



Directorate for Biological Sciences (BIO)



The Directorate for Biological Sciences (BIO) promotes and advances scientific progress in biology, largely through grants to colleges, universities, and other institutions, especially in those areas where the National Science Foundation (NSF) has major responsibility. NSF is the Nation's principal supporter of fundamental academic research on plant biology, environmental biology, and biodiversity. It provides support for research to advance understanding of the underlying principles and mechanisms governing life. Research ranges from the study of the structure and dynamics of biological molecules, such as proteins and nucleic acids, to studies of

cells, organs, and organisms and to studies of populations and ecosystems. NSF encompasses processes that are internal to an organism and those that are external and includes temporal frameworks ranging from measurements in real time through individual life spans to the full scope of evolutionary time.

In addition to the research and infrastructure support mentioned in this chapter, the Directorate for Biological Sciences takes an active role in numerous crosscutting programs and activities. Support is provided for active research participation grants for high school students: Research Assistantships for Minority High School Students (see <http://www.nsf.gov/bio/progdes/nsf8939.htm>); for undergraduates: Research Experiences for Undergraduates (see <http://www.nsf.gov/home/crssprgm/reu/start.htm>) and Undergraduate Mentoring in Environmental Biology (see NSF 03-585); and for faculty from K-12: Research Experiences for Teachers (see NSF 02-090), and from predominantly undergraduate institutions: Research Opportunity Awards (see <http://www.nsf.gov/bio/progdes/roasupps.htm>).

Funds are also provided for the early development of academic faculty as both educators and researchers through programs such as Faculty Early Career Development (see <http://www.nsf.gov/bio/progdes/CAREER.htm>), research conferences, symposia, workshops, and—in selected areas—doctoral dissertation improvement grants (see <http://www.nsf.gov/bio/progdes/bioddig.htm>).

Funds are available through the ADVANCE program to increase the representation and advancement of women in academic science and engineering careers, thereby contributing to the development of a more diverse science and engineering workforce (see NSF 02-121 for more information).

Information on many of the programs listed here is available on the NSF Crosscutting Programs home page, <http://www.nsf.gov/home/crssprgm>. Information is also available by referring to the alphabetical listing of programs on the BIO Directorate Programs and Deadlines Web site, <http://www.nsf.gov/bio/programs.htm>; or visit the BIO Directorate home page, <http://www.nsf.gov/bio>.

The BIO Directorate supports proposals and activities through the following administrative units:

- [Division of Biological Infrastructure \(DBI\)](#)
- [Division of Environmental Biology \(DEB\)](#)
- [Division of Integrative Biology and Neuroscience \(IBN\)](#)
- [Division of Molecular and Cellular Biosciences \(MCB\)](#)
- [Plant Genome Research Program](#)
- [Emerging Frontiers \(EF\)—BIO's Virtual Division](#)

Eligibility Requirements for BIO Proposals

The most frequent recipients of support for basic scientific research in the biological sciences are academic institutions and nonprofit research organizations. In special circumstances, grants are awarded to other types of institutions and to individuals. In these cases, preliminary inquiry should be made to the appropriate program officer before a proposal is submitted. Support may be provided for projects involving a single scientist or a number of scientists. Awards are made for projects confined to a single disciplinary area and for those that cross or merge disciplinary interests.

Multiple Principal Investigator [PI] Proposals

Increasingly, many important research problems in science can be addressed best by a team of investigators, each bringing different perspectives to the activity. A team approach may result in the application of novel techniques to biological questions or a more comprehensive treatment of scientific problems, and may also provide innovative opportunities for the training of students.

The NSF Directorate for Biological Sciences encourages proposals from three or more investigators—who may come from more than one academic institution—for collaborative studies focused on a single problem. Such proposals will be evaluated through BIO's core programs, in addition to proposals from individual investigators, as part of the programs' portfolio of activities. Investigators interested in submitting a multi-PI proposal may contact the appropriate BIO program for further advice and guidance.

Submission of Proposals to the BIO Directorate

All proposals directed to NSF must be submitted through NSF's FastLane system. For details about this policy, see the latest NSF *Grant Proposal Guide* (see <http://www.nsf.gov/cgi-bin/getpub?gpg> for latest version). General information about FastLane is available at <http://www.fastlane.nsf.gov>.

Incoming proposals are assigned to program officers within the BIO Directorate for merit review and recommendation. Research with disease-related goals, including work on the etiology, diagnosis, or treatment of physical or mental disease, abnormality, or malfunction in human beings or animals, is normally not supported. Animal models of such conditions or the development and testing of drugs or other procedures for their treatment also are not eligible for support.

Research proposals to the BIO Directorate (not including proposals for conferences or workshops) cannot be duplicates of proposals to any other Federal agency for simultaneous consideration. The only exceptions to this rule are (1) when the proposers and program managers at relevant Federal agencies have previously agreed to joint review and possibly joint funding of the proposal and (2) proposals from PIs who are beginning investigators (individuals who have not been a PI or co-PI on a federally funded award with the exception of a doctoral dissertation, a postdoctoral fellowship, or research planning grants). For proposers who qualify under the latter, the box for "Beginning Investigator" must be checked on the proposal cover sheet.

