

# **BIOCOMPLEXITY: SPECIAL COMPETITION**

## **Integrated Research to Understand and Model Complexity Among Biological, Physical, and Social Systems**

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Program Announcement

*NSF 00-22*

DIRECTORATE FOR BIOLOGICAL SCIENCES  
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SCIENCES  
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ECONOMIC SCIENCES  
OFFICE OF POLAR PROGRAMS

***DEADLINE DATES:***

***MESSAGE OF INTENT - JANUARY 31, 2000***  
***RESEARCH PROPOSALS - MARCH 1, 2000***  
***INCUBATION ACTIVITIES - MARCH 1, 2000***



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## SUMMARY OF PROGRAM REQUIREMENTS

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### GENERAL INFORMATION

**Program Name:** Biocomplexity: Special Competition: Integrated Research to Understand and Model Complexity Among Biological, Physical, and Social Systems

### Short Description/Synopsis of Program:

This special competition is the second year of a multi-year effort to enhance our understanding of the nature and dynamics of biocomplexity in the environment. Specifically, this special competition will support integrated research to better understand and model complexity that arises from the interaction of biological, physical, and social systems. Biocomplexity arises from dynamics spanning several levels within a system, between systems, and/or across multiple spatial (microns to thousands of kilometers) and temporal (nanoseconds to eons) scales. **This special competition will specifically support Research Projects** which directly explore nonlinearities, chaotic behavior, emergent phenomena or feedbacks within and between systems and/or integrate across multiple components or scales of time and space in order to better understand and predict the dynamic behavior of systems. **The competition will also support Incubation Activities** that enable groups of researchers who have not historically collaborated on biocomplexity research to develop projects via focused workshops, virtual meetings, and other types of development and planning activities.

### Cognizant Program Officers:

#### Biological Sciences (BIO)

Ted Elliott  
Phone: (703) 306-1479  
E-mail: [eelliott@nsf.gov](mailto:eelliott@nsf.gov)

#### Computer and Information Science and Engineering (CISE)

Y. T. Chien  
Phone: (703) 306-1980  
E-mail: [ychien@nsf.gov](mailto:ychien@nsf.gov)

#### Engineering (ENG)

Gary Poehlein  
Phone: (703) 306-1365  
E-mail: [gpoehlei@nsf.gov](mailto:gpoehlei@nsf.gov)

#### Geosciences (GEO)

Phil Taylor  
Phone: (703) 306-1587  
E-mail: [prtaylor@nsf.gov](mailto:prtaylor@nsf.gov)

### **Mathematical and Physical Sciences (MPS)**

Jim Rosenberger

Phone: (703) 306-1883

E-mail: [jrosenbe@nsf.gov](mailto:jrosenbe@nsf.gov)

### **Social, Behavioral and Economic Sciences (SBE)**

Cheryl Eavey

Phone: (703) 306-1729

E-mail: [ceavey@nsf.gov](mailto:ceavey@nsf.gov)

### **Office of Polar Programs (OPP)**

Polly Penhale

Phone: (703) 306-1033

E-mail: [ppenhale@nsf.gov](mailto:ppenhale@nsf.gov)

### **Applicable Catalog of Federal Domestic Assistance (CFDA) No.:**

47.074 (BIO), 47.070 (CISE), 47.041 (ENG), 47.050 (GEO), 47.049 (MPS), 47.075 (SBE), 47.078 (OPP)

### **ELIGIBILITY**

- Limitation on the categories of organizations that are eligible to submit proposals:

**U.S. institutions that are eligible for awards from the National Science Foundation, including colleges, universities, and other nonprofit research institutions such as botanical gardens, marine and freshwater institutes, and natural history museums may submit proposals. The NSF encourages collaborations with scientists at foreign institutions; however, primary support for any foreign participants/activities must be secured through their own national sources.**

- Limitation on number of proposals that may be submitted by a PI: **A Principal Investigator may submit only one proposal to this competition and he/she may only collaborate on one other proposal as a Co-Principal Investigator in this competition.**
- Limitation on eligible topics:

**NSF does not normally support technical assistance, pilot plan efforts, research requiring security classification, the development of products for commercial marketing or market research for a particular project or invention. 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 or testing of drugs or other procedures for their treatment also are not eligible for support. Research in bioengineering, with diagnosis or treatment related goals, however, that applies**

**engineering principles to problems in biology and medicine while advancing engineering knowledge is eligible for support. Bioengineering research to aid persons with disabilities is also eligible.**

- Limitation on the number of proposals that may be submitted by an organization:

**Proposals already submitted to other NSF programs are not eligible for consideration by this special competition. However, NSF will simultaneously review proposals submitted to another Federal agency when both agencies have agreed to joint review and joint funding of the proposal.**

