

DIRECTORATE FOR BIOLOGICAL SCIENCES (BIO)**\$683,360,000**
-\$73,240,000 / -9.7%**BIO Funding**
(Dollars in Millions)

	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request	Change over	
				FY 2018 Actual Amount	Percent
Molecular & Cellular Biosciences (MCB)	\$143.05	-	\$125.75	-\$17.30	-12.1%
Integrative Organismal Systems (IOS)	192.17	-	168.93	-23.24	-12.1%
Environmental Biology (DEB)	155.00	-	141.70	-13.30	-8.6%
Biological Infrastructure (DBI)	181.31	-	163.16	-18.15	-10.0%
Emerging Frontiers (EF)	85.06	-	83.82	-1.24	-1.5%
Total	\$756.60	-	\$683.36	-\$73.24	-9.7%

About BIO

BIO supports fundamental research and infrastructure that advances a unified understanding of life in all forms, from the biological molecules that are the machinery of living cells to the populations of organisms and species that underpin the functioning of the Nation’s ecosystems. Advances in biological sciences stimulate new technologies and directions for economic growth, and provide solutions for national needs in food, health, energy, and environment. For example, BIO supported research on how plants and animals respond and adapt to changing environments informs efforts to control invasive spread of non-native species and to predict and prevent the emergence of infectious diseases. Foundational BIO-supported research on microbes and their interactions with plants is fueling a revolution in agriculture. BIO support for basic research in cellular and synthetic biology is spawning advances in bio-based manufacturing and innovations that underpin the bioeconomy.

Fundamental research in BIO is also critical to convergent research in frontier areas of science and technology. Collaborations between the biological and physical sciences have contributed to advances such as biological computing, taking advantage of the extraordinary information density in genetic polymers, and the development of neuro-technologies that are powering advances in neuroscience and cognition. Quantum biology—the application of quantum theory to biological systems—provides tantalizing new insights into the power of photosynthesis as well as a fundamental understanding of vision, olfaction, and magnetoreception. Quantum biology research will enable bioinspired designs based on these quantum energy production and sensing systems that will enhance American security. Biology’s need to quantify living systems at all scales have propelled the frontiers of research in statistics, mathematical and computer sciences to consider larger and more complex data sets that benefit from machine learning and artificial intelligence. BIO also enables the development of a skilled workforce capable of foundational research and infrastructure development necessary for the unification of all the biological sciences as well as collaboration with scientists and engineers in other disciplines to speed understanding and innovation.

BIO provides the stewardship and foundational support for URoL, a convergence research funding opportunity focused on addressing scientific and societal needs. As the lead directorate for the URoL Big Idea, BIO is the steward of funds designated to the URoL NSF-wide investment. By framing the essential challenges and opportunities associated with genotype to phenotype (structure to function) relationships, BIO enables research that leads to a predictive understanding of biological systems at all scales. This knowledge is what drives advances in understanding the human body and improving health and will permit sustainable, efficient food production. It will allow the harnessing of biological systems to enable bio-based manufacturing and new forms of energy production.

BIO is making contributions to several other NSF’s Big Ideas. BIO participates in the QL—contributing to more efficient and robust quantum technologies for solar energy harvesting, communication, and navigation as well as cutting edge DNA-based quantum computing. BIO will support basic research in this area primarily through established research programs in MCB and research resource programs in DBI. BIO is on the leading edge of HDR—from contributing to the mapping and understanding of the properties, structure, and functions of tens of thousands of molecules in cells, to collecting and analyzing data from leading facilities such as the National Ecological Observatory Network (NEON), which seeks to enhance knowledge of environmental change, land use change, and invasive species on natural resources and biodiversity. BIO investments include CyVerse, Protein Data Bank, iDigBio, and Advancing Digitization of Biodiversity Collections. BIO participates in the NNA Big Idea through investments in environmental research and observational infrastructure in the Arctic, through Long-Term Ecological Research program (LTER) and NEON. For more information about the Big Ideas, please see the narratives in the NSF-Wide Investments chapter.

BIO provides 69 percent of the federal funding for non-medical, basic research at academic institutions in the life sciences.

