BIOTECHNOLOGY

Biotechnology Funding[1]

(Dollars in Millions)

	FY 2020 Actual	FY 2021 Estimate	FY 2022 Request
BIO	$110.00	$110.00	$130.00
CISE	9.04	6.00	6.00
EHR	16.07	9.00	9.00
ENG	92.76	90.94	101.50
GEO	8.00	10.00	10.00
MPS	73.48	51.20	52.20
SBE	1.93	1.50	1.50
OPP	2.11	1.60	2.00
IA	1.95	1.00	1.00
TIP[2]	9.27	9.06	69.06
Total	**$324.61**	**$290.30**	**$382.26**

[1] Funding displayed may have overlap with other topics and programs.

[2] FY 2020 and FY 2021 funding for TIP is shown for comparability across fiscal years.

Overview

Advances in genomics, proteomics, metabolomics, glycomics, cell biology, synthetic biology, chemical biology and computational methods are spurring rapid development of capabilities in biotechnology that drive innovation for the U.S. bioeconomy. These capabilities also provide solutions to societal challenges such as climate change and infectious disease. Biotechnology comprises the data, tools, research infrastructure, workforce capacity, and innovation that enable the discovery, utilization, and alteration of living organisms, their constituent components, and their biologically related processes. NSF investments to advance biotechnology serve to accelerate scientific discovery and to enable the harnessing of biological systems to create goods and services that contribute to agriculture, health, security, manufacturing, and environmental sectors of the United States.

NSF has long supported the fundamental biological research that catalyzed the development of modern biotechnology. Current investments include research and infrastructure in genomics, proteomics, synthetic biology, chemical biology, bioinformatics, computational biology, data analytics, structural biology, biophysics, tissue engineering, and development of new types of biomaterials, bio-probes, bio-based microelectronics, and biomanufacturing. In addition, NSF invests in educational programs that ensure a trained workforce to support U.S. capabilities in biotechnology, together with research on the ethical, legal, economic, and environmental consequences of synthetic biology and other biotechnologies, contributing to public understanding of product adoption and socially responsible use. These investments enhance biotechnology beyond the current state of the art and enable innovation that addresses climate change, food security, clean energy, and other important societal problems and ensures the development of a robust supply chain of biologically-derived materials that can increase U.S. resilience to global interruptions. Biotechnology promises to enable new modes of information storage, retrieval, and processing, as well as computation; foods and feedstocks that will provide raw materials for new bioindustries; new organs and organisms engineered to solve problems, from sensing of emerging infectious agents to development of self-healing materials for sustainable infrastructure; and other unimagined products inspired by life forms. Biotechnology advances will enable new predictive tools and platform technologies that empower the U.S.

to rapidly react to new and emerging biological threats, addressing economic and societal challenges and also responding with solutions for unanticipated challenges.

The importance of investment in synthetic biology and other biotechnologies was first highlighted by the Office of Science and Technology Policy (OSTP) in 2012[1] and was underscored recently as a key driver of the U.S. bioeconomy by the National Academies of Sciences, Engineering and Medicine in 2020.[2] In response to recommendations from the Government Accountability Office[3] and in collaboration with OSTP, NSF plays a lead role in coordinating interagency activities to promote synthetic biology and to develop next-generation tools to advance biotechnology. New investments at NSF in FY 2021 that catalyze biotechnology innovations include programs in Designing Synthetic Cells Beyond the Bounds of Evolution; Sentinel Cells for Surveillance and Response to Emergent Infectious Diseases; and Molecular Foundations for Biotechnology. The National Artificial Intelligence (AI) Research Institutes program includes a focus that effectively integrate biotechnology innovation and AI. These new investments complement existing programs in research, infrastructure, workforce development and translation that advance biotechnology and the bioeconomy.

Goals

1. *Foundational Research:* Support foundational research in science and engineering that will fuel innovations in biotechnology.
2. *Computing and Physical Infrastructure:* Develop the computing and physical infrastructure necessary to generate fundamental knowledge and advance accompanying biotechnology.
3. *Proof-of-Concept Development:* Deliver proof-of-concept processes, devices, applications, tools, and systems that exploit emerging discoveries and drive advances in biotechnology for scientific and societal benefit.
4. *Education and Workforce Development:* Empower the full spectrum of U.S. talent to build the capacity to achieve the above goals and to generate the biotechnology-literate workers who will implement the results of these breakthroughs.

FY 2022 Investments

Foundational Research

NSF will continue its support in the discovery of fundamental biological principles and the development of biotechnologies and other tools that permit measurement and use-inspired manipulation and design of living systems and their components. New interdisciplinary partnerships will serve to leverage biodiversity to motivate bio-inspired design and stimulate use-inspired solutions, including through the NSF Big Idea, Understanding the Rules of Life that supports relevant convergent research. Social-science researchers will engage to address issues of risk tolerance, public acceptance, and ethical considerations associated with new biotechnology discoveries and innovations.

Computing and Physical Infrastructure

NSF will continue to invest in bioinformatics and computational biology to solve the computational and data-science challenges inherent in biotechnology research. NSF will leverage investments in data analytics and computation, artificial intelligence and machine learning, and physical infrastructure–including distributed networks of biofoundries and regional mid-scale facilities–to support growth of U.S. biotechnology innovation.

[1] www.obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/national_bioeconomy_blueprint_april_2012.pdf
[2] www.nationalacademies.org/our-work/safeguarding-the-bioeconomy-finding-strategies-for-understanding-evaluating-and-protecting-the-bioeconomy-while-sustaining-innovation-and-growth
[3] www.gao.gov/products/gao-18-656

Proof-of-Concept Development

Sustained support for synthetic and engineering biology as a pillar of biotechnology will accelerate the design-build-test-learn cycle and leverage bio-inspired design to develop bio-machines and biomanufacturing technologies to address many of today's challenges.

Education and Workforce Development

To prepare a diverse biotechnological workforce, NSF will invest in students at multiple levels, through programs such as the International Genetically Engineering Machine competition open to high school students, the Advanced Technological Education program at two-year institutions, and sites and supplements for Research Experiences for Undergraduates as well as Research Experiences for Teachers, and the NSF Research Traineeship Program that prepares graduate students to conduct research in convergent areas and acquire skills that allow them to succeed in diverse employment settings, including in those outside academia.