BIOLOGICAL SCIENCES

$733,000,000
+$77,190,000 / 11.8%

Biological Sciences Funding
(Dollars in Millions)

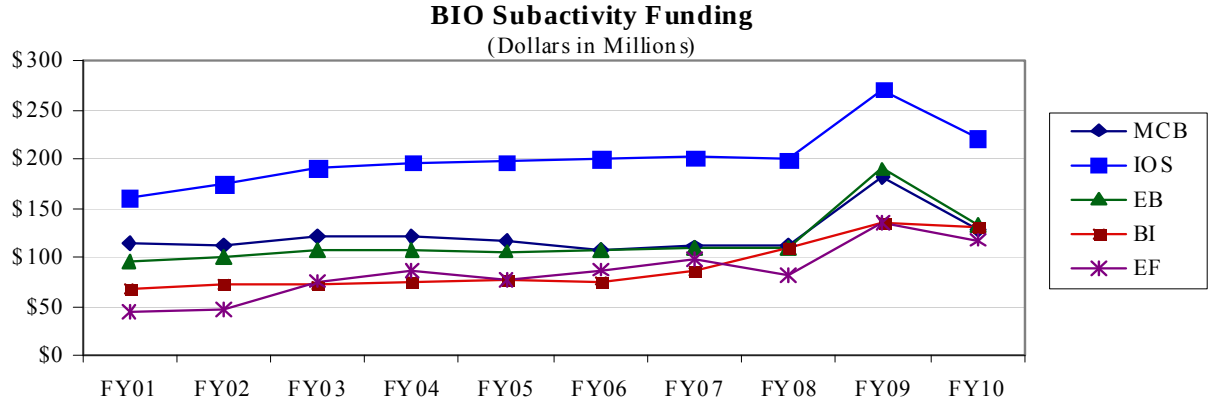
	FY 2008 Actual	FY 2009 Current Plan	FY 2009 ARRA Estimate	FY 2010 Request	Change Over FY 2009 Plan Amount	Change Over FY 2009 Plan Percent
Molecular and Cellular Biosciences	$112.28	$121.26	$60.00	$128.83	7.57	6.2%
Integrative Organismal Systems	200.04	211.62	60.00	221.84	10.22	4.8%
Environmental Biology	110.71	120.38	70.00	133.92	13.54	11.2%
Biological Infrastructure [1]	109.86	116.80	20.00	130.14	13.34	11.4%
Emerging Frontiers [2]	82.73	85.75	50.00	118.27	32.52	37.9%
Total, BIO	**$615.62**	**$655.81**	**$260.00**	**$733.00**	**$77.19**	**11.8%**
Major Components:						
Research and Education Grants	491.78	523.99	245.00	590.11	66.12	12.6%
Instrumentation/Research Resources	99.80	104.00	15.00	110.00	6.00	5.8%
Centers Programs	24.04	27.82	-	32.89	5.07	18.2%

Totals may not add due to rounding.

[1/] Funding for the Science of Learning Center (SLC) within the Division for Biological Infrastructure is included for all years for comparability. SLC will be cofunded with the Directorate for Social, Behavioral and Economic Sciences beginning in FY 2010.

[2/] In FY 2010, all centers are shifted from Emerging Frontiers to Biological Infrastructure. Funding is included in Biological Infrastructure for all years for comparability.

The mission of the Directorate for Biological Sciences (BIO) is to enable discoveries for understanding life. Through its investments in innovative and transformative research, BIO advances the frontiers of knowledge in the life sciences by increasing our understanding of complex living systems. BIO supported projects also provide the theoretical basis for advancing the growing body of research being done by other sciences and engineering fields that involves applying biological principles or employing biological systems or processes.



BIO in Context

BIO provides about 69 percent of federal funding for non-medical, basic research at academic institutions in the life sciences including environmental biology, a critical research area needed to answer questions related to climate change.