#### **AWARD INFORMATION**

- Type of award anticipated: **Standard Grants**
- Balance of awards anticipated in FY 2000: **90% of funds available for Research Projects  
10% of funds available for Incubation Activities**
- Amount of funds available: **\$50 million will be available for this competition in FY 2000**
- Anticipated date of awards: **September 2000**

#### **PROPOSAL PREPARATION & SUBMISSION INSTRUCTIONS**

- **Proposal Preparation Instructions**
  - Message of Intent requirements: **Strongly Encouraged**
  - Pre-proposal requirements: **None**
  - Proposal Preparation instructions:

**Standard NSF Grant Proposal Guide instructions and additional instructions specific to this announcement**

- Supplemental proposal preparation instructions:

**For research in Arctic regions, the Arctic Logistics Coordination form (see NSF-98-72) must accompany all submissions proposing fieldwork. NSF-UNOLS Ship Time Request Form must accompany all proposals requesting ship time. For research in the Antarctic, the Operational Requirements Cover Sheet and necessary worksheets must be submitted as described in NSF 99-93.**

- **Budgetary Information**
  - Cost sharing/matching requirements: **None**

- Indirect cost (F&A) limitations: **None**
- Other budgetary limitations:

**Research Projects** can be up to 5 years in duration. Annual budgets may be up to \$600,000, with budgets up to \$1 million each year possible if extremely well justified.

**Incubation Activities** can be up to two years duration with total budgets not to exceed \$100,000 and cannot be renewed.

- **FastLane Requirements**

- FastLane proposal preparation requirements: **FastLane submission required**
- FastLane point of contact:

For technical assistance with FastLane, please send an e-mail message to [biofl@nsf.gov](mailto:biofl@nsf.gov).

- **Deadline/Target Dates**

- Messages of Intent Deadline: **5:00 p.m., January 31, 2000 \***
- Research Proposal Deadline: **5:00 p.m., March 1, 2000 \***
- Incubation Activities Proposal Deadline: **5:00 p.m., March 1, 2000 \***

\* submitter's local time

## **PROPOSAL REVIEW INFORMATION**

- Merit Review Criteria: **Standard National Science Board approved criteria**

## **AWARD ADMINISTRATION INFORMATION**

- Grant Award Conditions: **GC-1 or FDP III**
- Special grant conditions anticipated: **None anticipated**
- Special reporting requirements anticipated: **All successful Research Project PIs are required to attend the annual awardees meeting at a date and place to be specified by NSF, during the tenure of the award, and to plan for a formal site visit by NSF at the midpoint of an award.**

## INTRODUCTION

Biocomplexity refers to phenomena that result from dynamic interactions among the biological, physical and social components of the Earth's diverse environmental systems. We commonly experience these phenomena as the "whole being greater than the sum of the parts."

Biocomplexity arises from the interplay between life and its environment, i.e., from the behavioral, biological, social, chemical and physical interactions that affect, sustain, or are modified by living organisms, including humans.

All systems associated with life, including human systems, exhibit biocomplexity. Population oscillations, host-parasite interactions, pathogen response to El Nino events, human responses to environmental stimuli, and bioreactor instability are but a few examples of complex behaviors exhibited by environmental systems defined or influenced by living organisms.

Since nonlinear or chaotic behavior, emergent phenomena, and interactions involving multiple levels of biological organization and/or multiple spatial (microns to thousands of kilometers) and temporal (nanoseconds to eons) scales often identify Biocomplexity, it is difficult to describe and study experimentally. This greatly restricts our ability to predict the behavior of most systems with living organisms, including those formed via human activity.

Breaking such systems into their component parts and studying them separately cannot lead to complete understanding. At some point, the system as a whole must be studied to identify emergent behaviors. In addition to a holistic approach, a clear, integrated conceptual framework for analysis is required. Such research is integrated formally and a priori, rather than by relying on ad hoc analysis of results collected at different times and places. At the same time the paradigms used to probe the complete system must be designed on the basis of the known properties of the components of the system.

Major questions about biocomplexity remain unanswered. How does complexity among biological, physical and social systems within the environment arise and change? How do emergent properties develop? How do systems with living components, including those that are human based, respond and adapt to stress? How does information and material move within and across levels in systems? Are adaptation and change predictable? How do humans influence and respond to biocomplexity in natural systems?

Decades of fruitful research, following the reductionist paradigm, generated a vast wealth of knowledge about the living and non-living subcomponents of many environmental systems. Now researchers from a broad spectrum of fields, armed with burgeoning databases and a new array of computational, observational, and analytical tools can undertake the integrative research necessary to tackle biocomplexity. The study of biocomplexity offers many challenges to modeling methods, including mathematical and computational ones. Descriptions of aggregate behavior, nonlinear phenomena, networks with distributed or local control, or combinations of continuous and discrete behavior as well as new visualization methods can be applied to address biocomplexity. Genome sequencing, DNA-chips, robotics, computer simulations, new sensors and monitoring systems, along with satellite-based imaging of the land and seas, all contribute to the flood of data relevant to the understanding of biocomplexity. Knowledge discovery

techniques (e.g., datamining, visualization, summarization, trend extraction, etc.) are being developed to convert the volumes of data into new knowledge.