Major Investments

BIO Major Investments
(Dollars in Millions)

Area of Investment	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request	Change over	
				FY 2018 Actual Amount	Percent
Advanced Manufacturing	\$3.33	-	\$3.33	-	-
Artificial Intelligence (AI)	12.53	-	13.78	1.25	10.0%
CAREER	45.54	-	41.09	-4.45	-9.8%
IUSE	2.23	-	1.90	-0.33	-14.8%
I-Corps™	0.98	-	1.00	0.02	2.0%
Quantum Information Sciences (QIS)	0.50	-	3.28	2.78	556.0%
UtB	45.56	-	43.21	-2.35	-5.2%
<i>BRAIN Initiative</i>	<i>15.50</i>	<i>-</i>	<i>19.54</i>	<i>4.04</i>	<i>26.1%</i>
NSF's Big Ideas					
<i>URoL Stewardship</i>	<i>-</i>	<i>-</i>	<i>30.00</i>	<i>30.00</i>	<i>N/A</i>

Major investments may have funding overlap and thus should not be summed.

- **Advanced Manufacturing:** BIO will support Advanced Manufacturing in collaboration with ENG, by supporting advances in standards in synthetic biology, the development of tools that will advance biomanufacturing and support for an Industry-Academia-NSF partnership (the Engineering Biology Research Consortium) that provides leadership and training to a network of practitioners that will enable the development of a thriving bioeconomy.
- **AI:** BIO, together with other NSF directorates/offices, will increase support for artificial intelligence. BIO’s AI investments occur primarily in DBI through the Advances in Biological Informatics program, and center-scale investments that advance computational capacity in bioinformatics. Artificial Intelligence methods such as machine learning, natural language processing, computer vision, and genetic algorithms are increasingly applied in biological research to solve problems such as genome sequence alignment, prediction of protein structure, reconstructing evolutionary relationships, predicting species range distributions, and extracting quantitative information from multi-media data sources.

- IUSE: BIO will continue to support activities related to undergraduate biology education through Research Collaboration Networks—Undergraduate Biology Education (RCN-UBE). For more information regarding IUSE, see the NSF-Wide Investments chapter.
- I-Corps™: BIO will increase support for I-Corps™ nodes and teams that test the feasibility of commercial prototypes developed from NSF/BIO supported research. For more information on NSF I-Corps™, see the NSF-Wide Investments chapter.
- QIS: BIO will increase support for QIS through investments in fundamental research in biophysics that seek to understand quantum phenomena within living systems and can inform applications in quantum information science.
- UtB: BIO will continue to support this cross-foundation activity. Investments in research on mapping circuits that drive behavior in a variety of organisms will be sustained. Support also is included for activities related to integrative and transdisciplinary team-based brain research; data science, infrastructure, tool development for understanding the brain, and specialized training and professional development in multi-disciplinary and international research and large-scale data management and analysis. For more information on UtB, see the NSF-Wide Investments chapter.
 - BRAIN Initiative: As part of UtB, BIO will sustain support for the BRAIN Initiative through the Next Generation Networks for Neuroscience (NeuroNex) program, including a new funding opportunity involving a partnership of NSF and funding agencies in Germany, United Kingdom, and Canada.
- URoL: BIO will provide stewardship support for NSF URoL Big Idea initiative. URoL emphasizes multi-disciplinary, team science approaches to achieving a predictive understanding of how complex traits of an organism emerge from the interaction of its genetic makeup with the environment. Science outcomes from URoL will advance biological theory explaining the complexity, diversity, and adaptability of all living systems, inform applications in human health and agriculture, and expand the bioeconomy.

BIO Funding for Centers Programs and Facilities

BIO Funding for Centers Programs					
(Dollars in Millions)					
	FY 2018	FY 2019	FY 2020	Change over	
	Actual	(TBD)	Request	FY 2018 Actual	Actual
				Amount	Percent
Total	\$21.00	-	\$16.10	-\$4.90	-23.3%
Centers for Analysis & Synthesis (DBI)	6.00	-	4.80	-1.20	-20.0%
STC: Bio/computation Evolution in Action CONsortium (BEACON) (DBI)	5.00	-	1.30	-3.70	-74.0%
STC: Biology with X-ray Lasers (BioXFEL) (DBI)	5.00	-	5.00	-	-
STC: Center for Cellular Construction (CCC) (DBI)	5.00	-	5.00	-	-

For detailed information about NSF Centers programs, please see the NSF-Wide Investments chapter.

BIO Funding for Major Multi-User Facilities

(Dollars in Millions)

	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request	Change over FY 2018 Actual	
				Amount	Percent
Total	\$71.90	-	\$63.60	-\$8.30	-11.5%
National Ecological Observatory Network (NEON) ¹	67.90	-	62.60	-5.30	-7.8%
Cornell Energy Synchrotron Source (CHESS)	4.00	-	1.00	-3.00	-75.0%

¹ FY 2018 Actual total includes a one-time expenditure of \$3.0 million for a cyberinfrastructure enhancements, not related to O&M.