In FY 2010, BIO's investments will focus on understanding the changing dynamics of the biosphere, research on the fundamental characteristics of biological energy systems, and efforts to enhance education and broaden participation. An example is the Basic Research to Enable Agricultural Development, (BREAD) program begun in FY 2009 in partnership with the Bill and Melinda Gates Foundation. This program supports basic research to test innovative hypotheses and novel approaches and technologies for sustainable, science-based solutions to problems of agriculture in developing countries. In FY 2008, over 13,000 individuals were supported through BIO funding.

The FY 2010 Request for BIO includes $20.0 million to leverage activities across the directorate aimed at increasing support for transformative research. Examples of potential foci for these investments include: stimulating interdisciplinary research; establishing collaboratories; capitalizing on developing priorities; employing sandpits, a process that couples novel/high risk research project development with real-time peer review; and exploring novel processes for problem solving.

Directorate-wide Changes and Priorities

Climate Research (+$46.0 million for a total of $46.0 million).

In FY 2010, BIO will make a major investment in NSF's new Climate Research effort. NSF proposes an integrated approach that includes: modeling of basic natural and human processes; fundamental research to support paradigm development and predictive understanding; environmental observation; inquiry-based studies of integrated natural and human systems; and research on the environmental significance of adaptation and mitigation strategies. Specific emphases include:

- Modeling: Enhance scalability of climate and ecosystem models to move climate modeling from the global to the regional scale; move ecological modeling from the local to the regional scale; and improve predictability at multiple scales to inform decision makers;
- Fundamental Research: Support a broad research portfolio in carbon cycling, biodiversity, and ecological systems and expand the Nation's workforce trained to address complex environmental challenges;
- Observation: Improve, upgrade and deploy critical environmental observing platforms and systems (Long Term Ecological Research and the National Ecological Observatory Network) and partner with the USDA to establish a set of Urban Long Term Research Areas.

The long-term goal of this program is to assert U.S. leadership in providing and communicating the fundamental knowledge base on climate change.

Disciplinary Research/Division Research (+$38.0 million, to a total of $512.96 million).

Increasing support for basic research in biology will yield insights that can be used to produce the next generation of nano-, bio-, and information technologies. BIO investments support integrative fundamental research across the biological scales, from intracellular macromolecules to the biosphere and results in the discoveries and new knowledge needed to address issues of national importance. Enhanced attention will be placed on developing areas of research such as: life in transition; energy, information, and novel products; and closing the loop of theory, observation, experimentation and technology.

Research Resources & Centers in the Biological Sciences (+$20.0 million, to a total of $142.54 million).
Funds will be used to continue efforts, to digitize and network U.S. specimen-based research collections. These collections provide proper validation of species including a wealth of ancillary data such as DNA samples and environment/habitat information. These data provide the baseline from which to begin further biodiversity studies and provide critical information about the existing gaps in our knowledge of life on earth. Filling these gaps is crucial to a complete understanding of the biodiversity of the planet, both in space and time, and the history of climate change. The Interagency Working Group on Scientific Collections developed a comprehensive report on the current status of federally owned collections; NSF, as part of that working group, surveyed federally supported collections. Both reports emphasized the digitization of collections to leverage past investments by making them available and searchable online to researchers worldwide.

In addition, support will be enhanced for research resources to include increased funding for Advances in Biological Informatics (ABI) and Instrument Development for Biological Research (IDBR), two vitally important research resource programs.

The centers supported by BIO will be managed as a cohort within DBI in order to promote synthesis across the complete range of biological research, integrate and streamline the resources required by the individual centers, promote education and outreach activities among the centers, and integrate other center-like activities requiring similar management practices.

National Ecological Observatory Network (+$200,000 million for a total of $13.50 million).
Increased investment in project planning for the National Ecological Observatory Network (NEON) will sustain project design and development activities until completion of the preliminary and final design reviews scheduled for completion in early FY 2010. Confirmation of baseline estimates for construction will inform the FY 2011 budget request.

Education and Learning Activities (+$11.5 million for a total of $50.86 million).
In partnership with EHR, GEO, and OPP, BIO will support innovative formal and informal education activities centered on the general theme of climate science.