The challenge of understanding biocomplexity in the environment requires sophisticated and creative approaches that integrate information across temporal and spatial scales, consider multiple levels of organization, and cross-conceptual boundaries. Advancing our understanding of the nature and role of biocomplexity demands increased attention and new collaborations of researchers from a broad spectrum of fields -- biology, physics, chemistry, ecology, geology, hydrology, mathematics, statistics, social and behavioral sciences, computer sciences and engineering.

## **PROGRAM DESCRIPTION**

Biocomplexity presents an exciting intellectual opportunity for researchers in many disciplines. It is also an especially important and timely initiative because humans are not only complex biological systems themselves but also impact the environment directly and dramatically at the systems level, for example, through their requirements for food, fuel, living space and resources for their socioeconomic enterprises. Talented researchers now have the tools to take up the challenge.

However, while an integrated approach to biocomplexity in the environment may be for some systems, not all systems or researchers are ready for this type of research. Therefore, in this Biocomplexity Special Competition NSF will support both **Research Projects** and **Incubation Activities**.

## **RESEARCH PROJECTS**

Competitive Research Projects will be those that take a systems-level approach; i.e., focus holistically on questions central to biocomplexity, e.g., those related to nonlinearities and feedbacks or involving explicit and a priori integration across multiple components or scales of time and space, and on which use an conceptual, mathematical or computational model, computer simulation, or artificial intelligence techniques to direct the research. Mathematical models must include estimates of the uncertainty in model predictions, e.g., misclassification rates, prediction accuracy, generalizability. All experiments or simulations should have sufficient sample size and be designed with an explicit analysis confirming the ability to demonstrate the hypothesized behavior of the models to within an acceptable prescribed level of precision, e.g., statistical power. Projects may also include the enhancement or development of new tools or techniques for the study of biocomplexity. All Research Projects are expected to involve researchers from several fields, with at least one quantitative expert, i.e., modeler, mathematician or statistician, on the research team, collaborating in groups or virtual centers.

Non-exclusive examples of possible Biocomplexity Research areas are:

- Complexity in the present day Antarctic dry valleys is governed by the interactions between paleoenvironmental conditions and short term fluctuations in modern physical and chemical processes. In addition, the most dynamic ecosystem activities occur over extremely small



spatial scales. Research that integrates paleo and present day conditions and microscale and mesoscale phenomena is needed to better interpret and model the behavior of these extreme ecosystems.

- In order to understand land cover change processes, we need to better understand the impact of the constructed environment, human activities and social structures on ecosystem functions. For example, what is the affect of property rights allocations or cultural norms on the rate of deforestation in a given area? Research on these complex processes requires the collaborative efforts of scientists from a number of disciplines, including engineering and social, behavioral, biological, and computer sciences.
- As humans spread out of the tropics 100,000 or more years ago, they encountered a diversity of environments, necessitating adaptation to new diets, climates, infectious diseases and other stressors. Understanding the complex interplay of social institutions, behavior, and genetic change through time and space are key to unraveling the origins and extent of modern human diversity and our adaptations as a species.
- The environmental impact of industrial products over the long term is still not adequately understood. As new materials evolve and come into use, the impact of human endeavors on the environment will change. How can materials be designed to be resilient during use but biodegradable once discarded? What are the factors during production, use and disposal that must be considered in order to design materials with minimal environmental impact?
- Recent studies suggest that ecosystem processes are influenced by species diversity. However, the mechanisms are unclear. Research that tests mechanistic models relating species diversity of various groups of organisms to ecosystem productivity and response to disturbance may help unravel this puzzle. Such studies may help determine whether and how shifts in species diversity due to human activities broadly affect ecological functioning and are important to factor into economic models for sustainable ecosystem management.
- Biological invasions involve complex human and biological interactions at a variety of scales, from the very local and short term to the international and long term. Quantitative approaches that are required to understand biological invasions include: population models to analyze how characteristics of invader species and invaded communities affect each step of the invasion process, statistical meta-analysis of case studies to help identify general patterns in the characteristics of invaders, vectors, invaded communities and ecological impacts, and quantitative analyses of the impacts of human interests, including health, economics, and cultural values, on species invasions.
- Many geological processes, as well as those that operate on geological media and on materials used in the constructed environment and which were long thought to be strictly "inorganic" are now know to be directly or indirectly biologically controlled. Tools (e.g., molecular sequencing, laser confocal and atomic force microscopy, and environmental scanning electron microscopy) are now available to investigate the diverse, complex interactions between microbes and minerals. Some important themes to pursue in biocomplexity, geomicrobiology, and infrastructure stability include: formation and change

through time of sediments and rock materials, microbial control of chemical composition of soils and the impact of microbial consortia on man-made structures.