Deadlines and Target Dates

In most cases the BIO Directorate has established deadlines and target dates for the submission of proposals. To confirm a date, refer to the electronic NSF *E-Bulletin*, <http://www.nsf.gov/home/ebulletin>; or visit the BIO Directorate home page, <http://www.nsf.gov/bio>; or contact the appropriate program director. The earliest possible effective date for an award is approximately 6 months after the target or deadline date. Unless there is a program solicitation stating otherwise, proposals must conform to all format requirements in the NSF *Grant Proposal Guide* (see <http://www.nsf.gov/cgi-bin/getpub?gpg> for latest version), with special attention paid to page limitations, font size, and appendix materials. Some programs or specific competitions have program announcements/solicitations that provide more details about the activities described in this guide.



DIRECTORATE FOR BIOLOGICAL SCIENCES

Division of Biological Infrastructure

The Division of Biological Infrastructure (DBI) supports activities that provide the infrastructure for contemporary research in biology.

DBI supports research through the following clusters:

- [Instrument-Related Activities](#)
- [Research Resources](#)
- [Training](#)

For More Information

Write to the Division of Biological Infrastructure, National Science Foundation, 4201 Wilson Boulevard, Room 615, Arlington, VA 22230; or contact the division by telephone, 703-292-8470; or visit the DBI home page, <http://www.nsf.gov/bio/dbi/start.htm>.

• Instrument-Related Activities Cluster

The Instrument-Related Activities Cluster is located within the Division of Biological Infrastructure and includes the following areas:

1. [Multi-User Biological Equipment and Instrumentation Resources](#)
2. [Instrument Development for Biological Research](#)
3. [Improvements in Facilities, Communications, and Equipment for Research at Biological Field Stations and Marine Laboratories](#)

This cluster also manages biology-related proposals submitted to the Major Research Instrumentation (MRI) Program. MRI is administered by the NSF Office of Integrative Activities (<http://www.nsf.gov/od/oia/start.htm>). See the *MRI Program Announcement (NSF 04-511)* for further details.

For More Information

Visit the cluster's Web site, http://www.nsf.gov/bio/dbi/dbi_instrument.htm.

1. Multi-User Biological Equipment and Instrumentation Resources

Provides cost-shared support for the acquisition of major items of specialized multi-user instrumentation, thereby providing access to state-of-the-art instruments. The instrumentation must be used in the conduct of research that falls within the purview of the BIO Directorate. The institution is required to share the capital cost.

- **Research at Undergraduate Institutions (RUI) Proposals for Multi-User Biological Equipment and Instrumentation Resources**—The Multi-User Biological Equipment and Instrumentation Resources Program (see program announcement [NSF 98-137](#)) accepts proposals through the RUI Program (see program announcement [NSF 00-144](#)). The Multi-User Biological Equipment Program requires that one of the principal investigators be actively receiving NSF funding for research. NSF recognizes that research in NSF-funded areas at RUI institutions is often supported by other sources. Therefore, for RUI institutions, the program makes an exception to the requirement for active NSF research funding provided that (1) the user group is conducting research in NSF-supported subject areas and (2) the user group is able to show adequate research support from other funding sources (such as private foundations or institutional research support) to support the proposed research activities.

2. Instrument Development for Biological Research

Supports the development of new instrumentation to increase the accuracy, range, or sensitivity of observations for BIO research fields, including development of concept and proof of concept for entirely new instruments; development of new instruments that will provide new capabilities or significantly extend currently achievable sensitivity or resolution; and development of improved or novel software for the operation of instruments or the analysis of data or images. For more information, see program announcement [NSF 98-119](#).

3. Improvements in Facilities, Communications, and Equipment for Research at Biological Field Stations and Marine Laboratories

Biological Field Stations and Marine Laboratories (FSMLs) are off-campus facilities for research and education conducted in the natural habitats of terrestrial, freshwater, and marine ecosystems. FSMLs support biological research and education by preserving access to study areas and organisms, providing facilities and equipment in close proximity to those study areas, and fostering an atmosphere of mutual scientific interest and collaboration in research and education. To fulfill these roles, FSMLs must offer modern laboratories and educational spaces, up-to-date equipment, appropriate personal accommodations for visiting scientists and students, and modern communications and data management systems for a broad array of users. In recognition of the importance of FSMLs in modern biology, NSF invites proposals that address these general goals of FSML improvement. For more information, see program guideline [NSF 02-040](#).

• Research Resources Cluster

The Research Resources Cluster is located within the Division of Biological Infrastructure and consists of the following:

1. [Biological Databases and Informatics](#)
2. [Support of Living Stock Collections](#)
3. [Biological Research Collections](#)

For More Information

Visit the cluster's Web site, <http://www.nsf.gov/bio/dbi/dbiresearch.htm>.