Additional funding will build upon activities in the BIO/EHR partnership that have included 'conversations' with undergraduate educators and researchers, co-funding of innovative education awards and networking grants, and a planned July 2009 *Vision and Change in Undergraduate Biology Education* conference co-sponsored by BIO and EHR. FY 2010 funding will support Research Coordination Networks that join biology and education researchers and practitioners to enhance the exchange of ideas and innovative practices. New this year will be a set of incubation grants to build upon themes of the Vision and Change conference, and expand and complement the Howard Hughes Medical Institute (HHMI) Experiments in Undergraduate Science Education competition.

Program Evaluation and Performance Improvement

The Performance Information chapter describes the Foundation's performance evaluation framework, which is built upon the four strategic outcome goals in NSF's Strategic Plan: *Discovery, Learning, Research Infrastructure*, and *Stewardship*. Performance evaluation is conducted at all levels within the Foundation, using both qualitative and quantitative measures – including an agency-wide annual review of research and education outcomes by an external expert committee and periodic reviews of programs and portfolios of programs by external Committees of Visitors (COVs) and directorate Advisory

Committees. Other performance indicators, such as funding rates, award size and duration, and numbers of people supported on research and education grants, are also factored into the assessment process.

In FY 2008, BIO held two COVs in June 2008 for the Molecular and Cellular Bioscience and for the Integrative Organismal Systems. The Directorate Advisory Committee met twice in FY 2008, in October 2007 and later in April 2008.

In FY 2009, BIO Committee of Visitors (COV) reviews took place for the Emerging Frontiers and the Division of Environmental Biology. All BIO divisions are responding to and implementing recommendations from recent COVs. COVs for the Division of Biological Infrastructure are scheduled for 2010. In addition, the National Research Council of the National Academy of Sciences is currently preparing a report on "The Role of the Life Sciences in Transforming America's Future." Funded by NSF and NIH, the Committee on a New Biology for the 21st Century held a workshop on December 3, 2008. The Committee expects to release a final report in August 2009.

Number of People Involved in BIO Activities

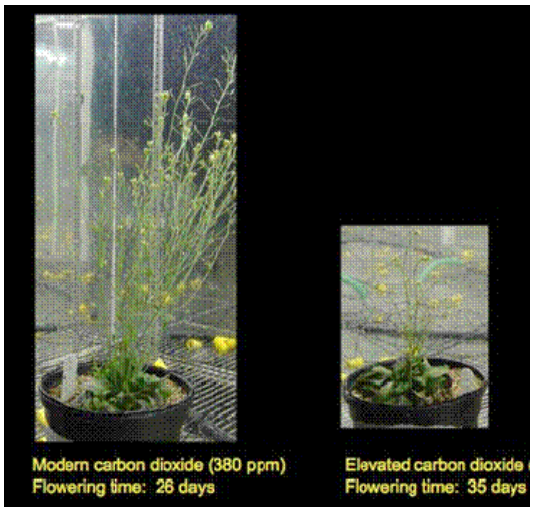
	FY 2008 Estimate	FY 2009 Estimate	FY 2009 ARRA Estimate	FY 2010 Estimate
Senior Researchers	3,942	4,021	1,100	4,600
Other Professionals	1,545	1,576	450	1,800
Postdoctorates	1,364	1,391	390	1,600
Graduate Students	2,745	2,800	785	3,200
Undergraduate Students	3,524	3,595	1,000	4,100
Total Number of People	13,120	13,383	3,725	15,300

BIO Funding Profile

	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate
Statistics for Competitive Awards:			
Number of Proposals	6,599	6,764	7,500
Number of New Awards	1,293	1,844	1,500
Regular Appropriation	1,293	1,319	1,500
ARRA		525	
Funding Rate	20%	27%	20%
Statistics for Research Grants:			
Number of Research Grant Proposals	5,473	5,585	6,200
Number of Research Grants	898	1,366	1,040
Regular Appropriation	898	916	1,040
ARRA		450	
Funding Rate	16%	24%	17%
Median Annualized Award Size	149,347	157,300	168,300
Average Annualized Award Size	179,267	188,900	202,000
Average Award Duration, in years	3.2	3.0	3.0

