BIOLOGICAL SCIENCES $581,790,000

The FY 2006 Budget Request for the Directorate for Biological Sciences (BIO) is $581.79 million, an increase of $5.18 million, or 0.9 percent, over the FY 2005 Current Plan of $576.61 million.

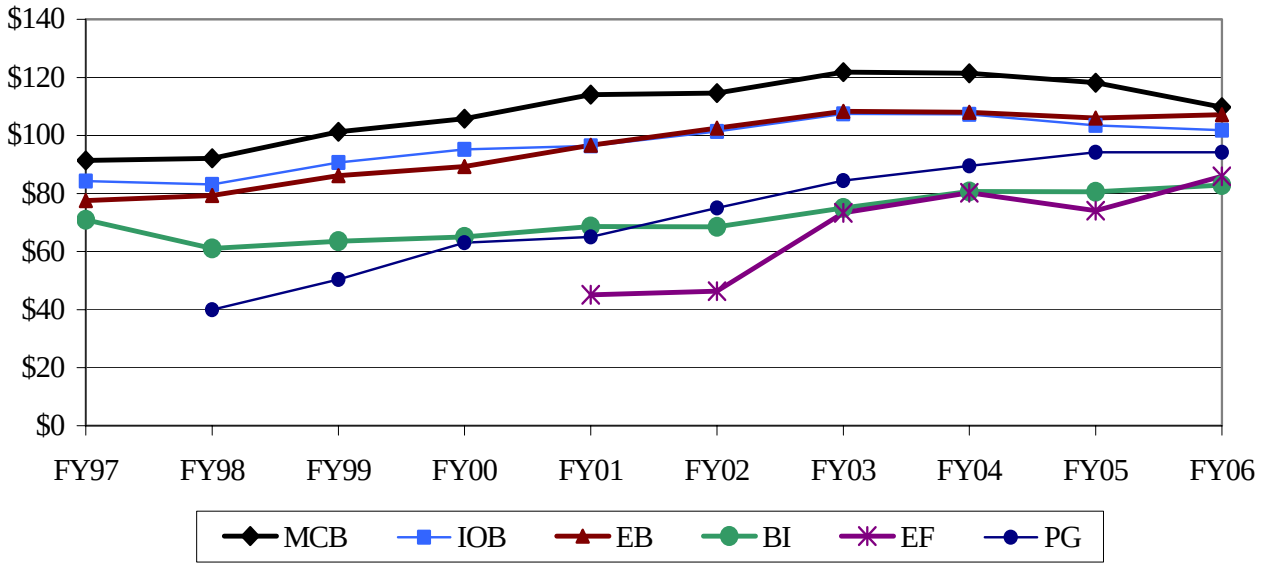
Biological Sciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Molecular and Cellular Biosciences (MCB)	121.42	118.16	109.75	-8.41	-7.1%
Integrative Organismal Biology (IOB)	107.29	103.50	101.76	-1.74	-1.7%
Environmental Biology (EB)	107.94	106.04	107.18	1.14	1.1%
Biological Infrastructure (BI)	80.68	80.62	82.93	2.31	2.9%
Emerging Frontiers (EF)	80.24	74.05	85.93	11.88	16.0%
Plant Genome (PG)	89.47	94.24	94.24	0.00	0.0%
Total, BIO	$587.05	$576.61	$581.79	$5.18	0.9%

Totals may not add due to rounding.

The Directorate for Biological Sciences (BIO) supports the vitality of the biological sciences at U.S. colleges and universities, especially in those areas where NSF has a major responsibility. BIO supports research, infrastructure, and education.

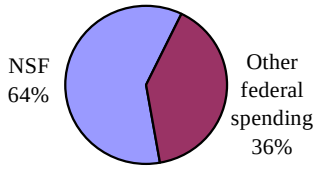
BIO Subactivity Funding
(Dollars in Millions)



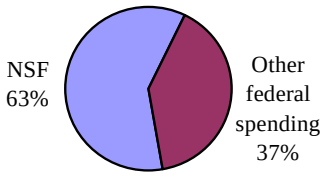
RELEVANCE

BIO is the dominant federal supporter of basic research in non-medical aspects of the biological sciences at academic institutions – providing over 63 percent of the support for these activities. Because most federal support for the life sciences goes to health-related research funded by the National Institutes of Health, NSF's contribution to the broader array of the biological sciences is significant and strategically focused – particularly in such areas as environmental biology and plant sciences.

Federal Support for Basic Research in Environmental Biology at Academic Institutions



Federal Support for Basic Research in Non-Medical Biological Sciences at Academic Institutions



Fundamental research on understanding all aspects of "life" – from the cell to whole ecosystems – is supported within NSF, where the ability to integrate the range of biological sub-disciplines is unique. BIO support represents 64 percent of all federal funding for basic research in environmental biology and an estimated 59 percent of support in plant biology at academic institutions. Additionally, NSF plays a catalytic role in supporting interdisciplinary biological research through investments that develop a deeper understanding of complex biological systems through collaborations among physical, computational, behavioral, social, and biological researchers and engineers. Issues of national importance related to the environment, economy, and human welfare require an understanding of how living organisms function and interact with non-living systems. BIO-supported research enhances this understanding.

Summary of Major Changes by Division *(Dollars in Millions)*

BIO FY 2005 Current Plan……..…….. $576.61

Molecular and Cellular Biosciences -$8.41

Decreased support in part reflects the transfer of Microbial Observatories and microbial interactions and processes research to the Emerging Frontiers Subactivity to form the core of a new emphasis on Microbial Biology. Additional real decreases in the core will result in fewer awards being made. In addition to Microbial Biology, FY 2006 priorities include areas of emerging importance: analysis of living networks and complex interacting processes; cyberinfrastructure; plant biology and the Arabidopsis 2010 project.

Integrative Organismal Biology -$1.74

Decreased support reflects the initiation of the Microbial Biology emphasis in Emerging Frontiers. Funds will be directed from other areas of core support to focus on research areas of emerging importance such as: integrative studies on organisms; integration of developmental biology and evolutionary physiology; and the genetic/cellular basis of behavior.

Environmental Biology +$1.14

Increased support will be allocated to areas of research on complex ecological and evolutionary systems, with an emphasis on aquatic and watershed systems. Some funds will be redirected from other areas of core support to focus on this important area of pioneering research. A small budgeted increase for the National Center for Ecological Analysis and Synthesis is planned as well.