1. Biological Databases and Informatics (BDI)

Encourages support of new approaches to the management of biological knowledge that render the collection, maintenance, dissemination, and query of the data and information therein of greater use to the scientific community. For more information, see program announcement [NSF 02-058](#).

In addition to the BDI Initiative, the National Science Foundation and the National Institutes of Health signed a Memorandum of Understanding in fiscal year 2003 to participate in a new program, Tools for Collaborations that Involve Data Sharing. The program invites proposals to develop tools and techniques to harness the unprecedented volume of data generated by collaborations among researchers. Further information about the program is available at <http://www.nsf.gov/bio/progdes/nsfnihtools.htm>.

2. Support of Living Stock Collections

Supports repositories of research organisms, genetic stocks, and seeds, as well as cell lines and DNA clones that are associated with the whole organisms in the collection. The resources supported through this activity are considered essential for national or international scientific research in the biological sciences. Funds are also provided for curatorial databases and for linking the information associated with the collection to other information resources or scientific databases. Long-term support of a collection or repository will require the development and use of such databases. For more information, see program announcement and guidelines [NSF 97-80](#).

3. Biological Research Collections

Supports collection improvement; computerization of specimen-related data; research on curatorial and collection management techniques; and activities such as symposia and workshops to discuss subjects that enhance collections availability and utilization by the research community. For more information, see program announcement [NSF 03-566](#).

• Training Cluster

The Training Cluster is located within the Division of Biological Infrastructure and supports training-related activities. It consists of the following:

1. [Research Experiences for Undergraduates Sites](#)
2. [Undergraduate Mentoring in Environmental Biology](#)
3. [Collaborative Research at Undergraduate Institutions](#)
4. [Integrative Graduate Education and Research Training](#)
5. [Postdoctoral Research Fellowships](#)



For More Information

Visit the cluster's Web site, <http://www.nsf.gov/bio/dbi/dbitraining.htm>.

1. Research Experiences for Undergraduates (REU) Sites

This Foundation-wide program provides opportunities for undergraduate students to experience hands-on participation in research and related scholarly activities. BIO provides support to grantees who involve students in special training programs and ongoing research through the REU Sites and Supplements Program. For more information, see program announcement [NSF 03-577](#).

2. Undergraduate Mentoring in Environmental Biology (UMEB)

The UMEB Program is designed to enable institutions to create innovative programs that will encourage undergraduate students—especially those from underrepresented groups—to pursue a career in environmental biology. UMEB supports projects designed to engage undergraduate students in year-round research activities and to provide sustained mentoring support. For more information, see program announcement [NSF 03-585](#).

3. Collaborative Research at Undergraduate Institutions (C-RUI)

The C-RUI Program supports the collaboration of faculty across all science disciplines to engage in research activities that require the expertise of biologists (as well as nonbiologists) to solve biological problems requiring a multidisciplinary approach. Key elements in the program include the integration of research and teaching and the training of undergraduate students. The program is intended to build the research infrastructure at undergraduate institutions and to encourage multidisciplinary (e.g., biology and geoscience, biology and chemistry, biology and mathematics, biology and computer science) training of undergraduate students. It is the intention of the BIO Directorate to participate in this activity by continuing the C-RUI activity that began in fiscal year 1995. For more information, see program announcement [NSF 03-514](#).

4. Integrative Graduate Education and Research Training (IGERT)

The agency-wide IGERT Program was created by NSF to meet the need for a cadre of broadly prepared Ph.D.s with the technical, professional, and personal skills essential to address the varied career demands of the future. IGERT sponsors development of innovative, research-based graduate education and training programs in Ph.D.-granting institutions. The program supports projects that are based on multidisciplinary research themes and organized by diverse groups of investigators with appropriate research and teaching expertise. The use of a multidisciplinary research theme provides a framework for the integration of research and education activities and for collaborative efforts in training that span disciplinary areas. Thus, an IGERT project may involve investigators from one or more departments within a single institution or from more than one institution. The emphasis of the IGERT Program is on training graduate students; however, the program will support efforts that include undergraduate and/or postdoctoral training if such participation will strengthen the proposed training program.

For More Information

Information such as the IGERT program solicitation, answers to frequently asked questions about the program, detailed instructions on preparing and submitting IGERT preproposals or formal proposals, and the names of appropriate NSF staff are available on the IGERT Web site, <http://www.nsf.gov/home/crssprgm/igert/start.htm>.

5. Postdoctoral Research Fellowships

These fellowships are offered in select program areas to U.S. citizens, nationals, and lawfully admitted permanent resident aliens. Applicants choose a sponsoring scientist and present a research and training plan. These fellowships are awarded to individuals for research and training at any appropriate U.S. or foreign institution for 2 years, and require a change from the Ph.D. institution.