Recent Research Highlights

► **Is There a Relationship between Global Climate Change and Flowering?:** From a survey of past studies, researchers at the University of Kansas knew that rising CO2 exerts a strong effect on flowering time in the majority of plant species, although the mechanisms for this response are not yet well understood. Using *Arabidopsis thaliana*, a small flowering plant with a relatively short life cycle, the researchers for the first time demonstrated that elevated CO2 can influence the expression of genes involved in the initiation of flowering. More specifically, they found that the gene *Flowering locus C* plays a large role in determining delayed flowering in plants grown at elevated carbon dioxide. By describing these specific mechanisms, scientists are in a better position to predict the future responses of plants to a changing environment, and from this, they can determine the best approaches for improving crop responses to increasing carbon dioxide concentrations of the future.



This image shows Arabidopsis thaliana plants of the same age that were grown at future (elevated) and modern carbon dioxide concentrations. Notice that the plant grown at elevated carbon dioxide (right) exhibits delayed flowering relative to the plant grown at the modern carbon dioxide value (left). Although it cannot be seen in this photo, the elevated carbon dioxide-grown plant is as large as the modern carbon dioxide-grown plant, but substantial amounts of plant tissue remain underground at this earlier stage of development. *Credit: Justin Graham.*

► **Sugary Tropical Maize Shows Promise for Biofuel:** Scientists at the University of Illinois report that certain tropical varieties of maize, when grown in the Midwest, can accumulate sugars in their stalks at levels comparable to those of sugarcane grown in Brazil. The tropical maize could have a dramatic impact on U.S. ethanol production for biofuel because it requires less nitrogen fertilizer than conventional corn. It is also a more desirable biofuel crop for farmers because it can be integrated easily into current crop rotations. Because of its high sugar content, tropical maize can be processed without the additional treatments required by current biofuel crops, such as switchgrass and corn stover, to convert cellulose or starch into the sugars that are then fermented into ethanol.

► **Global Warming Affects World's Largest Freshwater Lake:** Scientists from Wellesley College and Russian colleagues report the rising temperature of the world's largest lake, located in frigid Siberia, shows the region is responding strongly to global warming. The lake contains 20 percent of the world's fresh water and is large enough to hold all the water in the United States' Great Lakes. At 25 million years old, Lake Baikal predates the emergence of humans. The researchers' conclusions rely on a 60-year data set, collected on Lake Baikal by three generations of a single family of Siberian scientists. Data collection continued through every season, in an environment where winter temperatures drop to -50 degrees Fahrenheit. Lake Baikal was expected to be among those most resistant to climate change due to its tremendous volume and unique water circulation, but the lake now joins other large lakes, including Superior, Tanganyika and Tahoe, in showing effects of climate change from warming of its vast waters to changes in the microscopic plants and animals that inhabit it.

This well-known landmark, Shaman Rock on Lake Baikal in Russia, stands guard over an ancient lake whose pristine condition is changing quickly. *Credit: Nicholas Rodenhouse.*

► **New Maze Puts Maize Mutants on Display:** The Maize-10-Maze Project is a collaborative outreach effort between Florida State University and Florida A&M University. The project, part of the Forestry and Conservation Education Summer Program, was designed to be a living field map of the maize genome with each of the 10 rows of plants representing the ten chromosomes of corn. About 100 naturally occurring mutants, such as albino or six-inch-high dwarf mutants, were used to illustrate the genetic control of plant growth and development. The maze field was open to the public with the goal of educating people of all ages about maize genetics, mutants, and how mutations affect plants. The program's goal is to broaden participation by encouraging underrepresented minority high school students to consider plant science as a future career.