For detailed information on individual facilities, please see the Facilities chapter.

Funding Profile

BIO Funding Profile

	FY 2018 Actual Estimate	FY 2019 (TBD)	FY 2020 Estimate
Statistics for Competitive Awards:			
Number of Proposals	4,767	-	4,800
Number of New Awards	1,192	-	1,110
Funding Rate	25%	N/A	23%
Statistics for Research Grants:			
Number of Research Grant Proposals	4,207	-	4,200
Number of Research Grants	994	-	900
Funding Rate	24%	N/A	21%
Median Annualized Award Size	\$196,844	-	\$200,000
Average Annualized Award Size	\$226,756	-	\$220,000
Average Award Duration, in years	3.2	-	3.2

BIO supports investment in core research and education as well as research infrastructure.

In FY 2020, BIO will invest \$16.10 million in research centers, accounting for 2.4 percent of the BIO budget. This total is down from FY 2018 Actual as two centers are phasing down as planned. BIO's FY 2020 Request funds one Center for Analysis and Synthesis, the National Socio-Environmental Synthesis Center (SESync), and the three Science and Technology Centers.

O&M funding for BIO-supported facilities is 9.4 percent of BIO's FY 2020 Request.

Program Monitoring and Evaluation

External Program Evaluations and Studies:

- IOS will initiate a National Academies of Sciences, Engineering, and Medicine (the National Academies) workshop on future directions in Functional Genomics, which will inform future IOS investments in this critical area related to NSF's Big Idea, URoL.

- DBI funded an award (1827445) to the National Academies, entitled, “Biological Collections: Their Past, Present, and Future Contributions and Options for Sustaining Them”. This will inform how the division chooses to proceed at the end of the 10-year campaign on digitizing and maintaining collections through the Advancing Digitization of Biodiversity Collections and Collections in Support of Biological Research programs.

Workshops and Reports:

- MCB supported multiple workshops that have and continue to inform the planning of the division’s research programs.
 - Workshops entitled “Finding your inner modeler: how computational biology can advance your research and how to get started” were initiated in FY 2017. The series of workshops were developed to promote the use of computational modeling by cell biologists. These workshops contribute to the continued enhancement of the quantitative/predictive portfolio of awards in MCB.
 - A workshop entitled “The Role of Crowdfunding in the STEM Ecosystem” was held in early FY 2018. The workshop was convened to examine the practice, benefits, challenges, and limitations of using crowdfunding to finance basic research in the fields of science, technology, engineering, and mathematics. MCB is currently preparing a solicitation that provides seed funding for projects and resources to take advantage of community co-funding as a new model of partnership within MCB.
 - A workshop entitled “Towards the Design of Synthetic Cells” was held in May 2018. The workshop explored the open challenges in the design and assembly of synthetic cells from perspectives spanning the biological and physical sciences, and engineering. The report from this workshop informed the development of the solicitation released in late FY 2018; Understanding the Rules of Life: Building a Synthetic Cell: An Ideas Lab Activity.¹
 - A workshop entitled “2018 Workshop: Quantum Biology and Quantum Processes in Biology”, held in November 2018, brought together leaders in the field of quantum biology from the biological and physical sciences, to explore the opportunities and challenges in quantum biology. The results of this workshop have helped inform BIO’s participation in the QL NSF Big Idea, and planning for new activities in the Quantum Biology space.
- IOS supported multiple workshops, meetings and Research Coordination Networks that informed planning of the division’s research programs for FY 2020.
 - The FY 2016 NSF-sponsored workshop report “Unpacking the Phenotype, Deciphering Genome to Phenome Relationships: Interdisciplinary Research at the Interface of the Biological and Mathematical Sciences”² led to current investments in the recently established Mathematics of Complex Biological Systems (MathBioSys) Research Centers co-funded by NSF and the Simons Foundation.
 - A workshop in October 2017 “Breakthroughs 2030: A Strategy for Food and Agricultural Research” led to a National Academies’ Breakthroughs 2030 report that helped guide the FY 2019 solicitation for plant genomics research in IOS.³
 - In September 2016, “A Scientific Planning Workshop for Coordinating Brain Research Around the Globe” involved more than 60 scientists from 12 countries and a wide range of disciplines discussed grand challenges for global brain sciences and infrastructure needs. The issues raised during the workshop inform NSF’s BRAIN Initiative and UtB activities.
 - The 2016 “Collaborative Workshop in Advancing Research on Plant Biotic Interactions” and its

¹ www.nsf.gov/pubs/2018/nsf18599/nsf18599.htm

² www.nsf.gov/mps/dms/documents/Deciphering_Genome-to-Phenome_Relationships.pdf

³ <http://nas-sites.org/dels/studies/agricultural-science-breakthroughs/>

resultant white paper⁴ continues to provide valuable information on investments for IOS, including the interagency USDA-NSF Plant Biotic Interactions Program.