- Marine organisms interact with the atmosphere by taking up or releasing trace gases that influence both the world's heat balance and the screening of harmful UV-B radiation. Nitrous oxide, dimethyl sulfide, methane, and methyl halides all have complex biological sources and sinks in marine systems. Each affects the heat balance of the earth, and some impact stratospheric ozone, which leads to increases in UV-B radiation, that in turn potentially can alter marine community structure, rates of photochemical transformation of dissolved organic matter, and thus carbon cycling in surface waters. These complex interactions and feedbacks, which are the hallmarks of trace gas dynamics between ocean and atmosphere, need to be investigated with regard to their biology.
- Single celled animals (protists) are key to understanding the evolution of more advanced organisms. Some species that reside in insect hind-guts contain within them organelles that are genetically related to mitochondria (the energy producing system in cells) and evolve hydrogen. There are other microorganisms that cluster around these organelles and use the hydrogen evolved for their own metabolism. The whole system is complex but modern genomic approaches make it possible to understand the dynamics of the system and its evolution.
- The nature and extent of interactivity between molecular scale phenomena and environmental factors and stressors is not well understood. For example, how are cellular processes such as self-replication and biosynthesis affected by changes in mineral composition, pollutants, or radiation levels? How has the mechanism of nutrient acquisition by organisms been shaped by competition from other organisms? Does competition for nutrients, or lack of it, result in discernable patterns in availability of particular nutrients?
- Biological networks (e.g., interacting genes, neurons, mycorrhizal fungi, plant roots), present an area where molecular, cellular and organismic biologists working with computer scientists (both software and hardware) can make progress in exploring very large-scale network problems. Thousands of interacting elements which determine emergent patterns can be represented as massive parameter spaces, and understood using computationally efficient methods.
- In many instances (locomotion, aggregation behavior, chemotaxis, etc.) sensors encode multimodal environmental stimuli (visual, mechanical and chemical) in nonlinear ways and process these through nonlinear filters. Responses to these stimuli modulate the sensitivity of the systems to stimuli. Moreover, memory and plasticity further confound simple linear analyses. Information is processed very fast, in adaptive and flexible ways, spanning a wide range of spatial and temporal scales. Biologists, in collaboration with computer scientists, need to develop adaptive and robust models and efficient algorithms for representing and understanding biological systems.

## **INCUBATION ACTIVITIES**

NSF also recognizes the need to enable groups of researchers who have not historically collaborated on Biocomplexity research. Consequently, **Incubation Activities**, or small grants to support focused workshops, virtual meetings, and to develop management and research interactions that could have a large payoff relative to the resources required, will be supported as part of this Special Competition.

## **ELIGIBILITY**

U.S. institutions that are eligible for awards from the National Science Foundation, including colleges, universities, and other nonprofit research institutions such as botanical gardens, marine and freshwater institutes, and natural history museums may submit proposals. The NSF encourages collaborations with scientists at foreign institutions; however, primary support for any foreign participants/activities must be secured through their own national sources.

NSF does not normally support technical assistance, pilot plan efforts, research requiring security classification, the development of products for commercial marketing or market research for a particular project or invention. Research with disease-related goals, including the 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 or testing of drugs or other procedures for their treatment also are not eligible for support. Research in bioengineering, with diagnosis or treatment related goals, however, that applies engineering principles to problems in biology and medicine while advancing engineering knowledge is eligible for support. Bioengineering research to aid persons with disabilities is also eligible.

Proposals already submitted to other NSF programs are not eligible for consideration by this special competition. However, NSF will simultaneously review proposals submitted to another Federal agency when both agencies have agreed to joint review and joint funding of the proposal.

A Principal Investigator may submit only one proposal and he/she may only collaborate in one other proposal as a co-Investigator. When consortia of eligible individuals or institutions submit a proposal, a single principal investigator must be designated as the project director and a single institution must accept overall management responsibility. When appropriate, collaborating scientists at foreign institutions, and those associated with entities such as national laboratories, state agencies, and Federally Funded Research and Development Centers, can be accommodated through consultant or subcontract mechanisms administered by the submitting U.S. institution, within the limits imposed by applicable legislation and regulations. Federal employees may not receive salaries or in other ways augment their agency's appropriations through grants made by this program.

## AWARD INFORMATION

In FY 2000, NSF expects to expend up to \$50 million on the activities described above, depending on the quality of submissions. Typical **Research Projects must be** multidisciplinary, involve at least one quantitative expert on the research team, may involve more than one institution, and can be up to 5 years in duration. Annual budgets may be up to \$600,000, with budgets up to \$1 million each year possible if extremely well justified.

**Incubation Activities** can be up to two years duration with total budgets not to exceed \$100,000 and cannot be renewed.