Students learn about maize genetics as part of the Maize-10-Maze outreach project, directed by Dr. H. W. Bass (right) of Florida State University in partnership with Dr. O. Onokpise (left) of Florida A&M University. FACE is a three-week summer program designed to expose minorities to forestry, natural-resource conservation, and plant genetics. Here, area high school students collect pollen to carry out genetic crosses in preparation for the upcoming public field day, held at the FAMU Research Farm. *Credit: Courtesy H. W. Bass, Florida State, Tallahassee, FL.*

► **Harnessing the Energy Produced by Bacteria:** Researchers at the University of Minnesota-Twin Cities are creating miniaturized microbial fuel cells and sensors to harness the energy produced by certain bacteria. The bacteria appear to have a remarkable property – electrons from metabolism are transferred outside of the cell. One reason this occurs, they believe, is because the metals these bacteria use as their energy source in nature are insoluble. This means that some bacteria, when attached to a conductive surface, can produce an electrical current. This capability has been harnessed in so-called "microbial fuel cells" that use bacteria to convert wastewater organic compounds into electricity. The team has shown that the same phenomenon can be harnessed for use in biosensors and with other surfaces engineered to convert organic molecules into electricity. With the heightened interest in bio-energy, these bacteria have taken center stage as keys to new kinds of bio-electrical devices.

This photo shows a bank of eight electrochemical chambers containing glassy carbon or microfabricated gold electrodes, which are used to culture biofilms of anaerobic electricity-producing bacteria such as Geobacter sulfurreducens. Each 3-electrode chamber is connected to a potentiostat, allowing routine application of multiple voltammetry techniques able to detect electron transfer from bacteria to electrodes. *Credit: Daniel R. Bond, University of Minnesota*.

► **All Eyes and Ears on the Corn Genome:** A consortium of researchers led by the Genome Sequencing Center at Washington University in St. Louis has completed a draft sequence of the corn genome. This groundbreaking project was funded by NSF under the auspices of the National Plant Genome Initiative. Corn has one of the most complex genomes of any known organism and is one of the most challenging genomes sequenced to date. At 2.5 billion base pairs covering 10 chromosomes, this genome's size is comparable to that of the human genome. The draft sequence will be a valuable tool allowing researchers to uncover the functional components of individual genes and develop a picture of the genome organization. Scientists will be able to develop new varieties of corn that increase crop yields and resist drought and disease. Information gleaned from the corn genome is likely to be applicable to other grains, such as rice, wheat, and barley.

In 2005, NSF, DOE, and USDA funded the sequencing of the corn genome. *Credit: © 2008 Jupiter Images Corp.*

► **Gatekeepers Protect Plants from Ozone Damage:** Photosynthesis requires that plants exchange CO2, water, and other gasses with the atmosphere through stomatal pores. These "breathing" pores have guard cells on either side to help the plant control gas exchange, mostly to prevent water loss from plants when the pores are open. Recently, NSF-funded scientists from the University of California at San Diego, working with European collaborators, showed that the gene SLAC1 controls the amount of ozone, an atmospheric toxin, allowed into the plant by causing the guard cells to deflate shutting stomatal pores. This protects vulnerable internal tissues and slows photosynthetic activity until atmospheric ozone concentrations drop. Plants lose more than 90 percent of their water through evaporation from stomatal pores. Thus, understanding the basic genetic and biochemical mechanisms that control the guard cell regulation of the stomatal pores will contribute to breeding crops and other plants capable of withstanding severe droughts.

How the SLAC1 Anion Channel mediates stomatal closing. *Credit: Image courtesy Julian Schroeder, UCSD.*

Two guard cells surround this stomatal pore, allowing CO2 for photosynthesis into the plant. If atmospheric ozone concentrations would increase, the guard cells would swell, closing the stomatal pore. *Credit: Julian Schroeder, UCSD.*

► **What Happens When Permafrost Thaws?**: Recent findings from an NSF-supported study suggest that rising temperatures in boreal peatlands may not always increase the greenhouse gases responsible for global warming. Scientists predict that as rising atmospheric temperatures accelerate rates of permafrost thawing, organic matter stored in frozen peatland soil will decompose and release even more greenhouse gases into the atmosphere. A Villanova University team found that while warming leads to permafrost thawing, it also increases the growth of mosses that take up carbon from the atmosphere. Soil cores, which tell the climatic and ecological history of the peatland ecosystem, suggest that as the permafrost continues to degrade and the peatland begins to dry, slower-growing plants replace the water-loving, fast-growing mosses. Thus, while current rates of carbon uptake due to moss growth may compensate for greenhouse gas releases, over the long term, this offsetting process may become less important.