Biological Infrastructure +$2.31

Research Resources:

Support for instrumentation programs, in particular the multi-user instrumentation program, will be decreased. (-$5.05 million)

Funds redirected from instrumentation support will focus on biological databases and informatics activities. (+$7.00 million)

NEON: Planning and development of the National Ecological Observatories Network (NEON) project execution plan is well underway, and already has identified the critical need to develop cybernetwork and sensor tools as NEON moves to the construction stage. A priority will be placed on support to develop these critical tools in a manner consistent with the NEON project execution plan. (+$50,000)

Human Resources:

Stipends for REU (Research Experiences for Undergraduates) sites and Postdoctoral Fellowships will increase. Support for activities designed to broaden participation of under-represented and under-served communities will increase, including Research Opportunities for Community College Faculty supplements. (+$310,000)

Emerging Frontiers +$11.88

Microbial Biology

A new emphasis on microbial biology will be established. While microbial research has long been supported across the biological sciences, and will continue to be supported within core programs, some activities are being transferred from Molecular and Cellular Biosciences to Emerging Frontiers to form components of the new emphasis area for enhancement across disciplinary boundaries at the leading edge. Included in the emphasis area will be microbial genome sequencing, microbial observatories, microbial interaction and processes, and other microbial research and training activities. (+$12.21 million)

Frontiers in Integrative Biological Research (FIBR)

FIBR support will increase by $1.27 million in FY 2006 to augment research projects on complex, often multidimensional, major biological questions that are addressed using the creative application of a broad range of scientific concepts, strategies, and research tools from within and outside the biological sciences. (+$1.27 million)

Broadening Participation

Support will increase for research planning grants for early career researchers and career advancement awards to mid-career researchers to promote the professional development and retention of underrepresented scientists and engineers in the Biological Sciences. (+$1.0 million)

Center for Synthesis in Biological Evolution

The decrease of $600,000 to $3.0 million reflects a shift from start up costs to the day-to-day research and educational activities of the Center. (-$600,000)

Nanoscale Science and Engineering

Funding will decrease by $2.0 million to $3.85 million in FY 2006 in a planned phase of this priority area. BIO will emphasize research on nanoscale sensors and information processors that could provide new tools for understanding detection of environmentally important signals. (-$2.0 million)

Plant Genome No Change

Support for Plant Genome Research projects, which include Functional Genomics, Large-scale Sequencing for Genomes of Economically Important Plants, Informatics Tools Development, and Interagency Activity on Research Collaboration with Scientists in Developing Countries will continue at the FY 2005 level.

Subtotal, Changes +$5.18

FY 2006 Request, BIO……...… $581.79

Summary of Directorate-wide Investments *(Dollars in Millions)*

BIO FY 2005 Current Plan…….. $576.61

Core Research +$2.38

Disciplinary and interdisciplinary research in the BIO core will increase by $1.11 million for a total of $293.87 million.

Molecular & Cellular Biosciences	-$8.41 million
Integrative Organismal Biology	-$1.74 million
Environmental Biology	+$0.79 million
Biological Infrastructure	+$0.26 million
Emerging Frontiers	+$11.48 million

Funding will support awards central to 21st Century Biology. As research breakthroughs are realized from recent advances in genomics, proteomics, informatics, computer science, mathematics, physics, chemistry, engineering, and the earth and social sciences, a new biology has emerged that is multidimensional, multidisciplinary, information-driven, education-oriented, and internationally engaged. In FY 2006, a new emphasis on microbial biology will be fostered in the Emerging Frontiers Subactivity.

Centers -$0.25

Centers for Analysis and Synthesis

A decrease of $250,000 to a total of $6.82 million for two BIO-supported Centers: the Center for Ecological Analysis & Synthesis [+$350,000] and the Center for Evolutionary Synthesis [-$600,000].

Plant Genome Virtual Centers

Plant Genome Virtual Centers (centers without walls) are collaboratories where coordinated, multi-investigator teams pursue comprehensive plant genome research programs relevant to economically important plants or plant processes. Funding for FY 2006 will be maintained at $36.0 million, equal to FY 2005.

Research Resources +$2.00

An increase of $2.0 million for a total of $109.16 million. Research Resources provides essential support for the core infrastructure needs of the community supported by the BIO Directorate. This support includes multi-user instrumentation, development of instrumentation and new techniques, living stock centers, marine laboratories and terrestrial field stations, databases, and support for development of informatics tools and techniques. In FY 2006, a shift in resources from multi-user instrumentation is necessary to support the long-term needs of databases and the increasing dependence of the biological sciences' community on the cyberinfrastructure necessary for 21st century research and analysis.

National Ecological Observatory Network +$0.05

NEON will increase by $50,000 for a total of $6.0 million. The ongoing planning process for NEON will continue. Robust cyberinfrastructure has emerged as a key. Funds will continue development of necessary tools and infrastructure that would add critical components in preparation for construction of the NEON platform.

Broadening Participation +$1.00

An increase of $1.0 million will focus on fostering linkages between programs in BIO and LSAMP, AGEP, and CREST, and to continue support for the Career Advancement Awards and Research Planning Grants.

Subtotal, Changes +$5.18

FY 2006 Request, BIO…… $581.79

PRIORITY AREAS

In FY 2006, BIO will support research and education efforts related to broad, Foundation-wide priority areas in Biocomplexity in the Environment (BE), Nanoscale Science and Engineering (NSE), Mathematical Sciences (MS), and Human and Social Dynamics (HSD). Support for BE and NSE will decrease as programs transition into core activities across the Directorate for Biological Sciences.

Biological Sciences Investments in NSF Priority Areas
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Biocomplexity in the Environment	39.86	39.86	30.43	-9.43	-23.7%
Nanoscale Science and Engineering	5.31	5.85	3.85	-2.00	-34.2%
Mathematical Sciences	2.18	2.21	2.21	0.00	0.0%
Human and Social Dynamics	0.50	0.50	0.50	0.00	0.0%

Biocomplexity in the Environment: A total of $30.43 million will continue support for the Ecology of Infectious Disease and Microbial Genome Sequencing. A new program emphasis on environmental genomics will be initiated in FY 2006 in partnership with GEO and OPP. Assembling the Tree of Life program will continue with support from Emerging Frontiers.

Nanoscale Science and Engineering: A decrease of $2.0 million, for a total of $3.85 million, will begin the transitioning of the NSF-wide priority area into base programs. Base support for research on nanoscale science totals approximately $50 million across BIO research programs focusing on nanoscale studies of the structure, function, and assembly of cellular elements.

Mathematical Sciences: A total of $2.21 million will continue support for interdisciplinary science and engineering through research on mathematical and statistical challenges posed by large data sets, managing and modeling uncertainty, and modeling complex nonlinear systems.

Human and Social Dynamics: A total of $500,000 will be provided to support a focus on modeling human and social dynamics that are related to biological systems.

QUALITY

BIO maximizes the quality of the R&D it supports through the use of a competitive, merit-based review process. The percent of research funds that were allocated to projects that undergo external merit review was 97 percent in FY 2004, the last year for which complete data exist.

To ensure the highest quality in processing and recommending proposals for awards, BIO convenes Committees of Visitors, which are comprised of qualified external evaluators, to review each program every three years. These experts assess the integrity and efficiency of the processes for proposal review and provide a retrospective assessment of the quality of results of NSF's investments.

The Directorate for Biological Sciences also receives advice from the Advisory Committee for Biological Sciences (BIOAC) on such issues as: the mission, programs, and goals that can best serve the scientific community; how BIO can promote quality graduate and undergraduate education in the biological sciences; and priority investment areas in biological research. The BIOAC meets twice a year. Members represent a cross section of biology and include members from academic institutions and industry. The Committee includes a balanced representation of women, under-represented minorities, and geographic regions.

PERFORMANCE

NSF's FY 2006 Budget Request is also aligned to reflect funding levels associated with the Foundation's four strategic outcome goals and the ten investment categories highlighted in the FY 2003-2008 Strategic Plan. These categories were designed as a mechanism to better enable assessment of program performance and to facilitate budget and performance integration.

