

## DIRECTORATE FOR BIOLOGICAL SCIENCES

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/>) and Undergraduate Mentoring in Environmental Biology (see <http://www.nsf.gov/bio/progdes/nsf02090.htm>); and for faculty from K-12: Research Experiences for Teachers (see <http://www.nsf.gov/bio/progdes/nsf02090.htm>), 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>).

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](#)

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### 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.

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## Multi-Investigator Proposals in the BIO Directorate

Increasingly, many important research problems in science can best be addressed by groups of investigators. A group approach may result in a more comprehensive treatment of many scientific problems and also may provide innovative opportunities for training students.

The need for increased attention to research and training in biology by multiple principal investigators (PIs) has been identified by several workshops, such as the "NSF/BIO Workshop on Impact of Emerging Technologies on the Biological Sciences," and by advisory committees such as the NSF Biological Sciences Advisory Committee. In response to these recommendations, the BIO Directorate encourages proposals from three or more investigators, who may come from more than one academic institution, intending collaborative studies focused on a single problem. The directorate will evaluate these proposals in addition to proposals received from individual PI's as part of the portfolio of activities within the existing budget. As is the case for proposals from individual investigators, multi-PI proposals may provide for the training of students and may also involve industrial collaborations if appropriate. Investigators interested in submitting a multi-PI proposal should contact the cognizant BIO staff for further advice and guidance.

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## 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's divisions 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 Biological Sciences 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 doctoral dissertation, 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.

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## 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.

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## 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/>.

## • 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 Equipment and Instrumentation Resources for Biological Sciences](#)
2. [Instrument Development for Biological Research](#)
3. [Improvements in Facilities, Communications, and Equipment 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/>). See the MRI Program Announcement (NSF 01-171) for further details.

### For More Information

Visit the cluster's web site, [http://www.nsf.gov/bio/dbi/dbi\\_instrument.htm](http://www.nsf.gov/bio/dbi/dbi_instrument.htm).

## 1. Multi-User Equipment and Instrumentation Resources for Biological Sciences

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 Equipment and Instrumentation Resources for Biological Sciences**—The Multi-User Equipment and Instrumentation Resources for Biological Sciences Program (see program announcement [NSF](#)

98-137) accepts proposals through the RUI Program (see program announcement NSF 00-144). The Multi-User 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.

- **Joint NSF/NIH Multi-User Instrumentation Activity**—Offers support for the purchase of a single instrument with a total purchase cost exceeding \$500,000. Proposals that would normally be eligible for submission to both the National Institutes of Health (NIH) and NSF may be submitted to NIH for joint funding with NSF. Proposers must include the necessary NSF documentation, as summarized in program announcement NSF 98-137. Proposals will be evaluated by the agencies in a special review group that will be convened by NIH as a special NIH study section, with NSF participation. A program announcement for shared instrumentation grants will be published in the January issue of the *NIH Guide for Grants and Contracts*. There is one annual deadline date (usually in the last week of March) for receipt of applications.

## 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 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 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. FSML's 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 guidelines NSF 02-040.

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### • 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

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](#).

## 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

Provides support for collection improvement, collection computerization, research on curatorial and collection management techniques, and community-based development activities. Supplements are also provided to underwrite the involvement of undergraduate and high school students in collection-based research. For more information, see program announcement [NSF 02-117](#).

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### • 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. [Collaborative Research at Undergraduate Institutions](#)
3. [Integrative Graduate Education and Research Training](#)
4. [Postdoctoral Research Fellowships](#), including
  - Minority Postdoctoral Research Fellowships
  - Postdoctoral Research Fellowships in Interdisciplinary Informatics: Bridging Biology with the Mathematical and Physical Sciences
  - Postdoctoral Research Fellowships in Microbial Biology



#### For More Information

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

## 1. Research Experiences for Undergraduates (REU) Sites

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 Program. For more information, see program announcement [NSF 02-136](#).

## 2. Collaborative Research at Undergraduate Institutions (C-RUI)

The overall goals of C-RUI have now been incorporated into the NSF-wide program Research at Undergraduate Institutions (RUI) (see program announcement [NSF 00-144](#)). 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 and continued in fiscal years 1997, 1999, and 2001. We would like to assure the biology community of BIO's commitment to C-RUI activities and encourage qualified investigators at undergraduate institutions to apply for collaborative research funding. BIO further encourages applicants whose research would especially benefit from forging a collaboration with their colleagues across traditional disciplinary lines and, in doing so, offer their students exposure to a multidisciplinary research environment.

