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ABSTRACT

This guide for the fiscal year 1975 is designed to provide summary information about programs funded by the National Science Foundation, and is intended as a source of general guidance for institutions and individuals interested in participating in these programs. Program listings describe the principal characteristics and basic purpose of each activity, eligibility requirements, closing dates (where applicable), and the address from which more detailed information, brochures, or application forms may be obtained. (Author/EB)

Guide to Programs

National Science Foundation

FISCAL YEAR 1975

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This guide is designed to provide summary information about assistance programs of the National Science Foundation, and is intended as a source of general guidance for institutions and individuals interested in participating in these programs. Program listings describe the principal characteristics and basic purpose of each activity, eligibility requirements, closing dates (where applicable), and the address from which more detailed information, brochures, or application forms may be obtained.

DISCRIMINATION PROHIBITED

In accordance with Federal statutes and regulations, no person shall, on grounds of race, color, sex, or national origin, be excluded from participation in or denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from the National Science Foundation.

INTRODUCTION

The National Science Foundation is an agency of the Federal Government established in 1950 to advance scientific progress in the United States. The Foundation fulfills this responsibility primarily by sponsoring scientific research, encouraging and supporting improvements in science education, and fostering scientific information exchange. NSF does not itself conduct research or carry out education projects.

The Foundation supports scientific research and education projects in the mathematical, physical, medical, biological, social, and engineering sciences. The Foundation does not support projects in clinical medicine, the arts and humanities, business areas, or social work.

The National Science Board is the policymaking body of the National Science Foundation. It consists of 25 members appointed by the President, by and with the consent of the Senate, and includes the Director of the Foundation who serves on a full-time basis. The Board passes on new Foundation programs and on grants or contracts requiring a total commitment of more than $2 million or an annual expenditure of more than $500,000.

Proposals for support are ordinarily assigned to the appropriate division or office for review and evaluation. An organization chart depicting the major areas of program activity is provided on page 85.

In making its decisions on proposals, the Foundation relies heavily on the advice and assistance of advisory panels, outside reviewers, and other experts to ensure that NSF is able to reach fair and knowledgeable judgments. These scientists and educators come from colleges and universities, from nonprofit research and educational organizations, from industry, and from other Government agencies. Their counsel has proven invaluable to the Foundation.

The National Science Foundation Act of 1950, as amended, permits the Foundation to support basic research, without restriction as to the type of performer. It also permits the support of applied research at academic and other nonprofit institutions. By letter to the Director of April 13, 1972, and pursuant to the authority of Section 3(c) of the Act, the President extended the applied research authority in the following terms:

> The Foundation, in making grants or contracts for applied scientific research relevant to national problems involving the public interest, may support such work at other than academic and nonprofit institutions when the Director of the National Science Foundation determines that it would be advantageous to use the capabilities of such other institutions to accomplish the program objectives.

Within the limits of this Directive, it is the policy of the National Science Foundation to support research at

industrial or commercial organizations when it is advantageous for the attainment of its program objectives. The Director of the Foundation has determined in which research program areas industrial and commercial organizations will be encouraged to participate, and has approved the criteria for participation in the program.

The Foundation will continue to emphasize its traditional role of support for a strong national basic research capability, particularly in academic institutions, and the improvement of science education. At the same time, the participation of individual industry and other nonacademic organizations is encouraged in the following NSF program areas:

1. RANN (Research Applied to National Needs)
2. Experimental R&D Incentives Program
3. National R&D Assessment Program
4. International Decade of Ocean Exploration Program
5. Computer Applications in Research Programs
6. Computer Impact on Society Program
7. Science Information Service

Also, collaboration between industry and university researchers, as well as between industry and State or local governments, on appropriate programs is encouraged. Similarly, broader efforts through industry associations, groups of companies, or professional societies may be supported. Prospective proposers are encouraged to contact the appropriate program for program announcements and brochures and for preliminary discussions and guidance prior to the submission of a proposal.

Generally, awards are made in response to both solicited and unsolicited proposals. Normally, awards resulting from unsolicited research proposals are made on a cost-sharing or jointly funded basis while those from solicited proposals may provide for payment of full costs including fee. Proposals in response to specific program announcements are considered solicited only when the announcement so indicates.

Disposition of rights to data and inventions resulting from Foundation-supported research are subject to negotiation. Factors to be considered are the nature and purpose of the project and other factors involving the public interest, the commercial position of the awardee, and any equities he may have. At a minimum the Government will receive a royalty-free, paid-up license and the right to require the licensing of others on reasonable terms in certain circumstances.

The National Science Foundation looks forward to being able to utilize and properly integrate the capabilities of all institutions in the support of science and its contribution to society and the Nation.

Criteria for the Selection of Research Projects

The National Science Foundation administers several different programs of research support corresponding to several legislatively assigned objectives. To the maximum degree possible, these activities are designed to utilize and enhance existing scientific research potential and institutions. Purposeful adjustments are made when indicated.

In the selection of individual projects a number of widely understood and acknowledged criteria are considered. In different programs, the different criteria must be assigned different weights, according to the objectives being pursued. Also these criteria relate in different ways to the distinctive characteristics of different types of research-performing organizations.

INTRODUCTION

Policy Context

Public support of scientific research, specifically including *basic* research, is an accepted feature of United States public policy. Such support has two recognized major objectives:

— To foster and maintain basic research as an investment toward future opportunities, as insurance against unforeseeable future dangers, and as a vital element of culture;

— To bring about prompt, effective performance of applied research and problem-oriented basic research—insofar as specific needs for these can be foreseen—in the light of current understanding.

The National Science Foundation

It is not possible to make the distinction between basic and applied research a sharp one, and the Foundation is one of several Federal agencies that supports research of both kinds. The Foundation, however, is unique in its mission to foster basic research *per se* and in its responsibility for future scientific research capability. Thus the National Science Foundation Act of 1950, as amended, authorizes "programs to strengthen scientific research potential" as well as "scholarships and graduate fellowships." The Act authorizes support both of basic and of applied research and—in combination with Presidential directive—use of an unrestricted range of performers.

Agency Objectives and Methods

The Foundation thus has been charged with advancing several different but interrelated major objectives:

- Accomplishment of basic research;
- Accomplishment of applied research in selected areas;
- Long-term maintenance and strengthening of potential to accomplish both basic and applied research in the future.

This range of objectives has been reflected in the development of several different program formats for NSF support of research. But despite the approximate correspondence of programs to objectives, it remains true that research support actions are often taken with more than a single end in view. Thus the Foundation's method of pursuing any one objective may be modified or restricted by consideration of the others.

Functions Performed

Where research support is concerned, functions performed by the Foundation include:

— Allocation of resources to fields of science, to classes of scientific activity, or to areas of application;

— Selection of individual projects to be supported;

— Direct establishment or adjustment of institutional structures or capabilities.

CRITERIA

Allocation of resources to fields of science and to areas of application is not further discussed in this notice, but many of the criteria for individual project selection require only slight modification for use at the higher level of aggregation. Criteria for the creation or modification of institutional structures are dealt with in a separate section.

The following is an enumeration of criteria employed in the selection of research projects. To simplify later discussion, they are grouped in four categories.

Category A

Criteria relating to competent performance of research—the technical adequacy of the performer and of his institutional base:

1. The scientist's training, past performance record, and estimated potential for future accomplishment;
2. The scientist's demonstrated awareness of previous and alternative approaches to his problem;
3. Probable adequacy of available or obtainable instrumentation and technical support.

Category B

Criteria relating to the internal structure of science itself:

4. Probability that the research will lead to important discoveries or valid, significant conceptual generalizations within its field of science or (in the most favorable cases) extending to other fields as well;
5. Probability that the research will lead to significant improvements or innovations of investigative method—again with possible extension to other fields of science.

Category C

Criteria relating to utility or relevance:

6. Probability that the research can serve as the basis for new invention or improved technology;
7. Probable contribution of the research to technology assessment—i.e., to estimating and predicting the direct and indirect, intended and unintended effects of existing or proposed technologies.
8. Identification of an immediate programmatic context and user of the anticipated research results.