All awards will be made prior to September 30, 2000.

## PROPOSAL PREPARATION & SUBMISSION INSTRUCTIONS

### A. Messages of Intent for Research Project Proposals

A short electronic Message of Intent to submit a Research Project proposal can be sent on or before January 31 to: [biocom@nsf.gov](mailto:biocom@nsf.gov). The purpose of the message is to help NSF plan the review process by giving the Foundation an estimate of the number and topical breadth of proposals expected. The message should be **no more than 500 words long** (approximately one page of single-spaced text), and should touch on the following topics: 1) the question(s) to be addressed; 2) the integrated nature of the research as described in this announcement; 3) key elements of the research approach (methods, sites, organisms); and, 4) the identity of the investigators, institutions and facilities. **Do not send budgetary information.** An acknowledgement of receipt of the Message of Intent will be e-mailed by February 7. Please note that messages of intent are for planning purposes only. Proposal review and funding recommendations will be based on the full proposals.

### B. Proposal Preparation Instructions

Proposals submitted in response to this program announcement should be prepared and submitted in accordance with the general guidelines contained in the *Grant Proposal Guide* (GPG), NSF 00-2. The complete text of the GPG (including electronic forms) is available electronically on the NSF Web site at: <http://www.nsf.gov/>. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (301) 947-2722 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

Proposers are reminded to identify the program announcement number (NSF 00-22) in the program announcement/solicitation block on the NSF Form 1207, "*Cover Sheet for Proposal to the National Science Foundation.*" Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

Proposals must be submitted by FastLane (see "FastLane Requirements" section below) and must follow guidelines described in the *GPG* (NSF 00-2).

## RESEARCH PROPOSALS

Additional guidelines for full proposal preparation:

- **Cover Sheet (NSF Form 1207):** Begin project title with “BIOCOMPLEXITY:”
  1. In the NSF FastLane system read the proposal preparation instructions located at <http://www.fastlane.nsf.gov/a1/newstan.htm>. When completing the Cover Sheet make sure to select "Biocomplexity" as the NSF program to consider your proposal.

Multi-institutional proposals must identify a lead institution and must be submitted as a single proposal. Be sure to check the group proposal box on the cover. Only the lead institution should submit the proposal cover sheet (NSF Form 1207) via FastLane.

**NOTE: The BIO Proposal Classification Form (PCF) is not generated for proposals submitted to this competition.**

2. In the box labeled “Program Announcement/Solicitation No.” enter “NSF 00-22” with no additional characters.
3. In addition to the Principal Investigator (PI) NSF allows up to 4 individuals to be listed as Co-Principal Investigators (Co-PIs) on a proposal. Some proposals may involve more than 5 researchers, however. In this case the additional researchers can be listed in the Senior Personnel category. (On the FastLane FORM PREPARATION screen, click on 'Add/Delete Non Co-PI Senior Personnel')

- **Project Description**

**Research Plan (maximum length 15 pages):** The research plan **must** begin with a section that presents the conceptual, mathematical or computational model that frames the research activities and describes how the proposed work can lead to achieving a predictive level of understanding of the system under study.

The remainder of the Research Plan should describe the strategies, protocols, and timetables to be used in research procedures in sufficient detail to allow informed judgement by expert reviewers. The plan should indicate how the experiments/activities are designed to achieve the desired level of accuracy as well as a definitive elaboration of the methods of estimation, the inferential procedures to be used, and estimates of uncertainty for quantitative models and all research findings. The team should include at least one quantitative expert, who will provide data analysis including estimates of the uncertainty for quantitative models and all research findings.

Include information on the means by which data will be made available to the research community and to other users. In particular, specific arrangements made with other parties for the further exploration of selected types of discoveries should be spelled out. Proposals should take advantage of available opportunities for meaningful integration of research with education and outreach activities, and present these as an integral part of the research plan.

The Research Plan must include a research timetable and a clear statement of project priorities.

**Management Plan (maximum length 1 page):** The management plan should identify a single institution as the lead institution, if the proposal involves multiple institutions. It should detail the duties and responsibilities of participants, i.e., who will be doing what, including identification of a research team leader (usually the lead PI) and the activities of associated partners. A discussion of how data, ideas and people will be networked to facilitate the management, integration and dissemination of information and the generation of new knowledge is essential.

**Educational Activities (maximum length 2 page):** Because Biocomplexity projects are multi-disciplinary by design, they afford students an opportunity to experience a unique educational environment. Consequently, this section should include details on the education and training activities planned as part of the project. Describe specific sub-projects for undergraduates, graduate students or postdocs, if known. If specific training activities or workshops are proposed, include information on how participants will be selected. Opportunities for students to obtain novel research or educational experiences should be detailed. How the project will foster the integration of research and education should be presented.