- The “Interagency Strategic Plan for Microbiome Research FY 2018-2022”⁵ released in April 2018 serves as a guide for IOS investment into microbiomes, including microbial interactions with the environment, with animals and plants, and important ecosystem services such as soil stability, fertility, and sustainability.
- A 2016 symposium entitled “Neuroecology: Neural Mechanisms of Sensory and Motor processes that Mediate Ecologically Relevant Behaviors” has been influential in guiding investments into the development of research themes in behavior and neurobiology.
- DEB supported the following workshops to inform the planning of the division’s research programs for FY 2020:
 - Two 2018 NSF-National Natural Science Foundation of China (NSFC) workshops on Ecology and Evolution of Infectious Diseases provided valuable insights on future investments for DEB and helped establish a co-funding arrangement between NSF and NSFC within the Ecology and Evolution of Infectious Diseases program.
 - A 2017 workshop “Addressing data management challenges within integrative biodiversity projects” provided valuable information on investments for DEB related to integrating data across spatial, temporal, and biological scales

Committees of Visitors (COV):

- The IOS COV convened June 2018 and reviewed division operations and the core programmatic portfolio for the four-year period spanning FY 2014 through FY 2017. Included in the COV review was an evaluation of the Plant Genome Research Program operations and program portfolio over a five-year period from FY 2013 through FY 2017. The COV stated that IOS is a scientifically high-impact division centrally important to the overall mission of BIO. The COV was impressed at how well program directors and staff have functioned in promoting the mission of IOS. Major recommendations of the COV were to develop a broader strategic vision aligned with the priorities of the agency and directorate. IOS is addressing recommendations of the COV through its future planning activities, including a series of all-hands planning meetings, science discussions, and retreats.
- The MCB COV convened June 2018 and reviewed division operations and the programmatic portfolio for the four-year period spanning FY 2014 through FY 2017. Overall, the COV considered MCB to be on positive trajectory. The COV commended MCB for the work of the dedicated staff, the rigorous merit review, and the impactful science funded by the division. The COV had recommendations for ensuring that MCB sustained its positive trajectory. These include developing mechanisms to ensure retention and development of staff, to better communicate to the public the impact of MBC investments, to plan strategically for new funding opportunities and review paradigms, and to develop effective outreach to investigators less resilient to rejection. MCB is incorporating these recommendations in its future planning activities.
- In 2019, a COV will review programs in DEB.
- In 2020, a COV will review programs in DBI.

The Performance chapter provides details regarding the periodic reviews of programs and portfolios of programs by external Committees of Visitors and directorate Advisory Committees. Please see this chapter for additional information.

⁴ <https://apsjournals.apsnet.org/doi/10.1094/MPMI-01-17-0010-CR>

⁵ https://science.energy.gov/~media/ber/pdf/workshop%20reports/Interagency_Microbiome_Strategic_Plan_FY2018-2022.pdf

People Involved in BIO Activities

Number of People Involved in BIO Activities			
	FY 2018		FY 2020
	Actual	FY 2019	Estimate
	Estimate	(TBD)	Estimate
Senior Researchers	3,665	-	3,300
Other Professionals	1,350	-	1,200
Postdoctoral Associates	1,435	-	1,300
Graduate Students	2,691	-	2,400
Undergraduate Students	4,623	-	4,200
Total Number of People	13,764	-	12,400

DIVISION OF MOLECULAR AND CELLULAR BIOSCIENCES (MCB)

\$125,750,000
-\$17,300,000 / -12.1%

MCB Funding
(Dollars in Millions)

	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request	Change over	
				FY 2018 Actual Amount	Percent
Total	\$143.05	-	\$125.75	-\$17.30	-12.1%
Research	141.23	-	123.11	-18.12	-12.8%
CAREER	16.83	-	16.00	-0.83	-4.9%
Education	1.82	-	1.64	-0.18	-9.9%
Infrastructure	-	-	1.00	1.00	N/A
CHES	-	-	1.00	1.00	N/A

About MCB

MCB supports fundamental interdisciplinary research to uncover the basic principles that describe how information content in cells guides expression of cellular characteristics and is maintained and transmitted to the next generation; how material and energy are taken up, transformed, and flow through biological systems; and how biological molecules, which assemble into complex structures and compartments with varied functions, contribute to the processes required for life.