Category D

Criteria relating to future and long-term scientific potential of the United States:

9. Probable influence of the research upon the capabilities, interests, and careers of participating graduate students, postdoctoral associates, or other junior researchers;

10. Probability that the research will lead to radiation and diffusion, not only of technical results, but also of standards of workmanship and a tradition of excellence in the field;

11. Anticipated effect upon the institutional structure of U.S. science.

Because none of these considerations is susceptible to precise quantification, or even in most cases to unambiguous rank ordering, it would be more accurately descriptive to speak not of "criteria" but rather of "factors considered." Moreover, very different relative weights must be attached to the different factors in the case of different agency objectives or programs, as is explained in a later section.

Discussion

The first three criteria—those relating to competent execution—are given first consideration in every program. Every NSF-supported project is expected at the least to produce some valid new information or relationships. The best way to ensure this is to insist upon competent scientists and adequate facilities. All other considerations which follow, then, are predicated upon the assumption that these first three criteria are universally applied and that competent performance will be the normal expectation.

Criteria 4 and 5—those relating to the internal structure of science—summarize succinctly what the scientific community understands by the phrase "intrinsic scientific merit."

Criteria 6 and 7—those relating to utility or relevance—cannot be made entirely distinct from the preceding two, since that science judged best by internal standards has almost invariably turned out in the long run to be the most useful. Valid generalizations and powerful methods of observation and measurement usually lead to new invention, improved technology, and more confident assessment. Conversely, applied investigations designed to support invention, technology, and assessment tend to succeed in these purposes to the extent that they do uncover valid generalizations or improved methods. Thus differences between the two types of criteria are mainly ones of motivational specificity and time horizon. Research is properly termed "applied" when we visualize using the results in a very specific context—usually defined in terms of some already-formulated systems concept—or when we expect it will prove diagnostic of some already-recognized problem.

This specific relationship of applied research to a particular systems concept and plan of development is made still more explicit in criterion 8.

Criteria 9, 10, and 11—those relating to long-term scientific potential—address not so much the content of the research as the circumstances under which it is performed. They include, of course, the quality of training of scientists, but extend beyond this to the processes of scientific communication and publication, the evolution of traditional scientific disciplines, the spawning of new "interdisciplinary" disciplines, the manner in which scientific careers are developed, the organizational structures and settings in which all this goes on, and in general how the scientific tradition and the living corps of scientific capability of our Nation are maintained. While these criteria are seldom dominant in project selection or program development, they are always considered. The policy of the Foundation is not to undertake for short-term reasons any action which would seriously jeopardize the long-range science potential of the Nation.

APPLICATION TO SPECIFIC PROGRAMS

As has been described, the first three criteria are vigorously applied in all Foundation programs, and the last three also are always kept in view. More specialized emphases characterize individual programs, as follows:

Scientific Research Project Support

In this core program the emphasis is overwhelmingly upon the criteria of intrinsic scientific merit (1 and 5). Consideration is also given to the utility criteria (6 and 7)—not on a project-by-project basis but rather as considerations influencing the general level of effort to be applied to entire fields and subfields of science. Considerable direct weight is also given to criteria 9, 10, and 11(those relating to future and long-term potential). Projects are selected and administered not only to preserve but to enhance the essential character of proven successful institutions. Thus, it is Foundation policy to encourage such institutional and organizational features as:

- Participation in research by graduate students;
- Open publication of research results in the standard literature;
- Widest possible access to unique facilities for interested and competent scientists;
- Emphasis upon originality, elegance, and economy of method in university research; and
- Maintenance of vigorous informal communication through symposia, workshops, scientific meetings, etc.

Energy-Related General Research is administered as a specialized augmentation of Scientific Research Project Support. Here the utility criteria (6 and 7) play a major role—being decisive in selection of scientific areas eligible for participation. Within the eligible areas, individual projects compete on the basis of scientific merit. Criteria 9, 10, and 11 here play a role which is less direct and more passive than for the core Scientific Research Project Support Program.

National and Special Research Programs—The relative weight of the different criteria for these programs is essentially the same as for the Scientific Research Project Support discussed above. But, because there are for the most part large-scale coordinated efforts, often including a logistic component and requiring special planning and management, somewhat greater consideration is required for organizational and institutional factors (criterion 11)—as is further discussed in a later section.

Research Applied to National Needs—Here, criteria of utility (6, 7, and 8) play a dominant role. Criteria of scientific merit and long-range future potential, of course, are also considered. The utility criteria 6, 7, and in most cases 8, are applied to individual grants on a project-by-project basis. To help potential investigators meet these criteria and to ensure programmatic coherence, the Research Applications Directorate issues from time to time divisional program brochures, guidelines for preparation of unsolicited proposals, program solicitations, and occasionally, requests for proposals. Applicants for support are encouraged and assisted to establish communications with potential users of their results at an early stage of negotiations.

Criteria for Actions Which Create or Modify Institutional and Organizational Structures

Actions of this type occur frequently in the support of National Research Centers and under the National and Special Research Programs. The applicable criteria reflect greater intervention and responsibility on the part of the Government and decisions at a higher level of aggregation. They include:

Criteria of Need

Evidence of a real scientific need and an opportunity to attack important problems in a way, or on a scale, not otherwise feasible or available.

Evidence that the program objectives can better be achieved through the organization of a new structure than through use of an existing one.

Criteria of Long-Range Potential

Formulation of a mission well enough and broadly enough defined to hold out prospects of high scientific productivity over an extended period.

Evidence that a significant number of first-class scientists (as judged by their peers) believe deeply in the proposed activity and are willing to commit their personal scientific careers to it.

Evidence that the new structure and its programs will strengthen rather than detract from related work performed in other settings.

RELATIONSHIP TO SOME CHARACTERISTICS OF RESEARCH-PERFORMING ORGANIZATIONS

NSF policy is to use and reinforce proven strengths of U.S. scientific institutions. These institutions include organizations of different types, such as:

- Universities and colleges;
- Industrial research laboratories and in-house laboratories of Federal agencies;
- National Centers and other federally funded research centers
- Vendors of R&D services.

The Foundation seeks to avoid inadvertently changing the characteristics of proven organizations—either through individual actions, or as the cumulative result of many actions. Purposeful changes may occasionally be encouraged for specific reasons. Some relevant characteristics of the different types of organization include the following:

- Universities and colleges (academic institutions proper) have as their two principal missions teaching and the development and propagation of new knowledge and understanding. As applied to these organizations, therefore, criteria 9 and 10 may be regarded as criteria of "mission relevance."

- Academic organizations, traditionally, are deeply committed to considerations of intrinsic scientific merit (criteria 4 and 5) in developing and selecting their own research programs. This is largely a consequence of peer evaluation and peer pressure exerted upon the individual scientist.

- Organization along disciplinary lines is a prominent feature of academic research tradition. This is an indispensable virtue insofar as its guarantees comprehensive peer evaluation of scientific research *results*, but it presents some limitations for problem-oriented research. It should be borne in mind that new disciplines emerge from time to time and that the focus of established disciplines evolves continually.

- Academic environments also tend to place extreme value upon originality, methodological elegance, and upon the initiative and scientific judgment of the individual investigator. This characteristic again presents some limitations for problem-oriented research.

- Industrial research laboratories and Federal agencies' in-house laboratories generally have as their mission the generation of new knowledge and understanding in areas judged to be of immediate or potential concern and use in carrying out the commercial activities of the parent company or the mission of the agency.

- National Centers and federally funded research centers have as their mission the generation of new knowledge and understanding judged to be needed or desirable in the

public interest. These organizations are generally established to provide specialized research environments not readily obtainable in organizations of the other types.

● Vendors of R&D services include many of the "not-for-profit" R&D organizations and also a number of—usually more specialized—R&D companies. These organizations, in addition to maintaining some level of independent research, are unique in the extent to which they undertake contract research on topics and problems designated by outside purchasers. Collectively they constitute a reservoir of general purpose research capability for hire.