### **C. Budgetary Information**

Provide yearly budgets for the duration of the proposed project. When subawards are involved yearly budgets are required for each subaward. FastLane will generate cumulative budgets for the primary and subaward institutions. Budget justification is required.

### **D. Special Information and Supplementary Documentation**

This section should include copies of permits, if required, and messages of agreement from collaborators. For research in Arctic regions, the Arctic Logistics Coordination form (see NSF-98-72) must accompany all submissions proposing fieldwork. NSF-UNOLS Ship Time Request Form must accompany all proposals requesting ship time. For research in the Antarctic, the Operational Requirements Cover Sheet and necessary worksheets must be submitted as described in NSF 99-93.

Provide only the allowable items as noted above and in the *GPG*, Chapter II, Section D.10. Include the materials in the FastLane submission by scanning the documents and transferring them as a .PDF file through the "Supplementary Docs" module of the FastLane Proposal Preparation system.

## **INCUBATION ACTIVITY PROPOSALS**

Proposals for small grants to support focused workshops, virtual meetings, and to develop management and research interactions that would ultimately facilitate biocomplexity research may be submitted to individual NSF programs at any time up to March 1, 2000.

Investigators are **strongly encouraged** to contact the NSF program(s) most germane to the proposal topic before submitting an Incubation Activity proposal. This will facilitate determining whether the proposed work is an appropriate Incubation Activity for Biocomplexity funding, or whether the work is more appropriate for submission as a fully reviewed proposal.

- **Cover Sheet (NSF Form 1207)**

1. In the NSF FastLane system read the proposal preparation instructions located at <http://www.fastlane.nsf.gov/a1/newstan.htm>. When completing the Cover Sheet select the appropriate NSF Division and relevant program discipline to consider your proposal. Clicking “OK” designates this program as the NSF organizational unit of consideration.
2. In the box labeled “Program Announcement/Solicitation No.” enter “NSF 00-22” with no additional characters.
3. Begin the Project Title with “BIOCOMPLEXITY-- INCUBATION ACTIVITY: ...”.

- **Project Description (maximum length 5 pages)**

The project description should be concise (two to five pages) and include clear statements as to why the proposed activities should be considered particularly relevant to the overall goals of the Biocomplexity theme.

- **Biographical Sketches**

Brief biographical information is required for the PI and Co-PI(s) only, and should list no more than five significant publications or other research products.

- **Budgetary Information**

**Incubation Activities** can be up to two years duration with total budgets not to exceed \$100,000.

#### **E. Message of Intent and Proposal Due Dates**

**The Message of Intent to submit a Research Project proposal, while not required, is strongly encouraged.** Submit the Message of Intent electronically by 5:00 p.m., submitter's local time, January 31, 2000 to [biocom@nsf.gov](mailto:biocom@nsf.gov).

**Research Project proposals must be submitted by 5:00 p.m., submitter's local time, March 1, 2000 via the NSF FastLane system.**

Incubation Activity proposals must be submitted by 5:00 p.m., submitter's local time, March 1, 2000 via the NSF FastLane system. Submit Incubation Activity proposals to relevant program disciplines.

**The signed Cover Sheet, including certification (NSF Form 1207), for proposals submitted to this competition, must be postmarked (or provide a legible proof of mailing date**

**assigned by the carrier) by March 7, 2000.** A proposal may not be processed until NSF has received the complete proposal (including signed Cover Sheet). Send the materials to:

National Science Foundation  
DIS-FastLane Cover Sheet  
4201 Wilson Boulevard  
Arlington, VA 22230

#### **F. FastLane Requirements**

Proposers must prepare and submit proposals using the NSF FastLane system. Detailed instructions for proposal preparation and submission via FastLane are available at <https://www.fastlane.nsf.gov/a1/newstan.htm>.

*Submission of Signed Cover Sheets.* For proposals submitted electronically, the signed paper copy of the proposal Cover Sheet (NSF Form 1207) should be forwarded to NSF within five working days following proposal submission in accordance with FastLane proposal preparation and submission instructions referenced above.

To use FastLane to prepare the proposal your institutions needs to be a registered FastLane institution. A list of registered institutions and the FastLane registration form are located on the FastLane Home page. To register an organization, authorized organizational representatives must complete the registration form. Once an organization is registered, PIN for individual staff is available from the organization's sponsored projects office.

Using NSF's FastLane requires the following software: Netscape Navigator 3.01 or above, or Microsoft Internet Explorer 4.01 or above; Adobe Acrobat Reader 4.0 or above for viewing PDF files; and Adobe Acrobat 3.X or above or Aladdin Ghostscript 5.10 or above for converting files to PDF.

To access FastLane, go to the NSF Web site at <http://www.nsf.gov>, then select "FastLane," or go directly to the FastLane home page at <http://www.fastlane.nsf.gov/>. Additionally, read the "PI Tipsheet for Proposal Preparation" and the "Frequently Asked Questions about FastLane Proposal Preparation," accessible at <https://www.fastlane.nsf.gov/A0/about/A1faq.htm>.