Biological Sciences

By Strategic Outcome Goal and Investment Category

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
People					
Individuals	55.66	58.90	58.90	-	-
Institutions	2.71	2.71	2.71	-	-
Collaborations	1.07	0.00	1.00	1.00	-
	59.44	61.61	62.61	1.00	1.6%
Ideas					
Fundamental Science and Engineering	330.08	313.55	315.93	2.38	0.8%
Centers Programs	58.77	64.60	64.35	-0.25	-0.4%
Capability Enhancement	23.75	17.82	17.82	-	-
	412.60	395.97	398.10	2.13	0.5%
Tools					
Facilities	4.70	7.15	7.20	0.05	0.7%
Infrastructure and Instrumentation	105.25	107.16	109.16	2.00	1.9%
Polar Tools, Facilities and Logistics	-	-	-	-	-
Federally-Funded R&D Centers	-	-	-	-	-
	109.95	114.31	116.36	2.05	1.8%
Organizational Excellence	5.05	4.72	4.72	-	-
Total, BIO	$587.05	$576.61	$581.79	$5.18	0.9%

Totals may not add due to rounding.

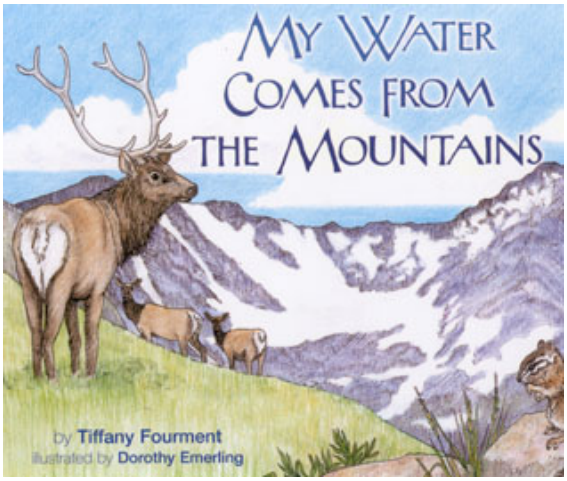
BIO will continue its commitment to education, training, and increasing diversity while emphasizing 21st Century Biology within all of its divisions and subactivities. The FY 2006 budget will maintain award size and continue to focus on multidisciplinary research activities, inter-agency partnerships, and international activities with special attention given to broadening participation at all levels.

Recent Research Highlights

DNA fingerprinting detects a deadly pathogen in North American forests. Pathogenic *Ceratocystis* is

an opportunistic fungus. It invades a plant's root system and eventually destroys the tissue within the trunk. North American forests containing aspen, hickory, maple, oak, poplar, and sycamore are highly susceptible to this plant pathogen, which has arrived from tropical regions on shipments of commercial wood products. Researchers are using nuclear and mitochondrial DNA fingerprinting to distinguish between native and introduced populations of this fungus. NSF-supported researchers, which include graduate students, have developed new procedures regulating the import of tropical wood-based materials into North America and assists with efforts to identify new exotic pests in forest ecosystems.

A new children's book is enhancing the high-altitude ecological literacy of valley dwellers. Models developed at a Colorado BIO Long Term Ecological Research (LTER) site – the only long-term study site for high-elevation areas on the North American continent, have revealed explicit links between aquatic and terrestrial ecosystems. Research results inspired a children's book about the water cycle, *My Water Comes from the Mountains*, a product of the Schoolyard LTER program targeting K-12 students. The book explores the ecology of the region and explains the hydrological cycle supplying water from the Colorado Mountains to the City of Boulder and ecosystems of the Continental Divide. The author, a former student at the LTER, invited students from her third grade class to draw their impressions of the LTER field site to illustrate the book, which is now available in bookstores. Copies have been distributed as class sets to the elementary schools in local school districts and beyond. A second children's book based on the Antarctic LTER site is already in the works.



Energy allocation during fasting in Northern Elephant seals: Starving for love. Northern Elephant seals, which weigh over 6,000 pounds, spend 60-80 percent of the time underwater, but come ashore twice a year, to molt, breed and give birth. Onshore, elephant seals fast and can lose as much as 1,500 pounds over a three-month period. To produce milk for their newborn calves, they metabolize fat

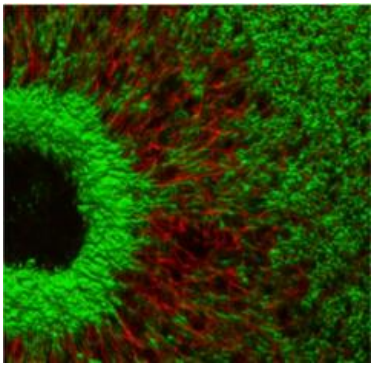
(blubber) reserves for energy. NSF-supported researchers have discovered that glucose production in fasting elephant seals is comparable to that of humans and dogs, two non-fasting adapted species, suggesting that seals can alter the rate of glucose production in response to food limitation in order to share and conserve energy. Determining how animals undergoing long-term fasting allocate their limited energy resources is furthering understanding of energy conservation and its affects on parental investment, growth and

development, among fasting and non-fasting adapted species. Research on glucose management has direct implications to the study of diabetes, as elephant seals maintain glucose levels that are considered to be diabetic-like in human systems.

Broadening participation in plant genomics. The cultivated potato is thought to have come to the U.S. from the Andes *via* Europe. NSF-supported esearchers working on disease resistance genes in cultivated and wild varieties of potato are partnering with the Makah Nation in Washington State to help them discover the origin of their indigenous potato variety, the Ozette potato. High school and college students are testing the idea that the Ozette potato came directly from the Inca in the Andean regions of Peru and Bolivia, rather than from Scottish and Irish immigrants in the 17th century. Participating students from the Makah and Yakima Nations conduct research in the laboratory using genetic markers that characterize potatoes from different areas and learn how to use computational tools to analyze their data.

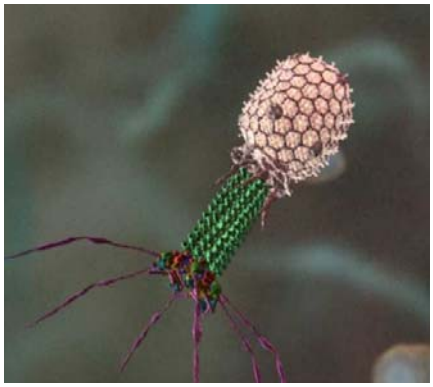
DiGIR: Driving the Federation of Biological Databases. Federated databases are rapidly becoming a major force in advancing biology. They supply an alternative to large expensive centralized databases and drive the development and acceptance of community standards and intellectual property norms that benefit all of biology by allowing universal access to data and broad collaboration. Using DiGIR (Distributed Generic Information Retrieval), a protocol developed for single point access to distributed data sources, NSF-supported researchers have created HerpNET, a federated, biodiversity database and MOBY, a federated genomics/proteomics database, making enormous amounts of distributed data available to researchers.

Healing in Cell Membranes. The cell membranes of individual cells, particularly animal cells that lack protective outer coverings, are fragile and vulnerable to mechanical injury. Cells cannot survive if their membranes have been breached. Therefore, the ability of a cell to rapidly repair injured membranes is critical to its survival. A BIO-supported study of wound healing at the cellular level used lasers to create holes in the membrane of frog cells. The cells were injected with fluorescent probes and imaged with high-resolution confocal microscopy to observe the healing process. After wounding, protein contraction in the cells pulled filaments to the wound border forming a contractile ring (green center ring in photo). Contraction of the filaments closes the wound resulting in healing. The results of this research help us better understand cells as complex systems and the mechanisms they use to repair their membranes and ensure their survival after an injury.