Discussion

Different factors tend to determine the scope and complexion of the research programs in the different types of organizations. Thus universities tend to be complement limited. For them the primary management decision is how many professional staff (faculty) to employ and which particular ones. Subsequently, these individuals determine program content. Industrial and mission agency in-house laboratories are "mission determined." That is, activity is weighed and selected according to mission requirements. Finally, R&D vendors are, at least to some extent, capability and market limited. Foundation policy is to recognize and, generally, to avoid disturbing these characteristic differences.

Contents

I. SCIENTIFIC RESEARCH PROJECTS

Programs described in Chapter I are administered by the Assistant Director for Research through more than 80 individual program offices.

Through its major program, Scientific Research Project Support (SRPS), the National Science Foundation provides project support for research in all of the sciences, including engineering, mathematics, and computer research. The Foundation further assists universities to procure specialized research facilities and equipment, and in the support of research workshops, symposia, and conferences. The majority of requests received in the SRPS program are submitted by U.S. universities and colleges on behalf of individual scientists or groups of scientists on their faculties. Foundation policy emphasizes research that also contributes to graduate and postdoctoral education in the sciences. Support of research at foreign institutions is provided only when it is clearly in the interest of science in the United States.

Research project proposals are considered primarily on the basis of scientific merit. Scientific merit is assessed according to the promise of significant scientific results, the possible scientific impact, the probable opening of a new field, and potential applications.

Scientific Research Project Support

THE SCIENTIFIC RESEARCH PROJECT SUPPORT (SRPS) program provides a broad base of support for fundamental research in all fields of science with the objective of increasing our store of scientific knowledge and enhancing our understanding of the scientific aspects of major problems confronting the Nation. Most of the research supported is basic in character, although some work of a more applied nature is also supported. Through this program support may also be provided for research workshops, symposia and conferences, and for the purchase of scientific equipment.

Grants normally provide support for periods up to 24 months. To provide reasonable assurance of long-term support for continuing projects of high scientific merit, approval may be provided for periods up to 60 months with funding provided in annual increments contingent upon the availability of the funds and satisfactory progress of the research.

Institutions are required to share in the cost of each unsolicited research project supported by an NSF grant or contract. Before submitting a proposal for research support under the SRPS program, the brochure GRANTS FOR SCIENTIFIC RESEARCH should be consulted for guidance in preparing the application. A recommended format is provided in the brochure, but standard application forms are not required.

Eligibility

The principal recipients of support under this program are academic institutions and institutions closely associated with advanced research training. In special circumstances, grants may also be awarded to other types of institutions and to individuals. In these cases, preliminary discussion with the Foundation is recommended. Support through SRPS may be provided to projects involving a single scientist or to projects covering the activities of a number of scientists. While most projects are confined to a single disciplinary area, awards also are made for projects which cross or merge disciplinary interests.

Deadlines

Proposals may be submitted at any time. Approximately 6 months should be allowed for consideration of a proposal.

Additional Information

The range of scientific support activity of these programs is summarized as follows:

Biological and Medical Sciences (excluding clinical aspects)

- **Cellular Biology**—Supports studies on the development of living things and their genetic and hereditary characteristics. A special program on understanding the human cell is also supported.
- **Ecology**—Supports both individual projects and large, integrated studies of terrestrial and freshwater ecosystems.
- **Systematic Biology**—Provides support for research in evolutionary biology and for the operation of critical resource centers such as museum research collections, herbaria, and stock centers.
- **Molecular Biology**—Supports research on structures, interactions, and functions of living systems at the molecular level.
- **Physiological Processes**—Supports studies in the metabolism of organisms and on the function and interaction of organ systems in plants and animals.

- **Psychobiology and Neurobiology**—Provides support for studies on human and animal behavior, and for research dealing with any aspect of the central nervous system.

Materials Research—Support is provided for research directed to understanding the properties of solids and cryogenic liquids. Studies in this area encompass research in solid state physics, physical metallurgy, process metallurgy, inorganic, polymer and physical chemistry, ceramics, and the engineering properties of materials.

Mathematical and Physical Sciences—Provides support for research in the following major areas:

- **Astronomy**—Supports ground-based observations and theoretical investigations of extra-terrestrial objects and phenomena.

- **Chemistry**—Supports research in the properties, structure, and transformation of matter.

- **Mathematics**—Provides research in core mathematics and in the application of mathematics to other sciences.

- **Physics**—Supports research on the most fundamental aspects of the properties and interactions of matter and energy. (Solid state physics is supported as part of the materials research program.)

Social Sciences—Support is provided for research in the social sciences which includes investigations in:

- **Cultural, physical, and social anthropology and archaeology**
- **Economics**
- **Economic and social geography**
- **The history and philosophy of science**
- **Political science**
- **Social psychology, sociology, and social indicators**
- **Linguistics, including computational linguistics**
- **Law-related, social scientific research**
- **Fundamental studies in science policy.**

Computer Research—Support is provided for basic research relating to the foundations and fundamental structure of the science of computing and the principles underlying the design of computer hardware and software systems. Also supported is work directed to the advancement of research methodology in scientific disciplines through the use of computer science and technology; and studies pertaining to the role of the computer in a broad spectrum of societal issues, such as privacy, human-machine interfaces, and energy-related computer modeling.

Engineering—Support is provided in the following major subject areas:

- **Electrical Sciences and Analysis**—Supports research in the general area of electrical engineering, including operations research, systems engineering, biomedical engineering, devices, control, and communications systems.

- **Engineering Chemistry and Energetics**—Supports research related to the technological development and economic growth of the chemical process, energy conversion, and related industries.

● **Engineering Mechanics**—Provides support for studies in solid and fluid mechanics; structural, materials, and geotechnical engineering; mechanical and industrial technology and water resources; and urban and environmental technology.

Environmental Sciences—Provides research support in the following areas:

● **Atmospheric Sciences**—Supports studies in physics, chemistry, energetics, and other fields related to the atmospheres of the Earth and the Sun.

● **Earth Sciences**—Supports studies dealing with the structure, composition, and history of the solid earth.

● **Oceanography**—Supports research in physical, chemical, and biological oceanography, in the geological processes affecting the ocean basins and in physical limnology.

Energy-Related General Research

WITHIN THE SCIENTIFIC RESEARCH Project Support (SRPS) program described on the previous pages, the National Science Foundation encourages the submission of proposals directed to enlarging our understanding of the scientific aspects of the Nation's energy problems. Proposals will be reviewed in the regular competition for research support and will be judged on their scientific merit.

Illustrations of research areas of current emphasis in Energy-Related General Research include: aerosols and other colloidal phenomena; biological catalysis; chemical catalysis; chemical and physical processes; combustion, corrosion; ecology; electrical power and transmission; electrochemistry; environmental motion; fission and fusion; geoengineering; societal response; heat and mass transfer; instrumentation development; mechanical properties of material; macroeconomic modeling; microbial conversions; computer simulation; nitrogen fixation; numerical analysis and approximation theory; photosynthesis; plasma dynamics; radiation effects; remote sensing; statistical mechanics; solid surfaces; systems theory; thermodynamics; and turbulence.

Eligibility

Eligibility is the same as for the SRPS program described on page 3.

Deadlines

Proposals may be submitted at any time.

Additional Information

Proposals should be prepared in accordance with the guidelines contained in the brochure GRANTS FOR SCIENTIFIC RESEARCH. A more complete listing and a brief description of research areas of current emphasis in Energy-Related General Research may be obtained from: The Office of Energy-Related General Research, Assistant Director for Research, National Science Foundation, Washington, D.C. 20550.

Doctoral Dissertation Research

THE NATIONAL SCIENCE FOUNDATION awards grants to improve the scientific quality of dissertations in the social sciences and certain sciences involving extensive field work. Grants are awarded for periods up to 21 months. Grant funds may not be used as a stipend for the doctoral candidate, although he may receive support from other sources.

Eligibility

Proposals may be submitted by universities on behalf of doctoral candidates for the support of dissertation research in systematic biology, ecology, and ethology (biological and medical sciences); oceanography, earth sciences, and atmospheric sciences (environmental sciences); and the social sciences, including science policy and problems of poverty. Proposals should be submitted by the dissertation advisor, department chairman, or chairman of the departmental committee on doctoral degrees.