- The BIO Directorate offers postdoctoral research fellowships in selected areas of biology to provide opportunities for recent doctoral scientists to obtain additional training; gain research experience under the sponsorship of established scientists; and broaden their scientific horizons beyond their research experiences during their undergraduate or graduate training. These fellowships are further designed to assist new scientists to direct their research efforts across traditional disciplinary lines and to offer them unique research resources, sites, and facilities, including foreign locations. NSF postdoctoral fellowships are awarded to individuals, and applications are submitted directly by applicants to NSF. Fellows must affiliate with an appropriate research institution and are expected to devote themselves full time to fellowship activities for the duration of the fellowship. At the conclusion of the fellowship, a fellow who accepts a tenure-track appointment at a U.S. institution deemed eligible to receive NSF funds may apply for a research starter grant. This program seeks to encourage research and training at the postdoctoral level at the intersection of biology and the informational, computational, mathematical, and statistical sciences. Complete information, including deadline dates and program announcement numbers, is available at <http://www.nsf.gov/bio/dbi/dbitraining.htm#pr>.
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DIRECTORATE FOR BIOLOGICAL SCIENCES

Division of Environmental Biology

The Division of Environmental Biology (DEB) supports fundamental research on the origins, functions, relationships, interactions, and evolutionary history of populations, species, communities, and ecosystems. Scientific emphases include biodiversity, molecular genetic and genomic evolution, mesoscale ecology, conservation biology, global change, and restoration ecology.

DEB also supports computational biology research (including modeling); a network of long-term ecological research sites; doctoral dissertation research; research conferences and workshops; and a variety of other NSF-wide activities.

DEB supports research through the following clusters:

- [Systematic and Population Biology](#)
- [Ecological Studies](#)

For More Information

Write to the Division of Environmental Biology, National Science Foundation, 4201 Wilson Boulevard, Room 635, Arlington, VA 22230; or contact the division by telephone, 703-292-8480; or visit the DEB home page, <http://www.nsf.gov/bio/deb/start.htm>.

• Systematic And Population Biology Cluster

The Systematic and Population Biology Cluster of thematic areas is located within the Division of Environmental Biology and supports research on the patterns and causes of diversity within and among populations and species. Research projects in Systematic Biology and Biodiversity Surveys and Inventories may involve any group of organisms, including terrestrial, freshwater, and marine taxa, and may range in subject from microbes to multicellular plants, animals, and fungi. Studies of populations of any groups of organisms in terrestrial, wetland, or freshwater habitats are considered in Population Biology.

The cluster includes the following areas:

1. [Population Biology](#)
2. [Systematic Biology](#)
3. [Biodiversity Surveys and Inventories](#)

For More Information

Visit the cluster's Web site, <http://www.nsf.gov/bio/deb/debsysbio.htm>.

1. Population Biology

Focuses on measuring population properties and understanding processes that lead to variation within and between populations. Approaches include empirical and theoretical studies of population structure and dynamics, microevolution, organismal adaptation, geographical differentiation, natural hybridization and speciation, and processes that lead to macroevolutionary patterns of trait evolution. Research areas include:

- **Population Ecology**—Supports studies of single species from an ecological and evolutionary perspective, including life history and life cycle phenomena of terrestrial, freshwater, and wetland organisms; demography of age- and stage-structured populations; population dynamics, including linear, nonlinear, and stochastic approaches; and patterns of natural and sexual selection.
- **Evolutionary Genetics**—Supports studies of the causes and consequences of variation, change, selection,

and evolution of biochemical characteristics, RNA and DNA sequences, mobile elements, and genic organization and function; the evolution of genetic architecture; evolutionary genomics; and population and quantitative genetics.

- **Evolution of Phenotypes**—Supports studies of how the properties of genes (number, arrangement, and pattern) and their interactions, including epigenetics and development, determine evolutionary processes; and how micro- and macro-evolutionary processes explain the evolution of complex phenotypes.

Research that addresses aspects of ecology and evolutionary biology is also supported within other parts of the National Science Foundation. Studies that focus on organism-centered analyses of physiology, morphology, behavior, or development should be directed to the Division of Integrative Biology and Neuroscience (IBN) (see information on IBN elsewhere in the BIO chapter). Studies that focus on marine organisms should be directed to the Biological Oceanography Program in the Division of Ocean Sciences (see the Directorate for Geosciences chapter of this Guide). Studies that focus on interactions among species should be directed to Ecology in the Ecological Studies Cluster, elsewhere in the DEB section. Interdisciplinary studies are welcome.

2. Systematic Biology

Main focus areas include (1) taxonomic revisions and monographs to improve biological classifications and nomenclature (titles should be prefaced “REVSYS” and may be submitted to this or the Biodiversity Surveys and Inventories Program); (2) phylogenetic analyses that produce or test phylogenetic hypotheses or models and the use of phylogenies to elucidate comparative studies, including those of morphology development and molecular evolution; (3) studies that lead to better methods of taxonomic identification and practice or advances in classificatory theory; (4) understanding the patterns and processes of biological diversity at and above the level of species; and (5) theoretical and comparative empirical studies—such as those of morphology, paleontology, biogeography, sequence data or genomes—that contribute to knowledge or models of the origin, diversification, distribution, and extinction of species and clades, or that determine the tempo and mode of evolutionary change at higher levels. Also included is the Special Competitions for Partnerships for Enhancing Expertise in Taxonomy, the deadline dates for which are announced via special solicitation (see [NSF 00-140](#) for the latest program announcement and guidelines).