**IMPORTANT NOTE:** For technical assistance with FastLane, please send an e-mail message to [biofl@nsf.gov](mailto:biofl@nsf.gov). If you have inquiries regarding other aspects of the proposal preparation or submission, please send an e-mail message to [biocom@nsf.gov](mailto:biocom@nsf.gov) before the deadline date for submission.



## **PROPOSAL REVIEW INFORMATION**

### **A. Merit Review Criteria**

Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program officers charged with the oversight of the review process. NSF invites the proposer to suggest, at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority serving institutions or adjacent disciplines to that principally addressed in the proposal.

Proposals will be reviewed against the following general merit review criteria established by the National Science Board. Following each criterion are potential considerations that the reviewer may employ in the evaluation. These are suggestions and not all will apply to any given proposal. Each reviewer will be asked to address only those that are relevant to the proposal and for which he/she is qualified to make judgments.

#### **What is the intellectual merit of the proposed activity?**

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

#### **What are the broader impacts of the proposed activity?**

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

PIs should address the following elements in their proposal to provide reviewers with the information necessary to respond fully to both NSF merit review criteria. NSF staff will give these factors careful consideration in making funding decisions.

#### **Integration of Research and Education**

One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can

engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learner perspectives.

### **Integrating Diversity into NSF Programs, Projects, and Activities**

Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- are essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

#### **B. Review Protocol and Associated Customer Service Standard**

All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. **Research project proposals submitted in response to this announcement will be reviewed by a multidisciplinary panel and by mail reviewers. Incubation Activity proposals will be reviewed internally by NSF program officers.**

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. A program officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation. NSF will be able to tell applicants whether their proposals have been declined or recommended for funding within six months for 95 percent of proposals. The time interval begins on the proposal deadline or target date or from the date of receipt, if deadlines or target dates are not used by the program. The interval ends when the division director accepts the program officer's recommendation.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with an NSF Program officer. A principal investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants Officer does so at its own risk.

### **AWARD ADMINISTRATION INFORMATION**

#### **A. Notification of the Award**

Notification of the award is made *to the submitting organization* by a Grants Officer in the Division of Grants and Agreements (DGA). Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program Division administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator.

## **B. Grant Award Conditions**

An NSF grant consists of: (1) the award letter, which includes any special provisions applicable to the grant and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award letter; (4) the applicable grant conditions, such as Grant General Conditions (NSF GC-1)\* or Federal Demonstration Partnership Phase III (FDP) Terms and Conditions\* and (5) any NSF brochure, program guide, announcement or other NSF issuance that may be incorporated by reference in the award letter. Electronic mail notification is the preferred way to transmit NSF grants to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

\* These documents may be accessed electronically on NSF's Web site at: <<http://www.nsf.gov/>>. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (301) 947-2722 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

More comprehensive information on NSF Award Conditions is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, (NSF 95-26) available electronically on the NSF Web site. The GPM also is available in paper copy by subscription from the Superintendent of Documents, Government Printing Office, Washington, DC 20402. The GPM may be ordered through the GPO Web site at: <<http://www.gpo.gov/>>. The telephone number at GPO for subscription information is (202) 512-1800.

## **C. Reporting Requirements**

All successful Research Project PIs are required to attend the annual awardees meeting at a date and place to be specified by NSF, during the tenure of the award, and to plan for a formal site visit by NSF at the midpoint of the award.

For all multi-year grants (including both standard and continuing grants) the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

Within 90 days after expiration of a grant, the PI also is required to submit a final project report. Approximately 30 days before expiration, NSF will send a notice to remind the PI of the requirement to file the final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

NSF has implemented a new electronic project reporting system, available through FastLane, which permits electronic submission and updating of project reports, including information on: project participants (individual and organizational); activities and findings; publications; and, other specific products and contributions. Reports will continue to be required annually and after the expiration of the grant, but PIs will not need to re-enter information previously provided, either with the proposal or in earlier updates using the electronic system.

Effective October 1, 1999, PIs are required to use the new reporting system for submission of annual and final project reports.

#### **D. New Awardee Information**

If the submitting organization has never received an NSF award, it is recommended that the organization's appropriate administrative officials become familiar with the policies and procedures in the NSF *Grant Policy Manual* which are applicable to most NSF awards. The "Prospective New Awardee Guide" (NSF 99-78) includes information on: Administrative and Management Information; Accounting System Requirements and Auditing Information; and Payments to Organizations with NSF Awards. This information will assist an organization in preparing documents that NSF requires to conduct administrative and financial reviews of an organization. The guide also serves as a means of highlighting the accountability requirements associated with Federal awards. This document is available electronically on NSF's Web site at: <http://www.nsf.gov/cgi-bin/getpub?nsf9978>.