Deadlines

Proposals may be submitted at any time; one or more grant requests may be made in a single proposal if the budget for each request is set forth separately. Four months should be allowed for processing the grant application.

Additional Information

A leaflet that sets forth application procedures is available from the Foundation. Communications may be addressed to: Division of Biological and Medical Sciences, Division of Environmental Sciences, or Division of Social Sciences, National Science Foundation, Washington, D.C. 20550.

Engineering Research Initiation Grants

THE NATIONAL SCIENCE FOUNDATION awards grants to encourage the development of meritorious and innovative research programs by engineering faculty members.

Two options are available to a prospective grantee:

Option A—provides research support for an investigator for a period of 18 months covering a summer and the following academic year and summer.

Option B—provides support up to 24 months for combining a research program with industrial experience. Under this option, it is expected that the investigator will devote at least one-fourth time during the academic year to research, and will spend 2 months of each summer preceding and following the academic year in a nonacademic environment directly related to the research activities. Additional support is provided to cover the costs associated with relocation during the two summers.

Eligibility

A proposal may be submitted on behalf of an individual who:

(1) Is an assistant professor, instructor or associate professor holding a full-time regular academic appointment on the engineering teaching faculty of an institution of higher education within the United States that confers graduate degrees in engineering;

(2) Is a citizen or permanent resident of the United States as of date of submission of proposal; and

(3) Has had no substantial research support.

(4) Was awarded the Ph.D. degree within 2 years of application.

Deadlines

Instructions for preparing engineering research initiation proposals are available in early October from the offices listed below. Request the ENGINEERING RESEARCH INITIATION GRANTS brochure. Proposals must be postmarked on or before the first Monday in December to be eligible for consideration.

Additional Information

Communications may be addressed to: Division of Engineering or Division of Materials Research, National Science Foundation, Washington, D.C. 20550.

II. NATIONAL AND SPECIAL RESEARCH PROGRAMS

National and Special Research Programs of the Foundation are major efforts of research or research support of such broad scope that extensive coordination of planning, management, funding, and logistics is essential to effective program performance. These programs may be characterized by inclusion of one or more of the following elements: international cooperation, coordination with other agencies of Government, a relationship to a specific geographic region, or interdisciplinary scientific investigations.

Except where otherwise noted, programs described in this chapter are administered by the Assistant Director for National and International Programs.

Global Atmospheric Research Program

THE NATIONAL SCIENCE FOUNDATION awards grants to support research projects which involve the general circulation of the atmosphere and the physical basis of climate. Such research may improve the capacity of long-range weather prediction, and explore the feasibility of large-scale weather and climate modification.

The Global Atmospheric Research Program (GARP) is a long-term commitment by many nations. Within the United States, by formal agreement among Federal agencies, the Foundation is the primary agency for the support of non-Federal research in the program, particularly at universities. The Department of Commerce is the primary agency for Federal activities.

Grants are normally made for periods up to 24 months. Projects of high scientific merit may be approved scientifically for periods up to 60 months, and will be funded on an annual basis for the term of the approval, contingent upon the availability of funds and the scientific progress of the research.

Eligibility

Institutions eligible to submit proposals under GARP are colleges and universities, and nonacademic, nonprofit organizations. Occasionally, NSF sponsors supporting efforts by other Government agencies, particularly for field programs.

Before submitting a research proposal, the NSF brochure GRANTS FOR SCIENTIFIC RESEARCH, available from the Foundation, should be consulted.

Deadlines

Proposals may be submitted at any time; approximately 3 months are required for consideration of a proposal.

Additional Information

Communications should be addressed to: Office for Climate Dynamics, National Science Foundation, Washington, D.C. 20550.

International Decade of Ocean Exploration

IN SUPPORT OF THE International Decade of Ocean Exploration (IDOE), the National Science Foundation awards grants and contracts for cooperative programs of ocean research and exploration with emphasis on environmental quality, environmental forecasting, seabed assessment, and living resources. The program supports a relatively small number of research projects which concentrate on broad scientific problems especially susceptible to concerted effort by the research community. Emphasis is placed upon scientific excellence and applicability of results. The Decade is unique in that it brings major efforts to bear on globally planned and coordinated studies of the ocean as a system.

The long-range goals of the Decade are:

(1) to preserve the ocean environment by accelerating scientific observation of the natural state of the ocean and its interactions with the continental margins;

(2) to develop and improve an ocean forecasting and monitoring system, to facilitate prediction of oceanographic and atmospheric conditions, and to reduce hazards to life and property and permit more effective use of marine resources;

(3) to expand seabed assessment activities to permit better management of ocean mineral exploration and exploitation.

(4) to improve worldwide oceanographic data exchange; and

(5) to increase opportunities for international sharing of responsibilities and costs for ocean exploration and assure better use of limited exploration resources.

The U.S. national program and other nations' IDOE programs are coordinated closely with the Long-Term and Expanded Program of Oceanic Exploration and Research of the Intergovernmental Oceanographic Commission of UNESCO. IDOE is identified as "the acceleration phase" of this program.

Eligibility

Industry and other organizations are eligible for support on the same basis as educational institutions in the Foundation's International Decade of Ocean Exploration program. Universities will receive support in the areas of research suited to their expertise. Unsolicited research proposals are subject to cost-sharing. Proposals are solicited as necessary in certain areas. Awards resulting from solicited proposals may provide full costs, with cost-sharing or fees negotiated as appropriate.

Guidelines on eligibility, programs, and proposal preparation are contained in the NSF publication INTERNATIONAL DECADE OF OCEAN EXPLORATION—A GUIDE TO THE PREPARATION OF PROPOSALS, which may be obtained from the Foundation.

Deadlines

Proposals may be submitted at any time, or in response to Request for Proposals, as appropriate.

Additional Information

Communications should be addressed to: Office for the International Decade of Ocean Exploration, National Science Foundation, Washington, D.C. 20550.

Arctic Research Program

IN FISCAL YEAR 1971, as a result of the designation of the National Science Foundation as lead agency for the extension of Federal research in the Arctic, an Arctic Research Program was initiated to provide support for academic research and to coordinate the Foundation program with other agency programs.

This program, administered by the Office of Polar Programs, has four objectives: (1) to increase man's knowledge of the arctic environment and its dynamic parameters and to make intelligent use of the resources of the region; (2) to provide increased coordination of the arctic research programs of the Federal agencies; (3) to increase cooperation in research with other nations having arctic interests; and (4) to develop mechanisms for the exchange of scientific data and research plans, nationally and internationally.

Within the Arctic Research Program are seven areas of concentration: marine research, including the polar pack ice; terrestrial biology, including analysis of the ecosystem; Man in the Arctic; atmospheric science, including solar terrestrial physics; glaciology, including permafrost; geology and geophysics; and information services.

The Foundation has in the past supported activities in the Arctic region through grants and contracts awarded by existing program elements of various offices and divisions. These programs will continue to support such activities.

Coordination of Federal agency research is accomplished through the Interagency Arctic Research Coordinating Committee (IARCC), which is composed of representatives of the 13 agencies sponsoring research in the Arctic or Subarctic and chaired by the National Science Foundation. The Foundation publishes a quarterly *Arctic Bulletin* on behalf of the IARCC. It is available on request from the address below.

Eligibility

Universities, colleges, and academically related nonprofit research organizations may submit proposals for grants or contracts for research project support. Industry and other organizations are eligible for support for solicited proposals. Projects normally are funded for 1 year, but may be funded for up to 5 years under certain circumstances.

Because of far-reaching scientific, logistic, and international implications of Arctic research projects, it is essential that scientists specify all field needs and requirements when submitting proposals. Proposers should also consult the Foundation's brochure GRANTS FOR SCIENTIFIC RESEARCH. Requests for support of field research should be submitted 1 year before the investigators wish to go into the field.

Additional Information

Communications should be addressed to: Office of Polar Programs, National Science Foundation, Washington, D.C. 20550.