3. Biodiversity Surveys and Inventories (BS&I)

The main focus areas of the BS&I Program include collecting, identifying, vouchering, and describing the species-level diversity of all forms of life on Earth, from microbes to mammals, including expeditionary work to document biotic diversity in poorly known terrestrial, freshwater, and marine environments. Supported surveys may be primarily area-based (focusing on species inventory and new species discovery, plus in some cases ecological, biogeographic, and/or evolutionary hypothesis testing), primarily clade-based (continental-scale to global species inventory and discovery within a particular taxonomic group), or primarily guild-based (surveys that couple species inventory and discovery with macroecological, historical biogeographic, and/or macroevolutionary hypothesis testing). Beginning in 2003, the BS&I Program is partnering with the ALL Species Foundation and other parts of NSF to support planetary biodiversity inventories (PBI) of the worldwide, species-level diversity of entire major groups of organisms. Proposed taxonomic revisions and monographs that improve biological classifications and nomenclature should be prefaced “REVSYS” and may be submitted to this or the Systematic Biology Program.

• Ecological Studies Cluster

The Ecological Studies Cluster is located within the Division of Environmental Biology and supports research on natural and managed ecological systems, primarily in terrestrial, wetland, and freshwater habitats. Research areas include experimental, theoretical, and modeling studies on the structure and function of complex biotic/abiotic associations and the coupling of small-scale systems to each other and to large-scale systems. Projects are encouraged that develop conceptual and synthetic linkages, such as theoretical and modeling studies; that are conducted at one or more scales of ecological organization; and that synthesize empirical and theoretical findings into new ecological paradigms.

The cluster includes the following areas:

1. [Ecosystem Studies](#)
2. [Ecology](#)
3. [Long-Term Ecological Research](#)
4. [Long-Term Research in Environmental Biology](#)

 **For More Information**

Visit the cluster's Web site, <http://www.nsf.gov/bio/deb/debecological.htm>.

1. Ecosystem Studies

Supports mechanistic or empirical investigations of whole-system ecological processes and relationships in the following areas: biogeochemistry (such as studies of decomposition), global and regional elemental budgets, and biotic versus abiotic controls of nutrient cycles; primary productivity, particularly ecophysiology within an ecosystem framework; and landscape dynamics, with an emphasis on quantitative models of disturbances, ecosystem resilience, and successional patterns.

2. Ecology

Supports community ecology and population interactions in such areas as dynamics and processes within specific communities or habitats; food-Web structure and landscape patterns formed by community dynamics; paleoecology; and organismal interactions, such as mutualism, plant/animal interactions, competition, predation, coevolution, and chemical or evolutionary ecology.

3. Long-Term Ecological Research (LTER)

Supports investigations of whole ecosystems and their component organisms and processes at sites that represent major biomes. Projects are multidisciplinary and actively encourage collaborative research with nonecological investigators. The deadline for submission of proposals is announced only via special solicitations. Unsolicited proposals will not be accepted.

4. Long-Term Research in Environmental Biology (LTREB)

Supports smaller studies that focus on evolutionary or ecological phenomena and require long-term investigation. These awards are designed to provide funding to help maintain ongoing long-term research projects. LTREB awards are not a source of startup funds to initiate long-term research, nor does DEB envision that LTREB projects will be the main source of extramural support for investigators. For further information, visit the LTREB Web site at <http://www.nsf.gov/bio/progdes/ltreb.htm>.

**DIRECTORATE FOR BIOLOGICAL SCIENCES****Division of Integrative Biology and Neuroscience**

IBN supports research aimed at integrative understanding of living organisms—plants, animals, and microbes—as units of biological organization. Such research encompasses:

- the mechanisms by which plants, animals, and microbes develop, grow, reproduce, regulate their physiological activity, and respond to their environment;
- the integration of molecular, subcellular, cellular, and functional genomics approaches to understand the development, functioning, and behavior of organisms in both laboratory and natural settings;
- all aspects of the nervous system, including its structure, function, development, and integration with the physiological and behavioral systems affected by it;
- factors influencing the behavior of animals in the laboratory and field;
- whole-organism approaches to physiological ecology; and
- the form and function of organisms in view of their evolution and environmental interactions.

Synthetic and analytic approaches that address this integration often require advanced computational techniques and interdisciplinary perspectives involving other areas of biology, behavioral science, physical science, mathematics, engineering, and computer science. In addition, the development and use of a wide diversity of organisms as biological models are encouraged to assist both in identifying unifying principles common to all organisms and in documenting the variety of mechanisms that have evolved in specific organisms. Current scientific emphases include biotechnology, biomolecular materials, environmental biology, global change, biodiversity, molecular evolution, plant science, microbial biology, and computational biology, including modeling. Research projects generally include support for the education and training of future scientists.