Using Genetics to Conserve Plant Species. *Vanilla planifolia,* a plant species in the Orchid family, is one of a few sources of the world's most popular extract, vanilla, and is the only orchid species out of approximately 25,000 that has significant agricultural value. In fact, U.S. manufacturers imported 2.5 million pounds of vanilla beans in 2002. Despite the plant's economic importance, little is known about the Orchid's natural history, including it's physical structure and pollination processes, and even less so about the plant's genetic makeup. Most vanilloid species respond poorly to cultivation, and many are under severe threat of extinction because of habitat destruction. By increasing our understanding of this plant's life history and evolution, BIO-supported researchers are working to ensure that this important plant will always be available.

From Nature to Nanotechnology. Researchers supported by BIO have learned how the bacterial virus, bacteriophage T4, attacks its host, the *E. coli* bacterium. The research describes for the first time how the virus uses a needle-like biochemical puncturing device to invade its host. By understanding how this tiny drilling mechanism works, scientists may be able to use nanotechnology to mimic the mechanism to create nanomachinery that could be used in manufacturing processes or for injecting nucleic acids into cells for a variety of biotechnology applications.



Other Performance Indicators

The tables below show the change in the number of people benefiting from BIO funding, and trends in the award size, duration and number of awards.

Number of People Involved in BIO Activities

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Senior Researchers	3,270	3,230	3,230
Other Professionals	1,740	1,720	1,730
Postdoctorates	1,460	1,470	1,470
Graduate Students	2,710	2,790	2,790
Undergraduate Students	2,440	2,450	2,450
K-12 Teachers	20	20	20
Total Number of People	11,640	11,680	11,690

BIO Funding Profile

	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate
Statistics for Competitive Awards:			
Number	1,432	1,406	1,419
Funding Rate	24%	24%	24%
Statistics for Research Grants:			
Number of Research Grants	925	909	917
Funding Rate	19%	19%	19%
Median Annualized Award Size	$133,191	$133,191	$133,191
Average Annualized Award Size	$171,016	$171,016	$171,016
Average Award Duration, in years	3.3	3.3	3.3

MOLECULAR AND CELLULAR BIOSCIENCES $109,750,000

The FY 2006 Request for the Division of Molecular and Cellular Biosciences (MCB) is $109.75 million, a decrease of $8.41 million, or 7.12 percent, over the FY 2005 Current Plan Level of $118.16 million.

Molecular and Cellular Biosciences Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Percent
Molecular and Cellular Biology	**$121.42**	**$118.16**	**$109.75**	**-$8.41**	**-7.1%**
Major Components:					
Research & Education Projects	$121.42	$118.16	$109.75	-$8.41	-7.1%

About MCB:

The Division of Molecular and Cellular Biosciences is organized into three clusters: Biomolecular Systems, Cellular Systems, and Genes and Genome Systems. In all these areas, analyses of complex processes requires multi-disciplinary research, involving not only biologists, but also physicists, chemists, mathematicians, computer scientists, and engineers. MCB actively pursues collaborations in all these areas. Research supported by MCB also contributes to the knowledge base and develops leading edge tools for research addressing questions at higher levels of biological organization, such as applications of genomics to studies of phylogeny and ecology.

The Biomolecular Systems cluster supports research at the interface of life science and physical sciences and includes the scientific themes of molecular biochemistry, biophysics, and metabolic pathways and networks. Development of cutting-edge technologies integrating theoretical, computational, and experimental approaches to the study of individual biological molecules and their functional complexes is a priority.

The Cellular Systems cluster supports research that addresses questions about how living cells are organized, how they communicate, and how they respond to internal and external signals. Areas supported include nanoscale studies of the structure, function, and assembly of cellular elements, such as the cytoskeleton, membranes, intracellular compartments, and eukaryotic and prokaryotic cell walls and envelopes. Cellular mechanisms underlying immune-like function in plants and diverse animals, particularly lower vertebrates and invertebrates, are also a priority.

The Genes and Genome Systems cluster supports studies of genomes and genetic mechanisms in all types of organisms. Areas of interest include genome organization, replication, recombination, repair, and vertical and lateral transmission of heritable information, as well as study of the processes that carry out and regulate gene expression such as transcription and translation of the information encoded in the genome. Although enhanced understanding in all these areas is of intrinsic value, it also has application in bio-based sectors of the economy, such as nanotechnology, and contributes to national security, particularly biosecurity.

In general, 42 percent of the MCB portfolio is available for new awards. The remaining 58 percent funds awards made in previous years.

MCB priorities for FY 2006:

Core Research: MCB funds pioneering research, especially studies of complex molecular and cellular systems and processes. Some of the activities represented in these areas of research include:

Research and Education at the Interface of Biology and the Physical Sciences: MCB core activities support research on the structure, dynamics, mechanisms of action, and control of the molecules that comprise the machinery of the living cell. In partnership with the divisions in the Directorate for Mathematics and Physical Sciences, MCB will continue to emphasize support for beginning investigators whose pioneering projects integrate research and education and so develop not only new knowledge, but a new generation of scientist-educators who bridge this interface.

Living Networks and Complex Processes: There is growing appreciation that the functions of living cells cannot be understood as a collection of individual, linear processes, but only when viewed as interacting and interdependent networks. MCB will give priority to theoretical, computational, mathematical modeling and simulation approaches in all areas of the molecular and cellular biosciences. Formulating and testing physical and mathematical models of the structure and function of living networks of complex molecules, metabolic pathways, and other exquisitely regulated cellular processes addresses one of the greatest computational challenges facing biology in the 21st century, creating multi-scale models that integrate our understanding of biological structure, function, and interactions at all levels into a predictive whole. From capturing and analyzing genome data to mathematically simulating complex networks of cellular signaling events, **Cyberinfrastructure** will play a key role.

Microbial Biology: Microbes make up most of the earth's biomass and are essential for the earth's functioning; yet except for the few that cause human disease we still know remarkably little about the vast majority of them. MCB will continue to give priority to research on microbes through its core activities. The establishment of a Microbial Biology emphasis in the Emerging Frontiers Subactivity recognizes the importance of this area of research, uniquely supported by NSF. Funds to support microbial observatories have been transferred to EF for this activity. Genome-enabled and biochemical approaches are being used to identify and characterize the metabolic machinery that enables the vast variety of microbes to populate every imaginable habitat on Earth.

Plant biology and the Arabidopsis 2010 Project: Unsolicited research supported by MCB led to the discovery of the value of *Arabidopsis thaliana* as a model flowering plant. The MCB Division will continue to make support for plant biology research, particularly research enabled by the availability of the complete genome sequence of *Arabidopsis* and directed toward a complete understanding of the functions of all *Arabidopsis* genes by the year 2010, a high priority.

Changes from FY 2005:

- Disciplinary and interdisciplinary research in the MCB core will decrease by $8.41 million. In part, this reflects the transfer of Microbial Observatories and Microbial Interactions and Processes research to the Emerging Frontiers Subactivity, but also reflects a real decrease in base funding.