Additionally, MCB supports convergence research at the molecular and cellular scales. This basic research at the interface of biological sciences, mathematical, physical, and computer sciences and engineering provide the basis for the quantitative, predictive, theory driven understanding of molecular and cellular functions of biological systems across the tree of life. MCB supported research, for example, contributed to the understanding of the mechanism of deoxyribonucleic acid (DNA) maintenance and repair, and mechanisms of clustered regularly interspaced short palindromic repeats (CRISPR) and CRISPR-associated (Cas) genome editing. Advances in basic research, such as these examples, enable the development of design rules for engineering molecules and cells, and lead directly to biological innovations that enhance medicine, agriculture, biomanufacturing, and contribute to food security and the environment. MCB supported research contributes to the NSF’s Big Ideas: URoL and QL.

In general, about 70 percent of the MCB portfolio is available to support new research grants, and 30 percent is available for continuing grants.

DIVISION OF INTEGRATIVE ORGANISMAL SYSTEMS (IOS)

\$168,930,000
-\$23,240,000 / -12.1%

IOS Funding
(Dollars in Millions)

	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request	Change over	
				FY 2018 Actual Amount	Percent
Total	\$192.17	-	\$168.93	-\$23.24	-12.1%
Research	182.29	-	160.23	-22.06	-12.1%
CAREER	13.58	-	13.26	-0.32	-2.4%
Education	3.53	-	3.13	-0.40	-11.3%
Infrastructure	6.35	-	5.57	-0.78	-12.3%
Research Resources	6.35	-	5.57	-0.78	-12.3%

About IOS

IOS focuses on the organism, the key link between single biological molecules and complex populations. IOS programs support research and education aimed at integrating knowledge across different levels of biological organization to understand the processes that build and maintain organisms. More specifically, IOS activities focus on mechanistic analyses of how biological systems interact and function – spanning the nervous system, growth and development, behavior, and biochemical, biophysical and physiological processes that are integrated to result in stability of organisms living in dynamic environments. Such analysis is fundamental to understanding the principles that produce the vast diversity of life on Earth and the mechanisms that allow for biological adaptation to change.

IOS encourages interdisciplinary science and the development of new approaches through the Enabling Discovery through GENomic (EDGE) Tools program. Investments in research, including tools for high-throughput analysis of agriculturally-important plants, are maintained as a priority, as is continued support for the NSF-Simons Research Centers for Mathematics of Complex Biological Systems. IOS will continue to leverage its activities across the spectrum of NSF basic science with agricultural research supported by the U.S. Department of Agriculture’s National Institutes of Food and Agriculture (NIFA). An example is a partnership between IOS and NIFA to fund research focused on plant biotic interactions.

Results of IOS-supported research are fully consistent with the NSF Big Idea: URoL. IOS’s contribution provides information to enable multi-scale biological integration to reveal emergent properties of organisms—spanning the biological diversity from microbes, to plants, to animals. IOS science is highly relevant to societal needs for future food security and sustainability, to understanding the healthy brain, as well as providing new knowledge on how organisms respond to environmental and social stressors.

In general, about 60 percent of the IOS portfolio is available for new research grants, and 40 is available for continuing grants.

DIVISION OF ENVIRONMENTAL BIOLOGY (DEB)

\$141,700,000
-\$13,300,000 / -8.6%

DEB Funding
(Dollars in Millions)

	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request	Change over	
				FY 2018 Actual Amount	Percent
Total	\$155.00	-	\$141.70	-\$13.30	-8.6%
Research	152.58	-	139.68	-12.90	-8.5%
CAREER	10.18	-	9.19	-0.99	-9.7%
Education	2.42	-	2.02	-0.40	-16.5%

About DEB

DEB supports fundamental research on Earth’s biodiversity and the ecological and evolutionary processes that explain the origin and maintenance of genetic variation in nature, including its history and patterns of speciation and extinction. DEB supported research also advances understanding of the functional importance of our natural biodiversity heritage to ecological and ecosystem processes occurring over short- and long-temporal and spatial scales. The discoveries from this research can inform strategies to develop, use, and sustain biological resources, including natural, agricultural, and other managed ecosystems, and to forecast changes in species populations and ecosystems over time.