An example of permafrost collapse in peatlands, resulting in the slumping of the soil surface and flooding. This will be followed by a complete change in vegetation, soil structure, and many other important aspects of these ecosystems. *Credit: Dale H. Vitt, Southern Illinois University Carbondale.*

Thawing permafrost in the peatlands of boreal forests in North America. *Credit: Dale H. Vitt, Southern Illinois University Carbondale.*

MOLECULAR AND CELLULAR BIOSCIENCES

$128,830,000
+$7,570,000 / 6.2%

Molecular and Cellular Biosciences Funding

(Dollars in Millions)

	FY 2008 Actual	FY 2009 Current Plan	FY 2009 ARRA Estimate	FY 2010 Request	Change Over FY 2009 Plan Amount	Change Over FY 2009 Plan Percent
Total, MCB	**$112.28**	**$121.26**	**$60.00**	**$128.83**	**$7.57**	**6.2%**
Major Components:						
Research and Education Grants	112.28	121.26	60.00	128.83	7.57	6.24%

Totals may not add due to rounding.

Molecular and Cellular Biosciences Division (MCB) (+$7.57 million, to a total of $128.83 million). MCB supports fundamental research and related activities to understand the dynamic underpinnings of complex living systems at the molecular, subcellular, and cellular levels. Priorities include projects that address questions related to the origin, organization, and properties of macromolecular structures, and/or subcellular and cellular components, as well as those that address the nature and operation of basic life processes.

In general, 33 percent of the MCB budget is available for new research grants. The remaining 67 percent funds continuing grants made in previous years.

The FY 2010 request includes:

- Support for additional innovative and potentially transformative disciplinary projects to advance our understanding of the molecular underpinnings of complex living systems. Central to this endeavor is building collaborations with the physical sciences to strengthen the theoretical, computational, and mathematical approaches that are critical for advances in this area. Also within the disciplinary increase is support to fund research on the transfer of energy and information between and among molecules, cells, organisms, and/or populations; traits that not only confer many of the unique properties of life such as robustness and resilience but also could form the basis for new energy sources and systems.

- Continued emphasis will be placed on the integration of research and education by increasing the number of CAREER awards.

INTEGRATIVE ORGANISMAL SYSTEMS

$221,840,000
+$10,220,000 / 4.8%

Integrative Organismal Systems Funding

(Dollars in Millions)

	FY 2008 Actual	FY 2009 Current Plan	FY 2009 ARRA Estimate	FY 2010 Request	Change Over FY 2009 Plan Amount	Change Over FY 2009 Plan Percent
IOS Project Support	$102.59	$110.40	$60.00	$117.58	$7.18	6.5%
Plant Genome Research Program	97.45	101.22	0.00	104.26	3.04	3.0%
Total, IOS	**$200.04**	**$211.62**	**$60.00**	**$221.84**	**$10.22**	**4.8%**
Major Components:						
Research and Education Grants	159.59	170.62	60.00	180.84	10.22	6.0%
Instrumentation	40.45	41.00	-	41.00	-	-

Totals may not add due to rounding.

Integrative Organismal Systems Division (IOS) (+$10.22 million, to a total of $221.84 million).
IOS supports research and education aimed at understanding plants, animals and microorganisms as complex systems by focusing on the structures and processes that affect organismal development, structure, performance, and interactions under varying environmental conditions. In general, 49 percent of the IOS Project Support budget and 31 percent of the Plant Genome Research Program budget are available for new research grants. The remaining 51 and 69 percent, respectively, primarily fund continuing grants made in previous years.

IOS Project Support (+$7.18 million for a total of $117.58 million in FY 2010) will give highest priority to projects that focus on:

- Understanding the mechanisms and principles that allow organisms to survive, adapt to, and transform their environment. A greater understanding of such principles will enhance our ability to predict organisms' responses to climate and environmental change and suggest mitigation and adaptation strategies.