The IBN Division also supports doctoral dissertation research; research conferences, workshops, and symposia; computational biology research; Undergraduate Mentoring in Environmental Biology; and a variety of NSF-wide activities.

The IBN Division supports research through the following clusters:

- Developmental Mechanisms
- Neuroscience
- Physiology and Ethology

 For More Information

Write to the Division of Integrative Biology and Neuroscience, National Science Foundation, 4201 Wilson Boulevard, Room 685, Arlington, VA 22230; or contact the division by telephone, 703-292-8420; or visit the IBN home page, <http://www.nsf.gov/bio/ibn/start.htm>.

• Developmental Mechanisms Cluster

The Developmental Mechanisms Cluster of thematic areas is located within the Division of Integrative Biology and Neuroscience (IBN) and supports research on the nature, control, and evolution of processes that comprise the life cycle of organisms. Approaches range from molecular genetics and genomic analysis of developmental processes to the experimental manipulation of whole organisms. Supported in this cluster is research on gametogenesis, fertilization embryogenesis, differentiation, pattern formation, morphogenesis, and areas of development specific to plants, animals, and/or microbes (e.g., self-incompatibility, seed and fruit development). Also supported are studies that explore the mechanisms of development in an evolutionary context.

 **For More Information**

Visit the cluster's Web site, <http://www.nsf.gov/bio/ibn/ibndevelop.htm>.

• Neuroscience Cluster

The Neuroscience Cluster of thematic areas is located within the Division of Integrative Biology and Neuroscience and supports research on all aspects of the nervous system structure, function, and development. Integrative approaches to basic research range from fundamental mechanisms of neuronal function at the molecular and cellular levels to adaptations of the brain for appropriate behavior in particular environments. A major focus is the development and use of a wide diversity of organisms as biological models for understanding fundamental principles of neuroscience. Multidisciplinary collaborative research projects are encouraged to apply different types of research techniques to single-focused problems in neuroscience.

Supported in this cluster is research on neural regulation of behavioral events, ranging from simple movements to complex adaptive and interactive responses; and studies that explore the computational functions of neurons, neural circuits, and nervous systems and encourage the development and testing of mathematical or computer models of neural systems. Also included is research on the development, regeneration, and aging of the nervous system, including aspects of cell lineage and determination; axonal navigation and cell migration; regulation of gene expression; neuronal morphogenesis; and neuron-glia interactions.

This cluster also supports research on understanding multifaceted relationships among the central nervous system, hormones, and behavior, especially in relation to environmental factors. This includes how the brain controls endocrine secretion and the effects of steroid and peptide hormones on the brain. Innovative approaches and techniques for exploring the cellular and molecular mechanisms of neuronal and glial cell function, including energy metabolism, ion and substrate transport, and synaptic mechanisms, are also supported. Included in this thematic area are studies of the mechanisms by which the nervous system acquires, encodes, and processes information about the environment, and research on neural processes at the molecular, cellular, systemic, and behavioral levels and psychophysical correlates of sensory neural processes.

 **For More Information**

Visit the cluster's Web site, <http://www.nsf.gov/bio/ibn/ibnneuro.htm>.

• Physiology And Ethology Cluster

The Physiology and Ethology Cluster of thematic areas is located within the Division of Integrative Biology and Neuroscience (IBN) and supports integrative studies of physiological functions at the genomic, cellular, systemic, and organismal levels, and animal behavior in both field and laboratory settings. Also considered are Long-Term Research in Environmental Biology (LTREB) proposals (for more information, see <http://www.nsf.gov/bio/progdes/ltreb.htm>).

The cluster supports research on the mechanism, development, function, and evolution of all animal behavior, including behavioral ecology and evolution; nonhuman learning and cognition; behavioral genetics; development of behavior; and behavioral physiology and motivation, including behavioral endocrinology, animal communication, and animal orientation. Also included are studies that address ecological or evolutionary questions in the areas of morphology, comparative physiology, physiological ecology, and biomechanics of plants, animals, protists, fungi, and bacteria, with emphasis on the study of whole organisms, living or extinct. These studies focus largely on how physiological or morphological mechanisms have evolved and how they may influence evolutionary pathways or interactions between organisms and their biotic or physiochemical environments. The cluster supports research on the basic physiological mechanisms at the molecular, cellular, tissue, organ, and whole animal level, with emphasis on the whole animal as an "integrated system." This includes studies of comparative physiology, functional morphology, endocrinology, epithelial transport, and biomechanics. Another focus is on understanding plants as "functional units" through the integration of genomic, molecular, biochemical, and biophysical approaches to studies of plant form and function. Examples include hormonal and environmental regulation of plant function, plant physiological interactions with pathogens, nitrogen-fixing organisms, mycorrhizae, and other beneficial or pathogenic organisms in the rhizosphere. The emphasis is on understanding the physiological and metabolic basis

of plant responses to such interactions.

 **For More Information**

Visit the cluster's Web site, <http://www.nsf.gov/bio/ibn/ibnphysio.htm>.