INTEGRATIVE ORGANISMAL BIOLOGY $101,760,000

The FY 2006 Budget Request for the Division of Integrative Organismal Biology (IOB) is $101.76 million, a decrease of $1.74 million, or 1.68 percent, over the FY 2005 Current Plan Level of $103.50 million.

Integrative Organismal Biology Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Percent
Integrative Organismal Biology	**$107.29**	**$103.50**	**$101.76**	**-$1.74**	**-1.7%**
Major Components:					
Research & Education Projects	$103.34	$99.55	$97.81	-$1.74	-1.7%
Centers					
STC for Behavioral Neuroscience	$3.95	$3.95	$3.95	$0.00	0.0%

About IOB:

The Division of Integrative Organismal Biology is organized into four clusters: Behavioral Systems, Developmental Systems, Environmental and Structural Systems, and Functional and Regulatory Systems. Research supported by the IOB Division focuses on understanding the structure and function of organisms, with particular emphasis on the mechanisms by which organisms develop, behave, and respond to their environment. Understanding organisms requires integration of information across levels of analysis and stages of development and across phyla, environments, and evolutionary time. It can also require advanced computational techniques and interdisciplinary perspectives from other areas of biology, the physical sciences, mathematics, engineering, social sciences and computer science. An underlying theme is the development and use of a wide diversity of organisms to identify unifying principles common to all organisms and to understand the variety of adaptive mechanisms that have evolved in specific organisms.

The Behavioral Systems cluster focuses on the development, function, mechanisms, and evolution of behavior, biological rhythms, and interactions between organisms. This cluster supports research on social and reproductive behavior; behavioral ecology and physiology; neural and hormonal mechanisms of behavior; interaction between behavior and the immune system; and the biological bases of learning, cognition, and communication

The Developmental Systems cluster focuses on the nature, control, and evolution of those processes that comprise the life cycle of organisms. Research on the mechanisms of gametogenesis, fertilization, embryogenesis, differentiation, pattern formation, and morphogenesis, including research on the development, regeneration, and aging of the nervous system is supported. Genomic approaches, gene networks, integration of developmental gene pathways, and computational approaches are included.

The Environmental and Structural Systems cluster focuses on the function and evolution of organisms in their physiochemical and biotic environments. Included are studies of physiological ecology, functional

morphology, animal sensation and movement, molecular bases of tissue biomechanical properties, and environmental genomics.

The Functional and Regulatory Systems cluster focuses on fundamental physiological mechanisms and how they have evolved, with emphasis on organisms as integrated systems. This area includes comparative physiology, neurophysiology, mechanisms of solute transport, and comparative or evolutionary immunology.

In general, 52 percent of the IOB portfolio is available for new awards. The remaining 48 percent funds awards made in previous years.

IOB Priorities for FY 2006:

Core Research: Funds will be redirected from lower priority research areas, by reducing the number of awards across IOB to enhance funding in areas of pioneering research and complex processes. Highest priority will be placed on the following areas:

Integrative Studies on Organisms: IOB will place highest priority on integrative studies that lead to a deeper understanding of the underlying principles, mechanisms, and processes in the behavior, development, physiology, and evolutionary fitness of organisms. Studies that combine the use of genomics, proteomics, cellular, biochemical, computational, and/or physiological approaches will be highlighted.

Integration of Developmental Biology and Evolutionary Physiology: Developmental biologists have, for many years, focused their efforts in understanding ontogeny by focusing on a relatively small number of "model" organisms, while physiologists have employed a broad array of study systems, each selected for its suitability to address a specific physiological mechanism. Research employing genomics, analytics, and phenomics to produce a conceptual, analytical and methodological synthesis of these two disciplines will also be a priority because it will lead to understanding how developmental and physiological systems are integrated and how complex phenotypes are built.

Genetic/Cellular Basis for Behavior: The integration of the ability to identify the activity of individual genes active in specific neurons, with the ability to identify and examine neural networks in a variety of organisms will allow the focusing of research on the genetic/cellular basis for behavior. Research in this area will examine how the activation of specific genes in individual neurons results in specific behaviors.

Changes from FY 2005:

- Disciplinary and interdisciplinary research in the IOB core will decrease by $1.74 million. Fewer awards will be made in all core areas.

ENVIRONMENTAL BIOLOGY $107,180,000

The FY 2006 Request for the Division of Environmental Biology (DEB) is $107.18 million, an increase of $1.14 million, or 1.08 percent, over the FY 2005 Current Plan Level of $106.04 million.

Environmental Biology Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Environmental Biology	**$107.94**	**$106.04**	**$107.18**	**$1.14**	**1.1%**
Major Components:					
Research & Education Projects	$89.17	$85.04	$85.83	$0.79	0.9%
Centers Program					
Long Term Ecological Research	$15.62	$17.53	$17.53	$0.00	0.0%
National Center for Ecological Analysis and Synthesis	$3.15	$3.47	$3.82	$0.35	10.0%

About DEB:

The Division of Environmental Biology is organized into four clusters: Ecological Biology, Ecosystem Science, Population and Evolutionary Processes, and Systematic Biology and Biodiversity Inventories. DEB supports fundamental research to inventory life on earth, to discover life's origins and evolutionary history, and to understand the dynamics of biological populations, communities and ecosystems, including their complex interactions, which result in goods and services that humans require (e.g., breathable air, potable water, food and fiber, crop pollination). Studies supported by DEB clusters accelerate the rate at which we discover new species; address the genealogical relationships of plants, animals, fungi, and microbes; elucidate the spatial and temporal dynamics of species interactions (e.g., competition, predation); discover the principles or rules by which species are assembled into functional communities and change through time; and determine the flux of energy and materials through ecosystems.

The Ecological Biology Cluster supports research on natural and managed ecological systems, primarily in terrestrial, wetland, and freshwater habitats. Research areas include experimental, observational, theoretical, and modeling studies on the structure and function of complex associations that focus on biotic components, and the coupling of small-scale systems to each other and to large-scale systems.

The Ecosystem Science Cluster supports research on natural, managed, and disturbed ecosystems, including those in terrestrial, freshwater, and wetland (including salt marsh) environments. Descriptive and manipulative approaches in field, mesocosm, and laboratory settings are supported, with the expectation that the bulk of the research is question- or hypothesis-driven.

The Population and Evolutionary Processes Cluster focuses on population properties that lead to variation within and among populations. Approaches include empirical and theoretical studies of microevolution, organismal adaptation, geographical differentiation, natural hybridization and speciation, as well as processes that lead to macroevolutionary trait patterns.

The Systematic Biology and Biodiversity Inventories Cluster supports the general science of systematics, whose three main missions are: to discover, describe, and inventory global species diversity; to analyze and synthesize the information derived from this global discovery effort into predictive classification systems that reflect the history of life; and to organize the information derived from this global program in efficiently retrievable forms that best meet the needs of science and society.

In addition, the LTER Program in the Ecosystem Science Cluster, which was founded in 1980 and is jointly funded by BIO, GEO and OPP, is a network of 26 comprehensive research sites ranging from Alaska, throughout the continental US and Puerto Rico, to Antarctica, in ecosystems broadly representative of the global range. Although most LTER sites focus on near pristine terrestrial ecosystems, the network also includes urban and agricultural sites, coastal estuaries, and near-coastal oceans (including a coral reef site in the South Pacific). A Network Office coordinates network information systems and cross-site communication, as well as education, outreach, and international activities, while promoting an open access data policy that facilitates synthesis. All LTER projects share five common research themes that facilitate multi-site comparisons and encourage interdisciplinarity. Over 1200 scientists and students participate in the LTER program.