U.S. Antarctic Research Program

THE NATIONAL SCIENCE FOUNDATION awards grants or contracts to support field research in Antarctica and to support study of resulting specimens or data in the United States.

Administered entirely by the Foundation, the U.S. Antarctic Research Program supports projects in all relevant sciences—human behavior, biology, cartography, geology, glaciology, meteorology, oceanography, solid-earth geophysics, and upper atmosphere physics.

After continuous work since the 1957-58 International Geophysical Year, an initial survey of the continent and its surrounding seas is nearing completion. Now, in addition to work by individual scientists or small groups, large technological projects—usually interdisciplinary and international— are under way to investigate specific processes, many of which have global relevance: drilling into bedrock to retrieve the continent's first deep rock cores, mounting a four-nation project that will lead to understanding of the mass budget of the ice cap, evaluating the living resources of the southern ocean, measuring worldwide pollution levels, and working toward the ability to predict long-range changes in global climate.

Field research can be carried out year-round at U.S. stations in the Antarctic Peninsula, in Ellsworth Land, on Ross Island, and at the geographic South Pole. From early October to late February, frequent air service is provided for scientists between the United States and all stations except the one on the Antarctic Peninsula, which is serviced by the Foundation's 125-foot research ship *Hero* from December to April. In the austral summer, temporary camps can be established within a wide radius of the permanent stations to meet specific research requirements. Austral summer research is sometimes carried out aboard icebreakers in the pack ice. Arrangements sometimes are made with other countries for support for research at their antarctic stations.

Stateside support is given as required for science information activities, including the ongoing *Antarctic Bibliography* and sorting centers for geological and biological specimens and for deep-sea sedimentary cores. The Foundation publishes the bimonthly *Antarctic Journal of the United States* (U.S. Government Printing Office, $6.50 per year, $8.25 foreign) to report field activities, preliminary findings, and trends in the program.

Eligibility

Universities, colleges, and academically related nonprofit research organizations may submit proposals for grants or contracts for research project support. Industry and other organizations are eligible for support for solicited proposals. Projects normally are funded for 1 year but under certain circumstances may be funded for up to 5 years. Multiyear projects of high scientific merit may be given assurance of support for the full term of the project, contingent upon availability of funds and scientific progress.

Because of far-reaching scientific, logistic, and international implications of all antarctic research projects, it is essential that scientists specify all field needs and requirements when submitting proposals. Proposers also should consult the Foundation's brochure GRANTS FOR SCIENTIFIC RESEARCH. Requests for support of field research should be submitted 1 year before the investigators wish to go into the field.

Additional Information

Communications should be addressed to: Office of Polar Programs, National Science Foundation, Washington, D.C. 20550.

Ocean Sediment Coring Program

THE NATIONAL SCIENCE FOUNDATION sponsors the acquisition of geologic samples from the floor of the deep ocean basins by means of rotary drilling and coring in the sediments and the underlying crystalline rocks. Portions of the core samples are made available to qualified scientists for individual research projects.

The major activity under the program is known as the Deep Sea Drilling Project, managed by the Scripps Institution of Oceanography of the University of California, San Diego. The drilling and coring operations are performed aboard the ship *Glomar Challenger*. About 60 deep ocean sites are occupied per year, yielding about 20,000 linear feet of 2 1/2-inch-diameter cores. Drill sites have been located in water depths exceeding 20,000 feet, and sub-bottom penetrations of more than 4,200 feet have been achieved. Since August 1968, about 489 holes have been drilled and cored at about 332 sites in the Atlantic, Pacific, Antarctic, and Indian Oceans; the Mediterranean, Caribbean, Bering, Norwegian, and Red Seas; and the Gulf of Mexico.

About 10 to 12 scientists participate aboard the drilling ship for each 2-month cruise, describing the cores lithologically and paleontologically as they come on board. These descriptions and resulting interpretations, along with those from shore-based laboratories, are published in a series of volumes—*Initial Reports of the Deep Sea Drilling Project*, one volume for each cruise. The volumes are placed with all major libraries, and are available for purchase by individuals from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Samples of core material for detailed analysis are available to qualified scientists throughout the world a year after the completion of the cruise that collected the cores.

Eligibility

Proposals for grants for studies of the core material may be submitted by academic institutions, nonprofit organizations, and individual scientists.

Deadlines

Proposals may be submitted at any time. Approximately 6 months are required to consider a proposal.

Additional Information

Communications should be addressed to: Office of National Centers and Facilities Operations, National Science Foundation, Washington, D.C. 20550.

Suggestions for scientific planning, including sites to be included on the drilling itinerary, may be addressed to: Manager, Deep Sea Drilling Project, Scripps Institution of Oceanography, University of California, San Diego, Calif. 92037.

Requests for samples of the core material may be directed to: Curator, Deep Sea Drilling Project, address as above.

Scientists interested in participating aboard the drilling ship may write to: Chief Scientist, Deep Sea Drilling Project, address as above.

Proposals for studies of core materials should be submitted to: Central Processing Section, Division of Environmental Sciences, National Science Foundation, Washington, D.C. 20550.

Oceanographic Facilities and Support

THE NATIONAL SCIENCE FOUNDATION awards grants or contracts for support of construction, modification, conversion, purchase, and operation of oceanographic facilities which lend themselves to shared usage. Community arrangements for shared use of these facilities have been developed under the University National Oceanographic Laboratory System (UNOLS).

Facilities supported under this program are those required for research both in the open oceans and in coastal areas. Examples of such facilities are ships, boats, submersibles, aircraft, piers, shipboard and related shore computing capability, and environmental simulation units.

The Foundation encourages local contributions from non-Federal funds whenever possible; however, there is no fixed requirement as to the amount of funds that institutions must contribute.

Before submitting a proposal for support under this program, institutions should seek advice from the Office for Oceanographic Facilities and Support (OFS). A general brochure and specific formats and instructions are available for certain program activities, such as ship operations support, shipboard technician support, and support of capital equipment.

Eligibility

The primary objective of OFS is to provide support for large and expensive oceanographic facilities in accordance with the demonstrated needs of NSF-funded research and training programs in the total academic oceanographic community. Access to NSF-funded facilities is assured to qualified users through UNOLS.

OFS support for major oceanographic facilities utilized by the academic community is concentrated at a limited number of institutions which are suitably located and have the logistic capability to carry out major facility operations. These facility-operator institutions have substantial ongoing oceanographic research programs of their own and also provide facilities support for research programs of non-operator institutions. Non-operator academic institutions with substantial oceanographic research programs may apply for direct facilities support if they can demonstrate the capability to conduct such operations to fulfill research requirements not now being met.

Deadlines

Ship operations, shipboard technician, and shipboard equipment proposals are due July 1 each year. Proposals requesting support for other activities may be submitted at any time during the year.

Additional Information

Communications should be addressed to: Office for Oceanographic Facilities and Support, National Science Foundation, Washington, D.C. 20550.

For information concerning UNOLS operations, communications should be addressed to: UNOLS Executive Secretary, Woods Hole Oceanographic Institution, Woods Hole, Mass. 02543.

III. RESEARCH APPLICATIONS

During recent years the National Science Foundation has developed improved capabilities to stimulate research efforts more immediately and directly related to problems of society and the environment.

The problems, challenges, and opportunities to which the scientific community must respond require careful and objective analysis, expansion of the pool of directly relevant knowledge, and considered efforts to make this knowledge available to interested users. Specific needs of the Nation provide the basis for program objectives and organization and management of the research supported under these programs. The principal program efforts included under Research Applications are presented under the collective heading Research Applied to National Needs (RANN). The major coordinated research programs administered under RANN are Energy, Environment, Productivity, and Exploratory Research and Problem Assessment.

To focus research on national needs the Research Applications Directorate has reorganized the program structure for RANN. Previously existing programs [Advanced Technology Applications (ATA), Environmental Systems and Resources, and Social Systems and Human Resources] have been realigned to direct major thrusts toward solving problems in the areas of environment and productivity. The Energy program and the Exploratory Research and Problem Assessment program remain essentially unchanged.