#### **CONTACTS FOR ADDITIONAL INFORMATION**

Please direct general inquiries about the Biocomplexity: Special Competition 2000 to the e-mail address ([biocom@nsf.gov](mailto:biocom@nsf.gov)) or to the following Program Officers:

##### **Biological Sciences (BIO)**

Ted Elliott  
Phone: (703) 306-1479  
E-mail: [eelliott@nsf.gov](mailto:eelliott@nsf.gov)

##### **Computer and Information Science and Engineering (CISE)**

Y. T. Chien  
Phone: (703) 306-1980  
E-mail: [ytchien@nsf.gov](mailto:ytchien@nsf.gov)

##### **Engineering (ENG)**

Gary Poehlein  
Phone: (703) 306-1365  
E-mail: [gpoehlei@nsf.gov](mailto:gpoehlei@nsf.gov)

##### **Geosciences (GEO)**

Phil Taylor  
Phone: (703) 306-1587  
E-mail: [prtaylor@nsf.gov](mailto:prtaylor@nsf.gov)

##### **Mathematical and Physical Sciences (MPS)**

Jim Rosenberger  
Phone: (703) 306-1883  
E-mail: [jrosenbe@nsf.gov](mailto:jrosenbe@nsf.gov)

**Social, Behavioral and Economic Sciences (SBE)**

Cheryl Eavey

Phone: (703) 306-1729

E-mail: [ceavey@nsf.gov](mailto:ceavey@nsf.gov)

**Office of Polar Programs (OPP)**

Polly Penhale

Phone: (703) 306-1033

E-mail: [ppenhale@nsf.gov](mailto:ppenhale@nsf.gov)

For technical assistance with FastLane, please send an e-mail message to [biofl@nsf.gov](mailto:biofl@nsf.gov).

**OTHER PROGRAMS OF INTEREST**

The NSF *Guide to Programs* is a compilation of funding opportunities for research and education in science, mathematics, and engineering. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter. Many NSF programs offer announcements concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices listed in Appendix A of the *GPG*. Any changes in NSF's fiscal year programs occurring after press time for the *Guide to Programs* will be announced in the NSF Bulletin, available monthly (except July and August), and in individual program announcements. The Bulletin is available electronically on the NSF Web site at <http://www.nsf.gov>. The direct URL for recent issues of the Bulletin is <http://www.nsf.gov/od/lpa/news/publicat/bulletin/bulletin.htm>. Subscribers can also sign up for NSF's Custom News Service to find out what funding opportunities are available.

## **ABOUT THE NATIONAL SCIENCE FOUNDATION**

The National Science Foundation (NSF) funds research and education in most fields of science and engineering. Grantees are wholly responsible for conducting their project activities and preparing the results for publication. Thus, the Foundation does not assume responsibility for such findings or their interpretation.

NSF welcomes proposals from all qualified scientists, engineers and educators. The Foundation strongly encourages women, minorities, and persons with disabilities to compete fully in its programs. In accordance with federal statutes, regulations, and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NSF (unless otherwise specified in the eligibility requirements for a particular program).

Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF-supported projects. See the program announcement or contact the program coordinator at (703) 306-1636.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation regarding NSF programs, employment, or general information. TDD may be accessed at (703) 306-0090 or through FIRS on 1-800-877-8339.

## **PRIVACY ACT AND PUBLIC BURDEN STATEMENTS**

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the review process; to applicant institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies needing information as part of the review process or in order to coordinate programs; and to another Federal agency, court or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne H. Plimpton, Reports Clearance Officer; Division of Administrative Services; National Science Foundation; Arlington, VA 22230.

### **YEAR 2000 REMINDER**

In accordance with Important Notice No. 120 dated June 27, 1997, Subject: Year 2000 Computer Problem, NSF awardees are reminded of their responsibility to take appropriate actions to ensure that the NSF activity being supported is not adversely affected by the Year 2000 problem. Potentially affected items include: computer systems, databases, and equipment. The National Science Foundation should be notified if an awardee concludes that the Year 2000 will have a significant impact on its ability to carry out an NSF funded activity. Information concerning Year 2000 activities can be found on the NSF web site at <http://www.nsf.gov/oirm/y2k/start.htm>.

The National Science Foundation is committed to making all of the information we publish easy to understand. If you have a suggestion about how to improve the clarity of this document or other NSF-published materials, please contact us at [plainlanguage@nsf.gov](mailto:plainlanguage@nsf.gov).

Catalogue of Federal Domestic Assistance (CFDA) No.: 47.074 (BIO), 47.070 (CISE), 47.041 (ENG), 47.050 (GEO), 47.049 (MPS), 47.075 (SBE), 47.078 (OPP)

OMB No.: 3145-0058

NSF 00-22 (Replaces NSF 99-60) -- Electronic Dissemination Only