DIRECTORATE FOR BIOLOGICAL SCIENCES

Division of Molecular and Cellular Biosciences

The Division of Molecular and Cellular Biosciences (MCB) supports research and related activities that contribute to a fundamental understanding of life processes at the molecular, subcellular, and cellular levels.

Investigator-initiated research proposals are considered in the following clusters: Biomolecular Systems, Cellular Systems, and Genes and Genome Systems. Programs in MCB also support fundamental studies leading to technological innovation, proposals with substantial *computational components*, and multidisciplinary and small group research. MCB programs particularly encourage submission of proposals involving microbial biology, plant biology, theoretical and computational aspects of molecular and cellular studies, and molecular evolution. Genomic approaches are encouraged in all areas. The Division also coordinates a special BIO-wide competition for *Microbial Observatories and Microbial Interactions and Processes*. In addition, the Division supports a variety of NSF-wide activities including Biocomplexity in the Environment, Information Technology Research, Science and Technology at the Nanoscale, and Foundation-wide activities designed to promote integration of research and education, such as the Faculty Early Career Development (CAREER) and the Research in Undergraduate Institutions (RUI) Programs.

The MCB Division supports research through the following clusters:

- [Biomolecular Systems](#)
- [Cellular Systems](#)
- [Genes and Genome Systems](#)

 **For More Information**

Write to the Division of Molecular and Cellular Biosciences, National Science Foundation, 4201 Wilson Boulevard, Room 655, Arlington, VA 22230; or contact the division by telephone, 703-292-8440; or visit the MCB home page, <http://www.nsf.gov/bio/mcb/start.htm>.

• **Biomolecular Systems**

This cluster emphasizes the structure, function, dynamics, interactions, and interconversions of biological molecules. The context for such studies can range from investigations of individual macromolecules to the large-scale integration of metabolic and energetic processes. Research supported by this cluster includes development of cutting-edge technologies integrating theoretical, computational, and experimental approaches; the study of biological molecules and their functional complexes; mechanistic studies of the regulation and catalysis of enzymes and RNA; and higher-order characterization of the biochemical processes by which all organisms acquire, transform, and utilize energy from substrates. This cluster emphasizes the importance of multidisciplinary research carried out at the interfaces of biology, physics, chemistry, mathematics, computer science, and engineering.

The cluster includes the scientific themes of molecular biochemistry, molecular biophysics, and metabolic biochemistry.

 **For More Information**

Visit the cluster's Web site, <http://www.nsf.gov/bio/mcb/mcbbiomolec.htm>.

• **Cellular Systems**

This cluster supports research on the structure, function, and regulation of plant, animal, and microbial cells and their interactions with the environment and with one another. Areas supported include studies of the structure,

function, and assembly of cellular elements, such as the cytoskeleton, membranes, organelles, intracellular compartments, intranuclear structures, and extracellular matrix, including eukaryotic and prokaryotic cell walls and envelopes. In addition, support is provided for the study of intracellular and transmembrane signal transduction mechanisms and functions; and cell-cell signaling processes, including those that occur in biofilms. Research on cellular recognition and self-defense mechanisms is included. Research utilizing both traditional and innovative methodologies, multidisciplinary approaches, technique development, computation and modeling, and approaches that exploit genomic information is encouraged. Multidisciplinary approaches to the study of cellular systems, including research carried out at the interfaces of biology, physics, chemistry, mathematics, and computer science and engineering are also encouraged.

The cluster includes the scientific themes of cellular organization and signal transduction and cellular regulation.

The *Microbial Observatories and Microbial Interactions and Processes* competition is also housed in this cluster. This expanded activity supports integrative studies that explore novel microorganisms, their interactions in consortia and communities, and aspects of their physiology, biochemistry, and genomics in relationship to the processes that they carry out in their environments.

 **For More Information**

Visit the cluster's Web site, <http://www.nsf.gov/bio/mcb/mcbcell.htm>.

• Genes And Genome Systems

This cluster supports studies on genomes and genetic mechanisms in all organisms, whether prokaryote, eukaryote, phage, or virus. Proposals on the structure, maintenance, expression, transfer, and stability of genetic information in DNA, RNA, and proteins, and how those processes are regulated, are appropriate. Areas of interest include genome organization, molecular and cellular evolution, replication, recombination, repair, and vertical and lateral transmission of heritable information. Of equal interest are the processes that mediate and regulate gene expression, such as chromatin structure, epigenetic phenomena, transcription, RNA processing, editing and degradation, and translation. The use of innovative in vivo and/or in vitro approaches, including biochemical, physiological, genetic, genomic, and/or computational methods, is encouraged, as is research at the interfaces of biology, physics, chemistry, mathematics, and computer science and engineering.

This cluster includes the scientific themes of eukaryotic genetics, microbial genetics, and the biochemistry of gene expression.

 **For More Information**

Visit the cluster's Web site, <http://www.nsf.gov/bio/mcb/mcbgene.htm>.



