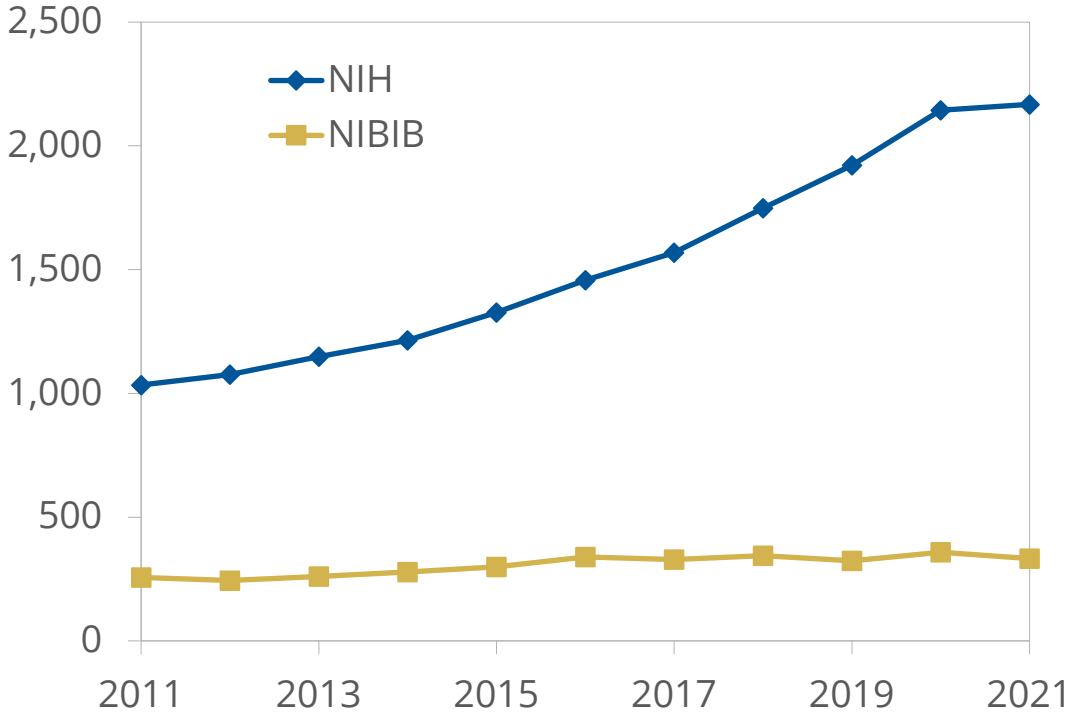
## Research Experiences for Undergraduates Sites

- Training in Emerging Biomedical Optics and Imaging Approaches, at the University of Arkansas
- Inclusion and Innovation in Medical Devices, at the University of Massachusetts Lowell

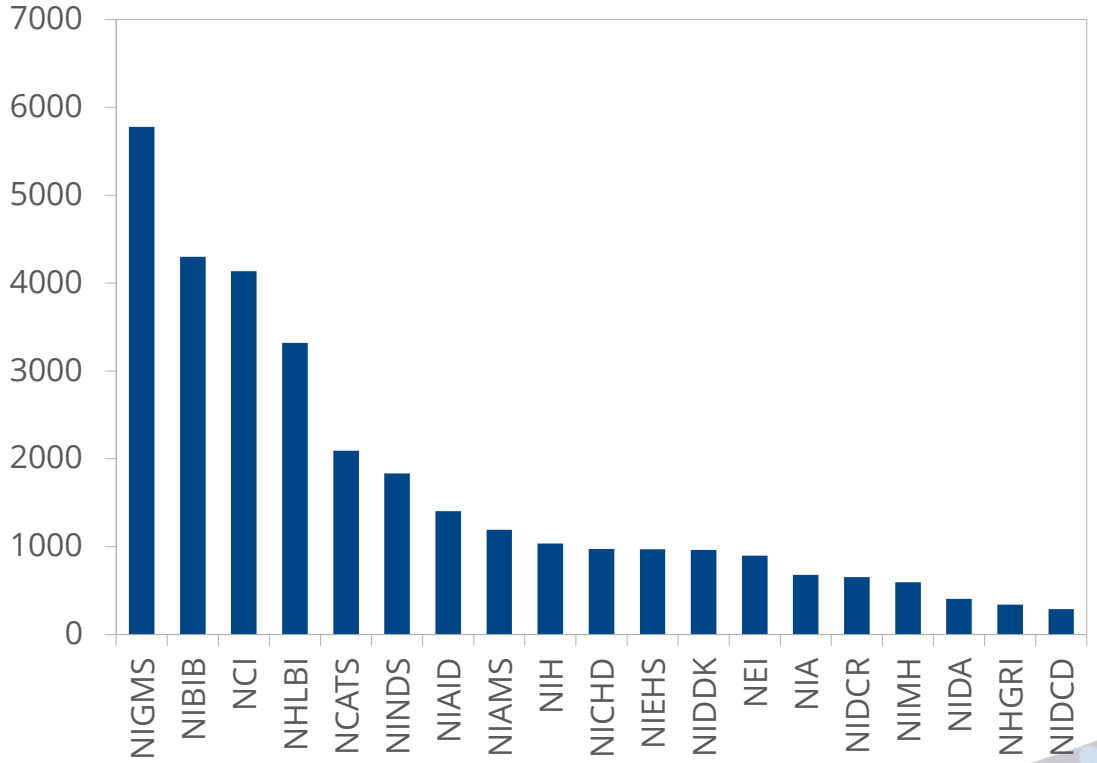
# Next Steps: Catalyze Purposeful Partnerships Between NSF and NIH in Women's Health