In general, 56 percent of the DEB portfolio is available for new awards. The remaining 44 percent funds awards made in previous years.

DEB priorities for FY 2006:

Core Activities: DEB supports research that addresses a continuum of questions ranging from evolutionary processes to ecosystem services, consistent with present community strengths; anticipated needs to catalyze future research; and developments in cyberinfrastructure. In essence, DEB supports studies of "What is there … how did it originate … how does it function … and how do the parts interact to form an integrated whole?" So that the information generated by these investigations is transformed to knowledge – within the scientific community and throughout the citizenry – DEB places a high priority on integrating research and education through activities that engage individuals at all levels from "K to gray."

Education and Outreach: DEB will continue to place a premium on outstanding education and outreach efforts that are coupled to research projects. DEB support will emphasize broad career horizons, experiential learning, and biosphere literacy, which prepare people to understand and apply information about the biosphere in daily life, at home, at work, and in the community. The historic levels of support for CAREER grants, Doctoral Dissertation Improvement Grants, and Research Experiences for Undergraduates will be maintained. DEB will maintain funding for the LTER Schoolyard Science activity to enhance engagement of students in the primary and secondary schools.

Complex Systems: DEB-supported activities will continue to focus on what NSF supports uniquely, or uniquely well. In this context, DEB will emphasize support for research on complex ecological and evolutionary systems, in particular research on aquatic or watershed systems that highlights emergent properties and forecasting capabilities. In supporting studies in such areas as biogeography, systematic biology, microbial ecology, and invasive species, particular emphasis will be given to quantitative understanding of the complex interrelationships between biological diversity, evolutionary processes, and ecosystem functioning. These efforts will depend on biological infrastructure such as advanced instrumentation and research collections.

Cyberinfrastructure: Special emphasis will be given to leveraging new cyberinfrastructure capabilities, developing partnerships with the informatics and computer sciences community, and bringing innovative tools into the arsenal of environmental biologists. These investments arise from the initial support from the ITR program, and are particularly evident in DEB centers: the LTER site network and NCEAS.

Disturbance Ecology: DEB will maintain support for disturbance ecology, emphasizing how such human activities as deforestation, habitat fragmentation, and species introductions affect the dynamics of biological systems, and subsequently alter the biological services that arise from those systems.

Long Term Ecological Research (LTER): This Program will continue to support site-based integrated research and educational activities that focus on five core areas: pattern and control of primary production; spatial and temporal distribution of populations selected to represent trophic structure; pattern and control of organic matter accumulation in surface layers and sediments; patterns of inorganic input and movement of nutrients through soils, ground water, and surface waters; and patterns and frequency of disturbance. The program includes emphases on cross-site collaborations, as well as the development of cyberinfrastructure capabilities for data management, visualization, and analysis.

Changes from FY 2005:

- Disciplinary and interdisciplinary research in the DEB core will increase by $790,000. This additional support and additional funds redirected from other activities will be allocated to the areas of complex ecological and evolutionary systems, with special emphasis on research that focuses on aquatic and watershed systems. This will include species discovery and phylogenetic relationships of organisms; the dynamics of freshwater and estuarine populations, communities and ecosystems; and theoretical and modeling studies that integrate the drivers, indicators and responses of water-based biological systems.
- National Center for Ecological Analysis and Synthesis: Synthetic and transformative research supported by this Center will be augmented by $350,000. The Center primarily supports research at the frontiers of population biology, ecology, and ecosystem science. The strong emphasis on quantitative, analytical, and broad scale research will continue to explore the intricacies of complex environmental systems, as well as strengthen multidisciplinary studies of relevance to natural resource management and conservation.

BIOLOGICAL INFRASTRUCTURE $82,930,000

The FY 2006 Budget Request for the Division of Biological Infrastructure (DBI) is $82.93 million, an increase of $2.31 million, or 2.86 percent, over the FY 2005 Current Plan Level of $80.62 million.

Biological Infrastructure Funding

(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Research Resources	$49.10	$49.32	$51.32	$2.00	4.1%
Human Resources	$31.58	$31.30	$31.61	$0.31	1.0%
Biological Infrastructure	**$80.68**	**$80.62**	**$82.93**	**$2.31**	**2.9%**
Major Components:					
Research & Education Projects	$75.98	$73.47	$75.73	$2.26	3.1%
Facilities					
National Nanotechnology Infrastructure Network	$0.30	$0.40	$0.40	$0.00	0.0%
National Ecological Observatories Network	$3.60	$5.95	$6.00	$0.05	0.8%
Cornell High Energy Synchrotron Source	$0.80	$0.80	$0.80	$0.00	0.0%

About DBI:

The Division of Biological Infrastructure is organized into two clusters: Research Resources and Human Resources. DBI's goal is to ensure that all biologists have access to the infrastructure required for both disciplinary and interdisciplinary research. Resources supported range from physical infrastructure, such as multi-user instrumentation, to research training for students at all levels. In addition, teams of biologists, mathematicians, physicists, chemists, computer scientists, and engineers are supported to develop new biological research tools such as software, new algorithms, and novel instrumentation.

The Research Resources cluster supports planning for the proposed National Ecological Observatories Network (NEON); instrument procurement and development; maintenance and improvement of living stock collections of microbes, plants and animals; development of biological databases and informatics tools; and enhancements to biological research collections. Research resource development for the Arabidopsis 2010 project is supported as well. These research resources are essential for cutting-edge biological research.

The Human Resources cluster supports a range of activities with the goal of nurturing the next generation of biologists. Projects supported are designed to meet NSF's goals of integrating research and education and broadening participation. This cluster also manages BIO's participation in the NSF-wide human resource development programs, i.e. REU sites, IGERT, ADVANCE, and GK-12.

In general, 68 percent of the DBI portfolio is available for new awards. The remaining 32 percent funds awards made in previous years.

DBI Priorities for FY 2006:

Research Resources

Instrumentation Resources: DBI supports three instrumentation programs: (1) Instrument Development for Biological Research (IDBR); (2) Multi-User Equipment (MUE) for biological research; and (3) improvement of Field Station and Marine Laboratories (FSML). In FY 2006 funding for IDBR and FSML will be maintained at FY 2005 levels. Additional resources will be redirected from instrumentation activities to biological databases and informatics to support cyberinfrastructure needs in biology.

Biological Databases and Informatics (BD&I): Biological research collection improvement and computerization, research on curatorial and collection management techniques, and community-based development activities are supported. In FY 2006 DBI will place a high priority on networking collection databases.

Biological research collections (BRC): BRC supports natural history collections archived at museums, botanical gardens, field stations, and academic institutions that are widely used for biological research and education. DBI will place a highest priority on networking of the collection databases.

Living stock collections (LSC): LSC supports repositories of research organisms, genetic stocks, seeds, cell lines and DNA clones that are associated with whole organisms in a collection. Funds are also provided for curatorial databases and for linking the information associated with a collection to other information resources or scientific databases. DBI gives highest priority to those resources most frequently used by the NSF-BIO community.