The Plant Genome Research Program (+$3.04 million for a total of $104.26 million in FY 2010) will emphasize:

- Support of genome-scale research that capitalizes on previous investments to accelerate basic discoveries of potential application in crop improvement and/or adaptation to global climate change.
- The Basic Research to Enable Agricultural Development (BREAD) Program will support basic research to test innovative hypotheses, approaches, and technologies for sustainable, science-based solutions to problems of agriculture in developing countries. BREAD is supported by the National Science Foundation (NSF) and the Bill and Melinda Gates Foundation through funding provided to NSF.

IOS will also continue to place a high priority on the integration of research and education by increasing the number of CAREER awards.

ENVIRONMENTAL BIOLOGY

$133,920,000
+$13,540,000 / 11.2%

Environmental Biology Funding

(Dollars in Millions)

	FY 2008 Actual	FY 2009 Current Plan	FY 2009 ARRA Estimate	FY 2010 Request	Change Over FY 2009 Plan Amount	Change Over FY 2009 Plan Percent
Total, DEB	**$110.71**	**$120.38**	**$70.00**	**$133.92**	**$13.54**	**11.2%**
Major Components:						
Research and Education Grants	110.71	120.38	70.00	133.92	13.54	11.2%

Totals may not add due to rounding.

Environmental Biology Division (DEB) (+$13.54 million, to a total of $133.92 million).
DEB supports fundamental research on the past, current, and future biosphere. Foci include the origin, extent and maintenance of biological diversity; impacts and feedbacks associated with climate change; and how populations and communities survive, adapt to, and transform their environment. In general, 41 percent of the DEB budget is available for new research grants. The remaining 59 percent primarily funds continuing grants made in previous years.

The FY 2010 request includes:

- Enhanced support for innovative disciplinary projects, especially in climate change and the dimensions of biodiversity. Advances in genomics as well as other biological advances coupled with developments in digitization and high performance computing make it feasible to establish the goal of determining the dimensions of Earth's biodiversity within a decade.
- The Long Term Ecological Research (LTER) program will be augmented by $2.0 million in FY 2010 to improve critical observing systems so that LTER sites can collaborate with NEON and other NSF environmental observatories.
- DEB will enhance its support for activities that integrate research and education by increasing the number of CAREER awards.

BIOLOGICAL INFRASTRUCTURE

$130,140,000
+$13,340,000 / 11.4%

Biological Infrastructure Funding

(Dollars in Millions)

	FY 2008 Actual	FY 2009 Current Plan	FY 2009 ARRA Estimate	FY 2010 Request	Change Over FY 2009 Plan Amount	Change Over FY 2009 Plan Percent
Total, DBI	**$109.86**	**$116.80**	**$20.00**	**$130.14**	**$13.34**	**11.4%**
Major Components:						
Research and Education Grants	35.78	39.36	20.00	41.00	1.64	4.2%
Instrumentation/Research Resources	47.87	47.61	-	56.25	8.64	18.1%
Centers [1]	26.21	29.83	-	32.89	3.06	10.3%
National Center for Ecological Analysis and Synthesis	*3.89*	*3.71*	*-*	*3.70*	*-0.01*	*-0.3%*
National Evolutionary Synthesis Center	*2.89*	*2.55*	*-*	*5.77*	*3.22*	*126.3%*
National Institute for Mathematical and Biological Synthesis	*0.35*	*1.85*	*-*	*2.35*	*0.50*	*27.0%*
Plant Science Cyberinfrastructure Collaborative (iPlant)	*6.63*	*9.11*	*-*	*10.97*	*1.86*	*20.4%*
Centers for Environmental Implications of Nanotechnology	*3.10*	*4.10*	*-*	*4.10*	*-0.00*	*-0.0%*
Center for Behavioral Neuroscience	*3.15*	*2.51*	*-*	*-*	*-2.51*	*-100.0%*
Center for Microbial Oceanography Research and Education	*4.00*	*4.00*	*-*	*4.00*	*-*	*-*
Science of Learning Center [2]	*2.20*	*2.00*	*-*	*2.00*	*-*	*-*

Totals may not add due to rounding.