## 3. 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.-degree-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 the training of 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 an IGERT preproposal or formal proposal, and the names of the appropriate NSF staff are available on the IGERT web site, <http://www.nsf.gov/home/crssprgm/igert/>.

## 4. 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 the applicant to NSF. Fellows must affiliate with an appropriate research institution and are expected to devote themselves full

time to the 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. Specific activities are described below. Complete information including deadline dates and program announcement numbers, is available at <http://www.nsf.gov/bio/dbi/dbitraining.htm#pr>.

- **Minority Postdoctoral Research Fellowships**—Seek to prepare minority scientists who are within 4 years of receipt of their doctoral degrees for leadership positions in academe and industry. The term "minority," as used here, refers to those racial or ethnic groups that are significantly underrepresented at advanced levels of science and engineering in the United States. They include American Indians or Alaska Natives (Native Americans), Blacks (African Americans), Hispanics, and Pacific Islanders. Tenure at a foreign institution can be followed by an additional third year of support at a U.S. institution. Fellows are invited to an annual meeting at NSF and are eligible to apply for research starter grants. Minority graduate students within 18 months of their doctoral degrees are eligible for travel awards to visit prospective sponsors before they prepare a fellowship application.
  - **Postdoctoral Research Fellowships in Interdisciplinary Informatics: Bridging Biology with the Mathematical and Physical Sciences**—Seek to increase the number of (a) junior scientists with doctoral degrees in the mathematical, chemical, and physical sciences who will pursue postdoctoral training with scientists in biology; and (b) junior scientists with doctoral degrees in the biological sciences who will pursue postdoctoral training with sponsors in the mathematical, chemical, and physical sciences. The intent of this cross-training program is to prepare junior scientists so that they are able to establish research programs in areas connecting the mathematical and physical sciences with biology and informatics.
  - **Postdoctoral Research Fellowships in Microbial Biology**—Support training and research on the basic biology of protozoan, microalgal, fungal, archaeal, bacterial, and viral species that are not generally considered to be model organisms, such as *E. coli*, *Saccharomyces cerevesiae*, or tobacco mosaic virus (TMV). The use of model organisms in comparative studies with non-model organisms is not excluded. Studies of the interactions of these microbes with each other and with plants and animals (e.g., symbiosis) may also be supported. Applicants are reminded that BIO does not support research with disease-related goals, including the etiology, diagnosis, or treatment of physical or mental disease, abnormality, or malfunction in human beings or animals. Animal or plant models of such conditions or the development or testing of drugs or other procedures for their treatment are also not eligible for support.
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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; Undergraduate Mentoring in Environmental Biology; and a variety of other NSF-wide activities.

DEB supports research through the following clusters:

- Systematic and Population Biology
- Ecological Studies

In addition to the areas supported by these clusters, DEB encourages studies of earth's species and their interrelationships through directorate-wide activities. For example, the Tree of Life Program (see program solicitation [NSF 02-074](#)) 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. The Ecology of Infectious Diseases Initiative--a joint NSF-NIH initiative--seeks to understand the ecological and biological mechanisms that govern relationships between human-induced environmental changes and the emergence and transmission of infectious diseases.

#### 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/>.

#### • 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 Biotic 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. Biotic 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 measures of 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) phylogenetic analyses that produce or test phylogenetic hypotheses or models and the use of derived phylogenies to elucidate patterns of structural, developmental, or molecular evolution; (2) studies that lead to improved classifications, better methods of taxonomic identification, contributions to classificatory theory, and nomenclature reform (included here are the Special Competitions for Partnerships for Enhancing Expertise in Taxonomy, the deadline dates for which are announced via special solicitation) (see program announcement and guidelines [NSF 00-140](#)); (3) understanding of processes that underlie the origin and maintenance of taxonomic diversity; and (4) theoretical and empirical studies of biogeographical, coevolutionary, and paleobiological patterns to develop models of the origin, diversification, distribution, and extinction of species and evolutionary lineages, and determine the tempo and mode of evolutionary change.