Arabidopsis 2010 Project: The Arabidopsis 2010 Project is a BIO-wide activity whose goal is to determine the function of all *Arabidopsis* genes by 2010. DBI supports 2010 projects that build community research resources such as collections of full-length cDNA clones and a large collection of *Arabidopsis* mutants.

National Ecological Observatories Network (NEON): NEON will be a continental scale research instrument consisting of geographically distributed infrastructure, networked via state-of-the-art communications. NEON will transform the conduct of ecological research and our ability to predict environmental change by enabling real-time ecological studies, spanning all levels of biological organization, on major environmental challenges at regional to continental scales. In FY 2006, planning for NEON implementation will continue.

Human Resources

Postdoctoral Research Fellowships: In FY 2006, BIO will focus on two fellowship programs: (1) Minority Postdoctoral Research Fellowships, and (2) Biological Informatics Postdoctoral Research Fellowships.

Undergraduate Mentoring in Environmental Biology (UMEB): UMEB supports 5-year projects designed to engage undergraduates, especially from under-represented groups, in year-round research and sustained mentoring activities. This program, which is run every other year, will be offered in FY 2006.

Cross-disciplinary Research at Undergraduate Institutions (C-RUI): This program for predominantly undergraduate institutions supports cross-disciplinary research that involves biologists and researchers from at least one other discipline. CRUI is offered in alternate years with UMEB.

Research Experience for Undergraduates (REU) sites: Support for REU sites continues to be a high priority, particularly since the program has provided opportunities for participation of students from underrepresented groups in innovative and novel ways, e.g. through collaborations between community colleges and research institutions.

Changes from FY 2005:

- Research Resources will increase by $2.0 million. Funds will be redirected from other activities in research resources to increase the informatics and database activities by $7.0 million.

- NEON will increase by $50,000 for a total of $6.0 million. The ongoing planning process for NEON will continue. As part of that process, specific technical needs are being identified for building NEON. Robust cyberinfrastructure has emerged as a key.

- Human Resources will increase by $310,000. Stipends for REU students and Postdoctoral fellows will increase to $400 per week and $45,000 per year, respectively. The participation of under-represented groups and under-served communities on BIO-supported research projects will be enhanced by making Research Opportunities for Community College Faculty supplements to BIO awardees.

EMERGING FRONTIERS $85,930,000

The FY 2006 Budget Request for the Emerging Frontiers (EF) Subactivity is $85.93 million, an increase of $11.88 million, or 16.0 percent, over the FY 2005 Current Plan Level of $74.05 million.

Emerging Frontiers Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Emerging Frontiers	**$80.25**	**$74.05**	**$85.93**	**$11.88**	**16.0%**
Major Components:					
Research & Education Projects	$80.25	$70.45	$82.93	$12.48	17.7%
Centers Program					
Center for Synthesis in Biological Evolution	$0.00	$3.60	$3.00	-$0.60	-16.7%

About EF:

The Emerging Frontiers Subactivity is an incubator for 21st Century Biology. EF supports pioneering research and networking activities that arise from advances in disciplinary research. By encouraging synergy among disciplines using project, network and centers models, Emerging Frontiers fosters new initiatives and catalyzes research at the boundaries of disciplines, which are subsequently integrated into core programs. In FY 2005 for example, the Research Coordination Networks program, after a three-year growth and development period within EF, was mainstreamed into BIO disciplinary programs. EF includes BIO-initiated multidisciplinary programs, programs that contribute to Homeland Security goals, as well as the NSF priority areas (Nanoscale Science and Engineering, Mathematical Sciences, Human and Social Dynamics, and Biocomplexity in the Environment). EF supports activities that broaden the participation of underrepresented groups in EF research and networking programs, thereby ensuring that the widest array of individuals and institutions participate in EF pioneering activities.

In general, 75 percent of the EF portfolio is available for new awards. The remaining 25 percent funds awards made in previous years.

EF priorities for FY 2006:

Microbial Biology: In FY 2006, a new emphasis on microbial biology at all levels from the molecular to the ecological will be established within EF. While microbial research has long been supported across the biological sciences, and will continue to be supported within core programs, some activities are being transferred from MCB to EF to form components of the new emphasis area. Included in the emphasis area will be microbial genome sequencing, microbial observatories, microbial interactions and processes, and other microbial research and training activities.

> **Microbial Genome Sequencing Program:** Microbial genome sequence data provide basic information about named microbial species and clues to the identity and function of microbes, newly isolated from nature or introduced by human agents. In FY 2006 the Microbial Genome

Sequencing Program, conducted jointly with the USDA CSREES competitive grants program, will continue support for microbial genome sequencing and will support experimental approaches and the development of tools to examine novel microbial sequences.

Microbial Observatories and Microbial Interactions and Processes Program: Microbial Observatories and Microbial Interactions and Processes funds researchers to enhance our understanding of the microbial world by using leading edge tools such as microbial genome sequence data.

Assembling the Tree of Life: Theoretically, all life from microbes to humans can be connected through phylogenetic relatedness to form a single, vast evolutionary *Tree of Life*. With support from EF, multidisciplinary teams of informaticians, mathematicians, and biologists, using advanced cyber tools as well as museum, molecular, and digital databases, will continue to tackle the enormous computational and scientific hurdles that must be overcome in Assembling the Tree of Life (AToL). If successful, the results of these efforts will be useful in agriculture, biomedicine, environmental management and other areas that rely on the comparative approach or model organisms.

Environmental Genomics: Understanding the complex biological processes that drive environmental systems requires multidisciplinary teams using the latest approaches and tools. In FY 2006, a partnership between BIO, GEO and OPP will bring the power of genomics to bear on important environmental topics such as relationships between nutrient cycling and ecological dynamics, population genetics, ecosystem structure and productivity; the evolution of species and changes in biodiversity; and ecosystem vulnerability and resilience to extreme events.

Ecology of Infectious Diseases Program: This program, jointly conducted with the NIH, continues to support efforts to understand the ecological and biological mechanisms that govern relationships between human-induced environmental changes and the emergence and transmission of infectious diseases. The potential benefits of findings from this program include: development of disease transmission theory, increased capacity to forecast disease outbreaks, and improved understanding of how diseases emerge and re-emerge.

Frontiers in Integrative Biological Research: FIBR continues support for research on major biological questions that are addressed using the creative application of a broad range of strategies and research tools from within and outside the biological sciences. FIBR projects encompass multiple levels of organization of complexity, time and space, or range of organisms or processes, use combined experimental and theoretical analyses; and apply a broad range of interdisciplinary approaches in a single, coherent effort.

Center for Synthesis in Biological Evolution: This center was first established in FY 2005 with funding through FY 2009. In FY 2006, it will continue to develop new tools and cross-disciplinary standards for management of biological information, support data analysis capabilities, host workshops, and begin to host and curate databases that are important for evolutionary synthesis.

Broadening Participation: BIO will strive to engage and broaden the participation of individuals from groups traditionally underrepresented in the biological sciences by providing planning grants for early career researchers, and funding career advancement awards to mid-career researchers to promote their professional development and retention in the biological sciences. Linkages between programs in BIO and programs in EHR such as CREST, AGEP, and LSAMP will be enhanced.