The new programs are Environment and Productivity. That part of the ATA program that was concerned with disasters and natural hazards (earthquake engineering and fire research), together with Environmental Systems and Resources, has become the Environment program. The balance of ATA, along with Social Systems and Human Resources, now forms the Productivity program.

The organizational structure of the directorate has changed to align with the new program structure. In addition, the Office of Experimental Research and Development Incentives has been transferred to the Research Applications Directorate.

Two additional Research Applications programs—Intergovernmental Science and Experimental R&D Incentives—are also included in the program descriptions on the following pages. Before submitting a proposal for research support, descriptive brochures on RANN, the Intergovernmental Science and Research Utilization programs, or Experimental R&D Incentives should be consulted.

The following criteria were utilized in developing the ongoing major coordinated research efforts of RANN:

- **Importance**—the significance and urgency of the problem area or the potential consequences for the Nation are great;
- **Payoff**—the benefits to be realized are significantly higher than the anticipated research and implementation costs;
- **Leverage**—science and technology can have a unique and substantial impact on the problem;

- **Readiness**—the effort is timely and scientifically ready and the skilled manpower is available;

- **Capability**—Federal, academic, and industrial capabilities exist to mount a successful research program

- **Need for Federal Action**—the research is not being conducted by private industry because the identifiable incentive is not sufficient or the market is fragmented;

- **Unique Position of NSF**—the NSF can most effectively serve the research needs of the Government because the problem;

  (a) falls between or outside areas of responsibility of other agencies;

  (b) spans the areas of responsibility of other agencies; or

  (c) relates to meeting longer range and special requirements of other agencies and the Nation.

Eligibility

Proposals may be submitted by colleges, universities, and profit and nonprofit organizations. These proposals may provide for collaborative arrangements with other universities, nonprofit and/or profit-making organizations.

Industry and other organizations are eligible to participate on the same basis as academic institutions in research related to national needs. Universities will continue to receive primary support in the areas of research suited to their special expertise. Unsolicited proposals are expected to offer a unique technical contribution and show strong relevance to program objectives to merit full evaluation. Such proposals are subject to cost-sharing. Proposals are solicited as necessary. Awards resulting from solicited proposals may provide full costs, with cost-sharing or fee negotiated as appropriate. Joint proposals from universities, nonprofit institutions, and industry are encouraged to bring broader capabilities as well as interdisciplinary skills to the support of the NSF Research Applications program.

Deadlines

Unsolicited proposals may be submitted at any time and should first be submitted in preliminary form for negotiation and discussion. Approximately 6 months are required for consideration of proposals. Program announcements, program solicitations, and requests for proposals may be issued from time to time in targeted areas. Such announcements will specify a deadline for submission.

Additional Information

The publication Guidelines For Preparation Of Unsolicited Proposals To Research Applied To National Needs describes the guidelines for preparation of proposals to the RANN program. Communications relating to a specific program area may be addressed to the appropriate division or office: Division of Advanced Energy Research and Technology, Division of Advanced Environmental Research and Technology, Division of Advanced Productivity Research and Technology, Office of Exploratory Research and Problem Assessment, Office of Intergovernmental Science and Research Utilization, or Office of Experimental R&D Incentives. General inquiries and requests for publications may be addressed to the Office of Programs and Resources, National Science Foundation, Washington, D.C. 20550.

Energy

THE ENERGY PROGRAM SUPPORTS research in areas which lead to the implementation and utilization of new energy concepts and options. The research is an interdisciplinary undertaking in which matters concerned with technology, environment, social aspects, legal, economics, and technology assessment are investigated.

The three general objectives in energy are to sponsor research on:

- Analysis of future, intermediate, and long-range needs and various strategies for meeting these needs.
- Environmental, economic, and social impacts of energy production, and use and means for assessing and ameliorating detrimental impacts.
- Neglected or otherwise underexploited technologies which may have significant impact on the energy problem.

Specific areas of emphasis include:

- **Solar Energy**—Research in solar energy explores and developes the technologies needed for terrestrial applications of solar energy. The areas of research are solar heating and cooling of buildings, production of electrical power from solar, thermal, and photovoltaic radiation, generation of clean fuels by bioconversion of organic materials, and generation of power utilizing wind and ocean thermal gradients.
- **Geothermal Energy**—Research in geothermal energy will help to assess and prove the potential of geothermal energy as an energy resource.
- **Energy Conversion and Storage**—Research applied to the development of improved technologies for conversion of energy resources to usable form, and improved energy storage.
- **Energy Systems**—Research deals with the analysis and synthesis of alternative means (including conservation) of meeting U.S. energy requirements while satisfying environmental quality constraints; the analysis of energy R&D opportunities; and mathematical modeling of major sectors of the energy industry.
- **Energy Resources**—Research seeks to expedite the development of novel and innovative technology that will allow the energy resources of the United States to be used in an effective and economical way.
- **Advanced Automotive Propulsion**—Research to acquire an understanding of basic fuel combustion and energy conversion processes as they relate to the design of engines with greater efficiencies, while maintaining low air polluting emissions.
- **Energy and Fuel Transportation**—Research seeks to develop improved methods to solve the complex problems posed by the transportation of energy from production to consumption sites including novel power transmission technologies, and the application of computer methodology to operating, planning, modeling, and optimizing these systems.

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Environment

THIS PROGRAM WILL DEVELOP scientific data and strategic frameworks to deal with environmental and natural resource problems, and with disasters and natural hazards. Included will be the complex trade-offs between economic and social development and environmental quality, and socioeconomic response to natural hazards.

MANAGING THE NATURAL ENVIRONMENT

Regional Environmental Management

The purpose of this program is to study regional environments and resources in order to establish the scientific basis for their management and use. A major aim of the Regional Environmental Management Program is the enhancement of man's capacity to select from the universe of development and management strategies those which most effectively achieve environmental quality objectives within the context of other societal goals.

Objectives of the program are:

- Define environmental problems, including those unique to a particular region and those common to many regions.
- Identify resources impacted and ecosystem relations to predict consequences of alternative schemes to correct environmental problems.
- Evaluate economic and legal mechanisms as management options available to decision-makers, the specific environmental effects of these options, and the potentially detrimental effects of other forms of public policy.
- Synthesize management schemes utilizing the necessary environmental, economic, and social information.
- Evaluate management schemes in relation to other policies designed to meet other societal objectives.

Major research efforts include studies of environmental aspects of:

- Coastal Zone Management
- Urban/Rural Environmental Management
- Land Use Allocation

Environmental Aspects of Trace Contaminants

This program is designed to develop an understanding of the impact on man and the environment of many known and potential environmental trace contaminants, such as manufacturing byproducts, agricultural and household wastes, oil and hazardous materials spillage and dissipation, and elements of the bio-geochemical environment for the purpose of understanding and control. Specific objectives are:

- Determine the levels of toxic substances in the environment, how and where they accumulate, and how they are destroyed.
- Assess the effects of these levels on animal (including man) and plant communities.
- Relate these findings to methods of control by current practices or new methods.

In order to attain these objectives:

- Toxic or hazardous substances must be separated from complex mixtures, identified, and measured.
- The movement and rates of flow of contaminants through the environment must be traced from their sources to their ultimate sinks.
- Target organisms along, and at the end of, the routes of flow and their sensitivity to toxic agents must be determined.

- The complex relationships between biotic communities and the effects of the biologically available toxicants must be understood.
- Research results must suggest improved monitoring systems, and ultimately lead to technological, legal, and economic abatement or control measures.

The major research elements are:

- Trace Contaminants in Biota and Food Chains
- Concentrations, Routes, and Rates of Flow
- Chemical Changes in Trace Contaminants
- Techniques for Measuring Specific Environmental Pollutants.

Environmental Effects of Energy

The objective of this program is to develop the scientific knowledge base needed to help in efforts to reduce conflicts between increased energy production and environmental quality. Alternative means will be sought to reduce the environmental impacts of energy extraction, generation, transportation, and consumption. Emphasis is placed on environmental effects susceptible to new control technology, as well as on indirect environmental consequences of energy extraction, transportation, and use.