[1] In FY 2010, all centers are shifted from Emerging Frontiers to Biological Infrastructure. Funding is included in Biological Infrastructure for all years for comparability.

[2] Funding for the Science of Learning Center (SLC) is added for all years for comparability. SLC will be cofunded with the Directorate for Social, Behavioral and Economic Sciences beginning in FY 2010.

Biological Infrastructure Division (DBI) (+$13.34 million, to a total of $130.14 million).
DBI supports research resources that include the development of research tools, acquisition of instrumentation, and infrastructure improvements; human resource activities; and centers. Approximately 49 percent of the DBI budget is available for new awards each year with approximately 22 percent available for new research grants. The remainder supports continuing grants made in previous years.

Research and Education Grants (+$1.64 million for a total of $41.0 million in FY 2010):

- In collaboration with EHR, OPP, and GEO, will support the planning and establishment of a Climate Change Education program.

Instrumentation/Research Resources (+$8.64 million for a total of $56.25 million in FY 2010):

- Enhanced support will be provided for research resources such as biological informatics and instrument development.

Centers (+3.06 million for a total of $32.89 million in FY 2010):

- A shift of the centers from EF to DBI will promote cross-center synthesis, as well as education and outreach activities among the centers. In addition, the shift will integrate and

streamline the resources required by individual centers and coordinate other center-like activities that require similar management practices. An increase of $3.22 million is due to the renewal of the National Evolutionary Synthesis Center (NESCent).

EMERGING FRONTIERS

$118,270,000
+$32,520,000 / 37.9%

Emerging Frontiers Funding
(Dollars in Millions)

	FY 2008 Actual	FY 2009 Current Plan	FY 2009 ARRA Estimate	FY 2010 Request	Change Over FY 2009 Plan Amount	Change Over FY 2009 Plan Percent
Total, EF	**$82.73**	**$85.75**	**$50.00**	**$118.27**	**$32.52**	**37.9%**
Major Components:						
Research and Education Grants	68.90	72.45	35.00	104.77	32.32	44.6%
Instrumentation/Research Resources			15.00			
Centers [1]	-	-	-	-	-	N/A
Facilities	13.83	13.30	-	13.50	0.20	1.5%
National Ecological Observatory Network	*13.83*	*13.30*	*-*	*13.50*	*0.20*	*0.02*

Totals may not add due to rounding.

[1] In FY 2010, all centers are shifted from Emerging Frontiers to Biological Infrastructure. Funding for all years is included in Biological Infrastructure for comparability.

Emerging Frontiers Division (EF) (+$32.52 million, to a total of $118.27 million).
EF identifies, incubates, and supports research areas or infrastructure that transcends scientific disciplines and/or advances the conceptual foundations of biology. EF develops and implements new forms of merit review, and mechanisms to support transformative research and stimulate creativity. These goals are accomplished by promoting cultural change within and across scientific disciplines to increase the frequency of multidisciplinary collaborations, by encouraging curiosity and exploration through novel mechanisms and investments, and by facilitating support of research areas relevant to all of biology by targeted co-funding throughout the directorate. In general, 50 percent of the EF budget is available for new research grants. The remaining 50 percent is used primarily to fund continuing grants made in previous years.

The FY 2010 request includes:

- The transfer of centers to DBI to enhance cross center synthesis and coordination and promote the sharing of best practices with other large DBI projects.
- Support for developing priorities (+$15.5 million) such as research to enhance our understanding of complex biological systems, especially those that will yield new knowledge about global change.
- A partnership with EHR (+10.0 million) to develop and support activities identified after a two year planning process to improve undergraduate biology education through new mentoring, curriculum and research experiences for students, and faculty development.
- Continued support for NEON as it finalizes project planning and review.
- Leveraging activities across the directorate to increase support for transformative research, Emerging Frontiers will establish an innovation fund (+$8.0 million) that will co-fund with other BIO divisions using innovative mechanisms for identifying and reviewing innovative research projects.