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Plant Genome Research Program

The Plant Genome Research Program was initiated in fiscal year 1998. It is part of a National Plant Genome Initiative established by the Office of Science and Technology Policy. The long-term goal of this program is to understand the structure, organization, and function of plant genomes important to agriculture, the environment, energy, and health. The program initiates new collaborative research and infrastructure projects annually, and provides ongoing support for activities started in previous years via mechanisms such as virtual centers and young investigator, individual, and small group awards.

 **For More Information**

Further information including results of previous competitions is available at http://www.nsf.gov/bio/dbi/dbi_pgr.htm.



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Emerging Frontiers – Bio's Virtual Division

The Emerging Frontiers (EF) Virtual Division was proposed in fiscal year (FY) 2003 to serve as an incubator for 21st Century Biology. EF supports evolving multidisciplinary research opportunities and networking activities that arise from advances in disciplinary research. By encouraging synergy between disciplines, EF provides a mechanism by which new initiatives will be fostered—and subsequently integrated—into core programs.

EF focus in FY 2004 is on the following initiatives:

- [Frontiers in Integrative Biological Research \(FIBR\)](#)
- [Research Coordination Networks \(RCN\)](#)
- [Biocomplexity in the Environment \(BE\)](#)
- [Nanoscale Science & Engineering](#)
- [Information Technology Research \(ITR\)](#)
- [Mathematical Sciences](#)
- [Human Social Dynamics](#)

• [Frontiers in Integrative Biological Research \(FIBR\)](#)

Invites new ideas for integrative research on major biological questions from a multidisciplinary point of view. Relevant scientific questions will be those recognized both as major challenges in biology and as beyond the scope of traditional single investigator or small team approaches. For more information, see program solicitation [NSF 03-581](#).

• [Research Coordination Networks \(RCN\)](#)

Seeks to encourage and foster communications and collaborations among scientists with common goals and interests. RCN provides support for groups of investigators to communicate and coordinate their research efforts across disciplinary, organizational, institutional, and geographical boundaries. Networks are formed around a focal theme and can involve a broad research question, group of organisms, or particular technologies or approaches. For more information, see program announcement [NSF 00-56](#).

• [Biocomplexity in the Environment \(BE\)](#)

Emphasizes research on the dynamics that occur within biological systems and between these systems and the physical environment via five topical areas: (1) Dynamics of Coupled Natural and Human Systems (CNH); (2) Coupled Biogeochemical Cycles (CBC); (3) Genome-Enabled Environmental Science and Engineering (GEN-EN); (4) Instrumentation Development for Environmental Activities (IDEA); and (5) Materials Use: Science, Engineering, & Society (MUSES). Further information—including results of previous competitions—is available at <http://www.nsf.gov/geo/ere/ereweb/fund-biocomplex.cfm>. In addition to the five topical areas listed here, the BE portfolio in BIO includes the following three competitions:

1. **Assembling the Tree of Life (AToL)**—Supports multidisciplinary teams that conduct innovative and integrative projects to resolve phylogenetic relationships among significant groups of organisms and develop innovative data acquisition and analysis in phylogenetics and phyloinformatics, with the ultimate goal of reconstructing a framework phylogeny for all species on Earth. For more information, see program announcement [NSF 03-536](#).
2. **Ecology of Infectious Diseases (EID)**—A joint NSF-National Institutes of Health initiative that seeks to understand the ecological and biological mechanisms that govern relationships between human-induced environmental changes and the emergence and transmission of infectious diseases.

3. **Microbial Genome Sequencing Program**—A joint NSF-U.S. Department of Agriculture initiative that invites research proposals to support high-throughput sequencing of the genomes of microorganisms, including viruses, bacteria, archaea, fungi, oomycetes, protists, and agriculturally important nematodes (program announcement in progress).

- **Nanoscale Science & Engineering**

Research is focused on studying the structure and regulation of macromolecular machines and macromolecular complexes that are capable of self-replication and self-assembly. Further information, including results of previous competitions, is available at <http://www.nsf.gov/home/crssprgm/nano/start.htm>.

- **Information Technology Research (ITR)**

Broadly invites innovative fundamental research proposals that address the challenges that face IT or seek advances at the frontiers of science and engineering through the creative and innovative use and further development of IT. The ITR Program is interested in fostering visionary work that could lead to major advances in the future, new and unanticipated technologies, revolutionary applications, or new ways to perform important activities. Examples of BIO-relevant areas include algorithms for designing, managing, and linking primary biological databases; development of new tools for microbial genomics; development of innovative database structures (both hardware and software) that support distributed storage of very dense files of genetic sequence and genomic data; and development of real-time information networks linking researchers worldwide engaged in Tree of Life research. Further information, including results of previous competitions, is available at <http://www.itr.nsf.gov>.

- **Mathematical Sciences**

Supports interdisciplinary research involving mathematics, science, and engineering and focuses on mathematical and statistical challenges posed by large data sets, managing and modeling uncertainty, and modeling complex nonlinear systems.

- **Human Social Dynamics**

Focuses on research in behavior, cognition, development, and neuroscience. For more information, see program announcement [NSF 03-552](#).

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