Changes from FY 2005:

- Center for Synthesis in Biological Evolution: The decrease in funding level to $3.0 million, or $600,000 less than FY 2005 reflects a shift from covering start-up costs to the day-to-day research and educational activities of the Center.
- Nanoscale Science and Engineering: Funding will decrease by $2.0 million to $3.85 million in FY 2006. BIO will emphasize research on nanoscale sensors and information processors that could provide new tools for understanding detection of environmentally important signals.
- Microbial Observatories and Microbial Interactions and Processes: Funding in FY 2006 will be $12.21 million to support projects that employ the latest genomic and leading edge tools to study microbes in their natural habitats.
- Broadening Participation: Support for research planning grants and career advancement awards will increase by $1.0 million to a total of $4.0 million. Further connections between BIO and EHR will be forged.
- Frontiers in Integrative Biological Research: The additional $1.27 million will allow BIO to make more of these complex, multi-disciplinary research grants and planning grants. FIBR grants have a longer duration and are funded at a higher average annual award size than many core research grants in order to facilitate these new approaches to major biological questions. Total funding is $20.0 million.

PLANT GENOME RESEARCH $94,240,000

The FY 2006 Budget Request for the Plant Genome Research (PGR) Subactivity is $94.24 million, equal to the FY 2005 Current Plan Level.

Plant Genome Research Funding
(Dollars in Millions)

	FY 2004 Actual	FY 2005 Current Plan	FY 2006 Request	Change over FY 2005 Amount	Change over FY 2005 Percent
Plant Genome Research	**$89.47**	**$94.24**	**$94.24**	**$0.00**	**0.0%**
Major Components:					
Research & Education Projects	$53.47	$58.24	$58.24	$0.00	0.0%
Virtual Centers	$36.00	$36.00	$36.00	$0.00	0.0%

About PGR:

The Plant Genome Research Subactivity was initiated in FY 1998, building upon an existing base of genome research supported throughout the BIO Directorate. PGR supports projects that make significant contributions to our understanding of plant genome structure and function. Emphasis is placed on plants of economic importance, as well as plant processes of potential economic value. Long-term benefits of this research include fundamental breakthroughs in our understanding of plant biology and practical applications to crop improvement, and the development of novel, plant-based products.

The program was established as part of the National Plant Genome Initiative (NPGI). NSF plays a major role in the NPGI. Other participating agencies include USDA, DOE, NASA, USAID, and NIH. The NSF program follows the guidelines and objectives of the NPGI. PGR works closely with the other agencies in coordinating funding activities through the Interagency Working Group on Plant Genomes under the auspices of the National Science and Technology Council within OSTP, and by jointly sponsoring activities ranging from genome sequencing projects to workshops.

PGR has supported two general kinds of projects, one to develop research infrastructure that would enable a broad community of scientists to participate in plant genome research and the other to understand the structure, organization and function of plant genomes using an integrative approach. Informatics and education/training are integral to both of these projects. Accomplishments and progress by plant genome funded researches on both fronts include:

- Sequenced the whole genome of a reference grass species (rice) and a reference dicotyledonous species (Arabidopsis);
- Determined the most efficient strategy to sequence the maize genome and began projects to sequence the entire maize genome;
- Deposited over 3 million Expressed Sequence Tags (ESTs) to genes from economically important plants in GenBank, the majority from Plant Genome Research Program projects;
- Established efficient maize transformation methods;

- Developed a novel tool (TILLING) to identify collections of mutations in any gene in any plant, applied to 16 plant species, and utilized in 6 countries including the TILLING facility at IRRI (the International Rice Research Institute) in the Philippines;
- Developed a high-throughput screen for finding mutations that affect the structure of plant cell walls and a collection of monoclonal antibodies to identify every chemical component of those walls;
- Sequenced the genomes of two important plant pathogens (a causal agent of potato blight and rice blast) and applying the information to understanding how the pathogen establishes the initial infection process and how the plant fights against it;
- Continued discovery of new genes involved in plant processes of economic importance, including disease resistance, stress tolerance, and floral development;
- Established a new kind of genome database for plants, called PlantGDB, which will point the way to the future, where plant genome data will be presented in an integrated and cross-referenced form;
- Established two centers to develop microarrays, data analysis tools, and a community database for rice and maize gene expression analysis; and
- Increased understanding of the domestication processes of major crop species from their wild relatives.

Plant species being studied cover about 20 economically important plants ranging from apple to wheat, including all major food, forage, fiber and wood crops.

In general, 32 percent of the PGR portfolio is available for new awards. The remaining 68 percent funds awards made in previous years.

PGR priorities for FY 2006:

PGR will place priorities on projects that build on research resources, tools and information accumulated over the last six years.

Continue Support for Maize Genome Sequencing: PGR will continue to support the interagency maize genome-sequencing project that began in FY 2005. Maize is the most economically important crop in the U.S. From a scientific standpoint, the maize genome when completed will become the most complex eukaryotic genome to be sequenced to date, including the human genome. This sequencing project was made possible because of earlier investments by PGR to understand the structure and organization of the maize genome as well as to develop the best sequencing strategies.

Understanding Complex Plant Processes of Economic Importance: The research community has become increasingly able to answer long-standing major questions in plant biology because of the new tools and information resulting from PGR activities. A new focus of the program will be on increased understanding of the fundamental mechanisms underlying complex plant processes of economic importance beyond merely identifying genes involved in the process. Such projects of high economic importance would include: (1) formation of specialized plant structure such as tubers and bulbs; (2) assembly of softwood and hardwood; (3) efficiency in water utilization by plants; (3) uptake of nutrients from the soil; (4) biosynthesis of organelles such as chloroplasts, mitochondria, and peroxisomes; (5) complex interactions between plants and other organisms; and (6) determination of photosynthetic rate.

Plant Genomics Data Management: Enormous amounts of data on many different aspects of plant genomics are flooding cyberspace. It is critical that seamless ways for biologists to access and make use of the data by biologists be developed. Two major focus areas will be databases and informatic tools. Specific issues associated with databases are the long-term curation and maintenance, interoperability among databases, and accessibility. Informatics tools are needed for the community to make maximum use of data in the databases. 21st Century Biology requires that scientists be able to interrogate existing data in order to make conceptual advances based on the analysis and synthesis of that data.

Research Collaboration with Scientists in Developing Countries: PGR will continue to support research collaboration between US scientists and scientists in developing countries with a focus on plant genomics and plant biotechnology. The activity began in FY 2004, and is coordinated with OISE at NSF as well as USAID. The intent of this activity is to support collaborative research linking US researchers with partners from developing countries to solve problems of mutual interest in agriculture, energy and the environment. It will place US and international researchers at the center of a global network of scientific excellence. Thus far, PGR has supported research collaboration with scientists from Mexico, Peru, Indonesia, Philippines, Nepal, India, and several African nations.

Virtual Centers: Virtual centers are PGR awards that involve multiple investigators from multiple institutions. They can be research projects or infrastructure building projects. Coordination of management of the outcomes of research, broadening participation of under-represented and under-served groups, training of the next generation of scientists, and outreach to K-12 teachers and students are emphasized.

Changes from FY 2005:

The FY 2006 Request is equal to the FY 2005 Current Plan. Budget allocation among various research projects will be made based on merit review of competing proposals. The only administrative change expected in FY 2006 is that PGR will limit the number of proposals a single investigator can submit to PGR per competition, in an effort to broaden participation of scientists and institutions from all segments of the US scientific community.