### 3. Biotic Surveys and Inventories

Main focus areas include collecting and recording the diversity of life on Earth. Permanent, well-curated collections and computerized databases are strongly encouraged as products of the program's support. For more information, see program announcement [NSF 01-150](#).

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#### • 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

Research supported includes 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 non-ecological investigators. The deadline date 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 that require long-term investigation. These awards are designed to provide funding to help maintain an ongoing long-term research project. 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>.

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**Division of Integrative Biology and Neuroscience**

The Division of Integrative Biology and Neuroscience (IBN) supports research aimed at understanding the living organism-plant, animal, microbe-as a unit of biological organization. Such research encompasses

- the mechanisms by which plants and animals 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/>.

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## • 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 those 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 either plants or animals (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>.

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## • 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 to 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>.

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## • Physiology And Ethology Cluster

The Physiology and Ethology Cluster of thematic areas is located within the Division of Integrative Biology (IBN) and Neuroscience 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 environment. 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 contributing to a fundamental understanding of life processes at the molecular, subcellular, and cellular levels.

Investigator-initiated research proposals are considered in the following general areas: biomolecular structure and function, biomolecular processes, cell biology, and genetics. Clusters in the MCB Division also support fundamental studies leading to technological innovation, proposals with substantial computational components, and multidisciplinary and small-group research. The division particularly encourages submission of proposals involving microbial biology, plant biology, theoretical/computational aspects of molecular and cellular studies, molecular evolution, and biomolecular materials. Genomics approaches are encouraged in all areas. MCB supports a variety of NSF-wide activities such as Biocomplexity in the Environment (BE), and activities designed to promote the integration of research and education, such as Faculty Early Career Development (CAREER) and Research at Undergraduate Institutions (RUI). Also considered are proposals for limited support of special meetings and workshops and the Undergraduate Mentoring in Environmental Biology (UMEB) activity. UMEB is intended to provide support for talented students to gain research experience in areas of biological science related to the environment and to foster an enriched and culturally diverse research and educational environment.

The MCB Division supports research through the following clusters:

- [Biomolecular Structure and Function](#)
- [Biomolecular Processes](#)
- [Cell Biology](#)
- [Genetics](#)

In addition to the areas supported by these clusters, the division encourages the discovery of novel microorganisms, microbial consortia, communities, activities, and other novel properties and the study of their roles in diverse environments through the directorate-wide Microbial Observatories Program competition (see program solicitation [NSF 02-118](#)). More broadly, the division emphasizes the exploration of all aspects of microbial biology including microbial physiology, genomics/genetics, and communities.

** 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/>.

**• Biomolecular Structure And Function Cluster**

The Biomolecular Structure and Function Cluster of thematic areas is located within the Division of Molecular and Cellular Biosciences (MCB) and supports research aimed at understanding the structure

and function of biological macromolecules, including proteins, nucleic acids, polysaccharides, and lipid assemblies. The research supported by this cluster encompasses a broad range of topics and techniques. The cluster encourages multidisciplinary and innovative efforts between biology and physics, chemistry, mathematics, and computer sciences.

The cluster includes the following areas:

1. [Molecular Biochemistry](#)
2. [Molecular Biophysics](#)



#### **For More Information**

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

## **1. Molecular Biochemistry**

Emphasizes structure-function relationships in biological macromolecules and supramolecular structures such as multienzyme complexes, membranes, and viruses. Other areas of emphasis include the mechanisms of regulation and catalysis by enzymes and RNA; biochemical reactions involved in bioenergetic processes and photosynthesis; key biochemical processes involved in synthesis and folding of proteins; and the synthesis of other biomolecular materials. Typically, a combination of experimental techniques is used in an integrated manner to explore the functions and mechanisms of the actions of biomolecules.

## **2. Molecular Biophysics**

Emphasizes research at the interfaces of biology, physics, chemistry, mathematics, and computer science, with focus on the development of new and cutting edge technologies that integrate theoretical, computational, and experimental approaches to the characterization of the structure, dynamics, interactions, and functions of biological macromolecules.

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## **• Biomolecular Processes Cluster**

The Biomolecular Processes Cluster of thematic areas is located within the Division of Molecular and Cellular Biosciences and supports research on molecular mechanisms by which genetic and metabolic processes occur in plant, animal, and microbial organisms. These processes and related regulatory features are the primary areas of emphasis.