Specific objectives of this program are to:

- Analyze environmental contaminants and land use consequences of energy resource extraction.
- Evaluate environmental effects and develop criteria for siting to minimize effects of fuel processing, central power stations, and other conversion facilities.
- Analyze the environmental effects of alternative uses of energy for transportation and industrial productivity.

DISASTER AND NATURAL HAZARD RESEARCH

The subprograms in this area are Earthquake Engineering, Fire Research, Weather Modification, and Socioeconomic Response to Natural Hazards. The natural hazards to be considered are primarily dynamic in nature and include earthquakes, tsunami and wind-induced waves, and unwanted fires.

Earthquake Engineering

The basic objectives of this program are to:

- Develop economically feasible design and construction methods for building earthquake-resistant structures.
- Develop methods of analysis which integrate acceptable structural risk with the natural hazard potential of proposed construction sites for the purpose of improved structural design and land-use decisions.
- Develop an improved understanding of social and economic consequences of individual and community policy decisions on earthquake-related issues.

Fire Research

The following objectives indicate the scope of the research:

- Increase the basic knowledge on the mechanisms of ignition and flame spread.
- Study specific classes of materials, particularly new materials for burning and the products of combustion.
- Obtain basic information on fabric flammability and associated hazards leading toward the setting of standards.

- Study flame spread mechanisms in structures.
- Develop models of flame spread.
- Develop knowledge of the mechanisms of flame suppressants.
- Seek improved means for fire detection, alarm, and control.

Weather Modification

The overall purpose of the Weather Modification Program is to study those atmospheric mechanisms which can be or are being influenced by man to modify natural weather patterns and evaluate the impact of their modification upon society.

The specific objectives may be defined as follows:

- Develop a level of understanding of the mechanisms of hail formation in severe convective storms which will lead to a more reliable method of hail suppression.
- Develop a more adequate knowledge of the ice nucleation mechanism in the atmosphere which will result in a capability to measure and predict the consequences of a seeding operation.
- Develop sufficient understanding of the mechanisms by which human habitation may produce anomalies in the weather patterns that adverse effects may be forecast in advance and corrective action taken to minimize the impact.
- Develop new and more accurate concepts of how, when, and under what circumstances weather can be modified by artificial means.
- Increase our understanding of the social, economic, legal, and ecological impact of operational weather modification practices upon society.

Socioeconomic Response to Natural Hazards

The purpose of this research is to evaluate the benefits and costs of different combinations of adjustments that can be applied to specific natural hazards. Studies will assess the effectiveness and comparative value of prediction and warning, disaster preparedness, physical protection, land-use management, insurance, and relief.

Productivity

THE OBJECTIVES OF THE RANN program of Productivity are to increase performance and output in the public and private sectors and to identify the impacts of public policies on productivity.

PUBLIC SECTOR PRODUCTIVITY

To improve public sector productivity, RANN directs major activities to the following areas:

● **Productivity Measurement**—There will be increased emphasis on the implementation and validation of measures by which to assess the effectiveness and efficiency of major Government functions such as fire protection, street maintenance, solid waste collection, etc. Work will be carried out on integrating the improved measurement methods into the budgetary processes of municipal governments.

● **Advanced Communications Technology**—Experiments will continue on investigating the use of two-way cables in improving urban administration and service delivery. Work will also continue on alternative forms of communications to enhance citizen-government feedback. The use of teleconferences to reduce energy and transportation requirements will be explored.

● **Technology Utilized by Local Government**—Research to develop performance specifications and other means for improving equipment procurement processes in local government will continue. The objective of this research is to provide local governments with improved criteria and procedures for making procurement choices.

● **Finance and Service Delivery**—Research on alternative organizational responsibilities for the delivery of urban services will be continued in the areas of solid waste, fire, police, and public health. Research on revenue sharing will be expanded to consider the costs and benefits of alternative mechanisms to provide assistance to State and local governments. Research will also begin on alternative Government programs for stimulating and guiding industrial development in given States and cities.

PRIVATE SECTOR PRODUCTIVITY

The second element of the RANN Productivity program is directed at improvements in private sector productivity. Federal support of research on private sector productivity is needed when private R&D performers cannot capture the benefits of R&D investments because of market conditions and structures; when the benefits of research occur beyond the planning horizons of the private sector; when the risks and uncertainties of the research are high; or when private market resources are inadequate and there will be a significant national benefit from the research.

● **Advanced Industrial Processing**—A major emphasis of the program is on research to incorporate enzyme technology in the food and pharmaceutical industries to attempt to lower processing and production costs.

● **Production Research and Technology**—The objective of this research is to develop and examine the new technological options for U.S. manufacturing and to assess their cost-effectiveness. Research focuses on the application of programmable automation to the discrete product industries, for example, durable goods. "Programmable automation" refers to using general-purpose machines and special computer programs to enhance productivity in industries, such as machine tools, which produce limited quantities of different kinds of goods.

● **Excavation Technology**—The objectives of this program are to increase excavation rates and to reduce the costs of subsurface excavation and construction. In the near future, two methods of ground disintegration (thermal-mechanical and water-jet techniques) will be advanced to the proof-of-concept stage and their cost-effectiveness compared.

● **Instrumentation Technology**—This program is directed at lowering unit cost in production, diagnoses, and manufacturing quality control. Textile processing is a major thrust, with specific applications in contour weaving.

● **Public Policy and Economic Productivity**—The objectives of the research on public policy and economic productivity are to examine the effectiveness of current policy instruments affecting productivity and inflation and to assess the benefits and costs of alternative policies and programs.

● **Macro-Economic Performance**—Research will be carried out on possible "structural" economic influences in inflation because of recent difficulties in explaining inflation through aggregate supply and demand relations. In addition, a series of industry-by-industry studies of the dynamics of foreign trade will be carried out together with a coherent and systematic examination of public policies and programs (R&D expenditures, anti-trust policies, tariffs, patent laws) as they affect trade.

● **Economic Growth in an Environment of Scarcity**—Research will be undertaken to determine how scarcity affects the search for and production of resource substitutes. The consequences for prices, employment, and efficient organization will be assessed.

● **Government Management and Regulation of the Economy**—Research will reexamine the adequacy of anti-trust policies as a means of influencing economic performance as well as the benefits and costs of alternative forms of regulation.

The benefits and costs of alternatives forms of Government procurement with emphasis on State and local levels will be assessed, since Government procurement of goods and the standards for procurement have an important effect on the quantity and quality of goods produced by the private sector. In addition, new techniques for forecasting economic performance will be analyzed and evaluated.

Exploratory Research and Problem Assessment

THIS PROGRAM SUPPORTS EXPLORATORY research and assessment projects to determine which national problems may be amenable to amelioration through the application of science and engineering capabilities. Assessments will help to define the role of science in dealing with societal problems and will also examine the impact of science and technology on society. Principal goals are to define adequately the broad context of particular societal problems; and to identify those research opportunities and strategies which are critical to dealing with the problems. In this way, new areas of potential research investment for RANN or other agencies can be identified and the prospects for a more extensive program assessed. Major components of the program are:

Technology Assessment

Technology assessment is the systematic study of the effects on society that may occur when a technology is introduced, extended, or modified, with special emphasis on the impacts that are unintended, indirect, or delayed.

Technology assessment may be viewed as one aid to the generation of public policy options with regard to the management of technology and as an input in the decision-making process. Assessment of physical, biological, and social technologies are all suitable for consideration under this program.

Selected Research Topics

Problem assessment and technology assessment studies may extend across the full range of national and social issues. Exploratory research is limited to areas which have been identified as gaps in Federal and private research activity, which have high potential payoff for the Nation, and which otherwise satisfy the general RANN criteria.

The range and type of problem areas planned for this research program include:

Minority Group Problems. Research will explore alternative mechanisms and methodologies for obtaining improved information on the nature and extent of problems affecting the disadvantaged minorities; on identifying policy-significant characteristics of minority communities; on exploring the interactions between society and programs which have special impacts upon minority populations; and on utilizing the talents of minority scientists and leadership in determining research priorities and in designing and conducting research projects.