# Growing the NSF-NIH Partnership

Annual publications with NSF ENG and NIH funding
2011-2021




Total publications with NSF ENG and NIH funding by Institute
2010-2022



# Biomedical Research Initiative for Next-Gen BioTechnologies - SynBio Control (BRING SynBio)

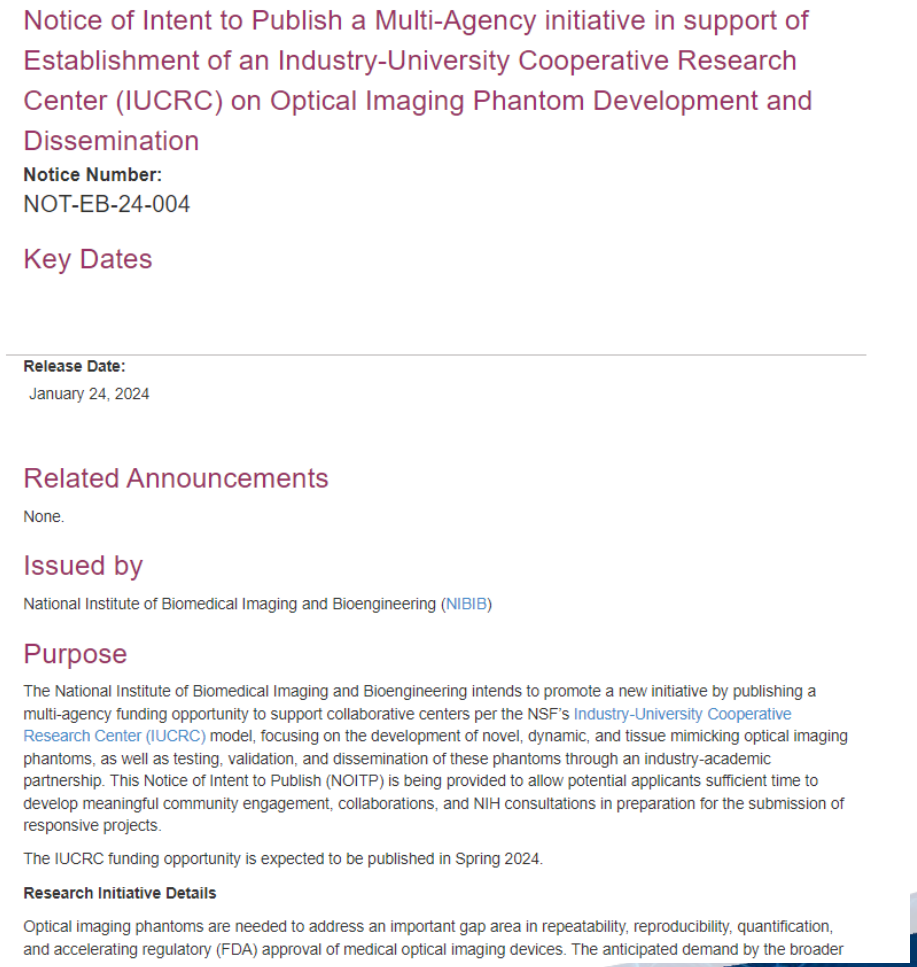
For advancing synthetic and engineering biology research and translating these findings into early-stage biomedical technologies

- NSF-NIH/NIBIB collaboration in two phases
- NSF 24-603 proposals due December 4, 2024

One project – 2 phases – 2 agencies – one proposal submission!

# Planned Industry-University Cooperative Research Center on Biomedical Imaging

- NSF and the NIH/National Institute of Biomedical Imaging and Bioengineering intend to publish a multi-agency funding opportunity
- IUCRC to develop of novel, dynamic, and tissue mimicking optical imaging phantoms, as well as testing, validation, and dissemination of these phantoms



Notice of Intent to Publish a Multi-Agency initiative in support of Establishment of an Industry-University Cooperative Research Center (IUCRC) on Optical Imaging Phantom Development and Dissemination

**Notice Number:**
NOT-EB-24-004

Key Dates

**Release Date:**
January 24, 2024

Related Announcements

None.

Issued by

National Institute of Biomedical Imaging and Bioengineering (NIBIB)

Purpose

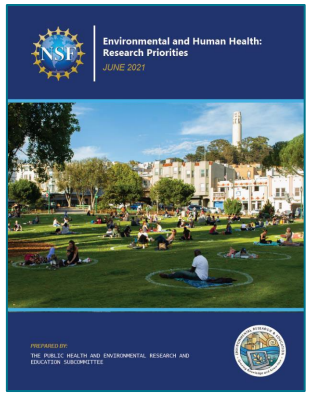
The National Institute of Biomedical Imaging and Bioengineering intends to promote a new initiative by publishing a multi-agency funding opportunity to support collaborative centers per the NSF's Industry-University Cooperative Research Center (IUCRC) model, focusing on the development of novel, dynamic, and tissue mimicking optical imaging phantoms, as well as testing, validation, and dissemination of these phantoms through an industry-academic partnership. This Notice of Intent to Publish (NOITP) is being provided to allow potential applicants sufficient time to develop meaningful community engagement, collaborations, and NIH consultations in preparation for the submission of responsive projects.

The IUCRC funding opportunity is expected to be published in Spring 2024.

**Research Initiative Details**

Optical imaging phantoms are needed to address an important gap area in repeatability, reproducibility, quantification, and accelerating regulatory (FDA) approval of medical optical imaging devices. The anticipated demand by the broader

# Environment and Human Health


**Climate change**

**Equitable access to education, health care**

**Critical and resilient infrastructure**

## RAPID center receives NIH grant to enhance disaster response and public health research

May 29, 2024

The grant enables the RAPID center to enhance its research on the intersection of engineering and public health, focusing on long-term health outcomes from disasters.

# Discussion