The cluster includes the following areas:

1. [Biochemistry of Gene Expression](#)
2. [Metabolic Biochemistry](#)



#### **For More Information**

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

## **1. Biochemistry of Gene Expression**

Emphasizes research using biochemical and molecular biological methods to investigate mechanisms for the replication, expression, transfer, and stability of genetic information, both DNA and RNA. These studies involve primarily in vitro biochemical approaches, including genomics. Gene expression

mechanisms are a major focus and include transcription and processing of mRNA regulatory features, including chromatin architecture, RNA stability, and translational mechanisms. Other areas of study include DNA replication, mutation, and repair.

## 2. Metabolic Biochemistry

Emphasizes research on many aspects of the dynamic activities of cells, including characterization of the biochemical pathways and other processes by which all organisms acquire, transform, and utilize energy from substrates and synthesize new small molecules and macromolecular cell components. Major topics of interest include the diversity of primary and secondary metabolism and mechanisms of metabolic regulation, in response to both internal and external signals. Also of interest are biotransformations of environmentally significant compounds; manipulations of metabolism with practical applications; quantitative and temporal aspects of metabolism; integration and subcellular organization of metabolic processes; and the use of new methods and technologies and approaches, including genomics, to conduct studies of metabolic pathways and networks.

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### • Cell Biology Cluster

The Cell Biology Cluster of thematic areas is located within the Division of Molecular and Cellular Biosciences (MCB) and supports research on the structure, function, and regulation of plant, animal, and microbial cells. Research that will utilize both traditional and innovative methodologies and encourage multidisciplinary approaches, technique development, modeling, and approaches that exploit genomic information is encouraged.

The cluster includes the following areas:

1. Cellular Organization
2. Signal Transduction and Cellular Regulation



#### For More Information

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

### 1. Cellular Organization

Supports studies of the structure, function, and assembly of cellular elements, such as the cytoskeleton, membranes, organelles, intracellular compartments, intranuclear structures, and extracellular matrix, including cell walls. This encompasses structural and dynamic aspects of cellular and intracellular motility, meiosis and mitosis, and cell shape and polarity, including the mechanisms of endocytosis, exocytosis, and intracellular trafficking of membranes and macromolecules.

### 2. Signal Transduction and Cellular Regulation

Supports the study of intracellular and transmembrane signal transduction mechanisms and functions. These include signal reception; ion channels; second messenger and/or signaling cascades and their interactions; cellular mechanisms of recognition and defense; and the regulation of cell cycle progression.

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## • Genetics Cluster

The Genetics Cluster is located within the Division of Molecular and Cellular Biosciences (MCB) and supports a wide range of studies directed toward answering significant questions of organization, recombination, function, regulation of function, and transmission of heritable information in all organisms, from viruses and micro-organisms to plants and animals. Specific areas include mechanisms of gene regulation, chromosome structure and replication, epigenetic phenomena, DNA repair and recombination, sex determination, genetic interactions between genomes, and molecular evolution and genomics.

The cluster includes the following areas:

1. Eukaryotic Genetics
2. Microbial Genetics



### For More Information

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

## 1. Eukaryotic Genetics

Emphasizes genetic studies of eukaryotic organisms. Studies of both organelle and nuclear genomes are included, as are studies of viruses of these organisms and parasitic or symbiotic interactions at the genetic level. Epigenetic phenomena, molecular evolution, and genomics are also areas of interest.

## 2. Microbial Genetics

Emphasizes genetic studies of eubacteria and archaeobacteria. Also included are studies of the genetics of bacterial viruses and other infectious agents of bacteria. Investigations of microbial interactions with other organisms are also considered if the emphasis of the study is on the microbe. Studies on molecular evolution of microbial genes and on genomics are also considered.

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**DIRECTORATE FOR BIOLOGICAL SCIENCES**  
**Plant Genome Research Program**

The Plant Genome Research Program was initiated in fiscal year (FY) 1998. It is part of a national plant genome research 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. In FYs 1998-2002, the program held separate competitions. The program initiates new collaborative research and infrastructure projects annually, as well as provides ongoing support for activities started in previous competitions.

 **For More Information**

Further information including results of previous competitions is available at [http://www.nsf.gov/bio/dbi/dbi\\_pgr.htm](http://www.nsf.gov/bio/dbi/dbi_pgr.htm).