DEB funded research provides the data, knowledge, and capability to predict the spread of infectious diseases and of invasive species, and their impacts on wild, managed, and agricultural systems. Models developed from biodiversity and ecological research are used to predict environmental drivers of conflict, enhance our ability to strategically prepare for environmental threats, and to field defense and mitigation capabilities that are resilient and adaptive.

In general, 74 percent of the DEB portfolio is available for new research grants, and 26 percent is available for continuing grants.

DIVISION OF BIOLOGICAL INFRASTRUCTURE (DBI)

\$163,160,000
-\$18,150,000 / -10.0%

DBI Funding
(Dollars in Millions)

	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request	Change over FY 2018 Actual	
				Amount	Percent
Total	\$181.31	-	\$163.16	-\$18.15	-10.0%
Research	30.94	-	32.21	1.27	4.1%
CAREER	2.92	-	2.64	-0.28	-9.6%
Centers Funding (total)	21.00	-	16.10	-4.90	-23.3%
Centers for Analysis & Synthesis	6.00	-	4.80	-1.20	-20.0%
STC: Bio/computational Evolution in Action CONsortium (BEACON)	5.00	-	1.30	-3.70	-74.0%
STC: Biology with X-ray Lasers (BioXFEL)	5.00	-	5.00	-	-
STC: Center for Cellular Construction (CCC)	5.00	-	5.00	-	-
Education	25.69	-	19.42	-6.27	-24.4%
Infrastructure	124.68	-	111.53	-13.15	-10.5%
NEON ¹	67.90	-	62.60	-5.30	-7.8%
CHES	4.00	-	-	-4.00	-100.0%
National Nanotechnology Coordinated Infrastructure (NNCI)	0.35	-	0.35	-	-
Research Resources	52.43	-	48.58	-3.85	-7.3%

¹ FY 2018 Actuals figure includes a one-time expenditure of \$3.0 million for a cyberinfrastructure enhancements, not related to O&M.

About DBI

DBI empowers biological discovery by supporting the development and enhancement of biological research resources, human capital, and facilities. DBI supports the development of, or improvements to, research infrastructure, including cyberinfrastructure; instrumentation; and improvements to biological research collections, living stock collections, and field stations and marine labs. In addition, DBI supports the development of human capital through undergraduate, and postdoctoral research experiences by participating in the NSF-wide IUSE and Research Experiences for Undergraduate Sites program. DBI also offers a multi-track postdoctoral research fellowships program with special emphasis on emerging areas of the biological sciences. Support for facilities, such as NEON, create opportunities to address targeted but deep biological questions that have major societal impact, particularly with respect to ecological forecasting. NEON is enabling the study of the biosphere and its response to environmental change at a continental scale. Additional infrastructure support will focus on developing capacity of the biological sciences research community through funding cyberinfrastructure and other tools necessary to address the NSF Big Idea: URoL.

In general, about 25 percent of the DBI portfolio is available for new research grants. The remaining 75 percent supports research grants made in prior years and the research infrastructure needed by the biological sciences community.

DIVISION OF EMERGING FRONTIERS (EF)

\$83,820,000
-\$1,240,000 / -1.5%

EF Funding
(Dollars in Millions)

	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request	Change over	
				FY 2018 Actual Amount	Actual Percent
Total	\$85.06	-	\$83.82	-\$1.24	-1.5%
Research	84.46	-	83.82	-0.64	-0.8%
Big Idea: URoL	-	-	30.00	30.00	N/A
CAREER	2.03	-	-	-2.03	-100.0%
Education	0.60	-	-	-0.60	-100.0%

About EF

EF serves as an incubator for innovation and integration within the biological sciences. It supports research that transcends scientific disciplines and advances conceptual foundations across all levels of biological organization. Innovative research and infrastructure activities in BIO typically begin development in EF and then move to other BIO divisions to become part of the disciplinary knowledge base. For example, support for design and early construction of NEON originated within EF but moved to DBI once NEON operations were initiated. EF also facilitates the development and implementation of new forms of merit review and mechanisms to support transformative research and stimulate creativity.

EF also provides the support for BIO participation in national initiatives, NSF priority areas, and other interdisciplinary, cross-division, and cross-directorate programs. Hence, EF is the steward for investments in NSF's Big Idea: URoL.

In general, 51 percent of the EF portfolio is available for new research grants, and 49 percent is available for continuing grants.