The Consumer and the Marketplace. Problem assessments and exploratory research on the interacting roles of the consumer and the marketplace. Emphasis will include issues of consumer safety and protection, consumer information, and consumer behavior. Special consideration will be given to areas of interest to Federal regulatory agencies.

Social Implications of an Aging Population. Problem assessments and exploratory research on the societal consequences of a changing age distribution. The emphasis will be on the longer term social aspects of gerontology.

Technology-Related Transnational Problems. Problem-oriented multidisciplinary research will be applied systematically to selected technology-related transnational policy issues which need urgent attention by the United States and the international community.

New Problems and Projects

Other research will be undertaken to provide needed assessment and exploratory research in response to creative, innovative ideas and approaches, where the societal problem satisfies the general RANN criteria but falls outside of the above-defined areas or the programs of RANN.

Intergovernmental Science Programs

THE NATIONAL SCIENCE FOUNDATION awards grants to enable State and local levels of government to develop new and improved programs and institutions for the systematic application of science and technology to governmental problems, and for the utilization of research resulting from NSF applied research programs.

The objectives of the Intergovernmental Science Programs are to:

- Advance the understanding of public issues and problems having scientific and technological content at the State and local levels of government.
- Improve the capability of State and local government institutions for defining their research and technology needs and seeking ways to facilitate the application of research to civil sector problems.
- Demonstrate innovative science and technology planning and decisionmaking processes relevant to State, local, and regional problems.
- Promote and strengthen Federal-State-local government and private sector research and utilization relationships.
- Stimulate public and private sector user capability to implement RANN (Research Applied to National Needs) results.

The proposed activity must involve a problem of general interest to State and local governments. Preference will be given to innovative approaches to the development of models for governmental use of science and technology. Activities supported may include development of mechanisms, manpower, and education programs (involving State and local government officials), technology assessment and forecasting studies, research utilization and information transfer, and exploratory studies to help develop science and technology-related innovative policies and programs for State and local governments. Institutional support may be provided to assist in establishment of centers for governmentally related science and technology applications. Conferences and seminar projects at the State, regional, and national levels, and projects to collect and analyze data on State and local scientific and technical resources may also be supported.

Eligibility

Proposals may be submitted by units of State and local governments and their State, regional, or national organizations, legislatures, professional schools, State academies of science, colleges, universities, and nonprofit institutions. Proposals combining academic institutions and units of government will be of particular interest. There is no requirement for matching funds, but normally applicants are required to share in the cost of any proposed activity. Contractual arrangements are made on occasion with profit-making organizations for the performance of work in which they are uniquely qualified.

Proposals may be submitted to other Federal agencies for partial support and to NSF for those activities that fall outside the program scope of other Federal agencies.

Deadlines

Proposals may be submitted at any time; processing of a proposal requires approximately 6 months. Informal inquiry to the Foundation may be made to determine whether or not a potential project would qualify for support.

Experimental Research and Development Incentives

THE NATIONAL SCIENCE FOUNDATION supports a program designed to provide experimental evidence concerning various incentives which the Federal Government might use to increase the application and use of science and technology in the civil sector. The objectives of the program are:

- Identify institutional barriers to innovation
- Test appropriate Federal action which might reduce such barriers.

The program will provide a focus in the Federal structure for testing various means of accelerating the rate of technological innovation in the private and public sectors of the economy. The program will support background studies to identify and understand barriers and blockages to the technical innovation process in selected areas of application, and experiments designed to investigate incentives intended to overcome these blockages. Each experiment will support tests of the effect of a specific incentive mechanism on a barrier or set of barriers which inhibit the innovative process.

Areas of current program interest include:

- Testing and validation by Federal laboratories and approved private testing laboratories of new products that significantly extend the current state-of-the-art and which have their primary market in the public sector, i.e., municipal, city, county, State, and regional governmental public services.

- Cooperative R&D activities between colleges and universities on the one hand and industries, industrial associations, professional societies, profit and nonprofit R&D institutions, Federal laboratories, or State and local governmental entities on the other hand. The cooperative R&D proposal may include two cooperating institutions or multi-institutional arrangements. The proposed research activity should be for product, process, or service development of primary interest to the nonacademic institutions and in which one or more academic departments have a parallel or collateral interest.

- Urban and public sector technology transfer mechanisms that involve and explore improving the effectiveness of the roles of:
  - Universities
  - Public service institutions
  - Non-Federal governmental jurisdictions
  - Research institutes
  - Corporations and Federal laboratories

Institutions interested in this area may submit proposals alone or jointly to support projects to test the effectiveness of incentives and technology transfer mechanisms to improve and accelerate the application of technology (products, processes, or service systems) to needs in the public service sector of the economy. In fiscal year 1975, projects will be limited to assessment and evaluation studies.

- Planning and definition studies in the area of financial incentives to technological incentives.

Eligibility

Proposals may be submitted by colleges and universities; industrial or trade associations; industrial organizations; and public service institutions, research institutions, and nonprofit organizations, including State and local governments. These proposals may provide for collaborative arrangements with other universities, nonprofit, and or profit-making organizations. Such arrangements are not mandatory.

Deadlines

Proposals may be submitted at any time and should be submitted in preliminary form for negotiation and discussion. Approximately 3 to 6 months are required for consideration of proposals.

Additional Information

Communications should be addressed to: Office of Experimental R&D Incentives, National Science Foundation, Washington, D.C. 20550.

IV. NATIONAL RESEARCH CENTERS

The National Science Foundation provides support for the development and operation of National Research Centers established to meet national needs for research in specific areas of science requiring facilities, equipment, staffing, and operational support which are beyond the capabilities of private or State institutions and which could not appropriately be provided to a single institution to the exclusion of others. Unlike many federally sponsored research laboratories, the NSF-supported National Research Centers do not perform specific research tasks assigned by or for the direct benefit of the Government. They are maintained for the purpose of making available, to all qualified scientists, the facilities, equipment, skilled personnel support, and other resources required for the performance of independent research of the scientists' own choosing, in the applicable areas of science.

The Foundation supports four astronomy centers (National Astronomy and Ionosphere Center at Arecibo, Puerto Rico; Cerro Tololo Inter-American Observatory near Santiago, Chile; Kitt Peak National Observatory at Tucson, Ariz.; and National Radio Astronomy Observatory at Green Bank, W. Va.) and one atmospheric research center (National Center for Atmospheric Research, Boulder, Colo.).

The centers are managed by the Office of National Centers and Facilities Operations in the Directorate for National and International Programs. More detailed information on each of these National Research Centers is given on the following pages.

National Astronomy and Ionosphere Center

THE NATIONAL SCIENCE FOUNDATION supports the National Astronomy and Ionosphere Center (NAIC), a national center devoted to research in radio and radar astronomy and ionospheric physics. The NAIC is operated and managed by Cornell University under contract to the Foundation. The NAIC headquarters is located on the Cornell University campus in Ithaca, N.Y., and the principal observing facilities are located in Puerto Rico, 12 miles south of the city of Arecibo.

The major objective of the center is to make available to the scientific community visitor-oriented research facilities that will contribute significantly to our understanding of the Earth's upper atmosphere; the Moon, planets, and other celestial radio sources; and the interstellar medium.

The primary instrument at NAIC is a 1,000-foot-diameter fixed spherical reflector. In 1973, the original wire mesh surface of this instrument was removed and replaced with 38,778 perforated 0.04-inch-thick aluminum panels. The final alignment of this new surface is in progress. When the alignment is completed in late 1974, the frequency range available for scientific research observation will be 12 times greater than before. The upper frequency limit will have been extended from 611 MHz to 7.2 GHz.

Another upgrading project at Arecibo, also scheduled for completion in late 1974, is the installation of a 450-kilowatt S-band (2,380 MHz) planetary radar transmitter. This project, sponsored by the National Aeronautics and Space Administration, will increase the sensitivity and resolution of the planetary mapping capability at NAIC by a thousandfold over what was available in 1971.

NAIC provides telescope users with a wide range of research and observing instrumentation, including receivers, transmitters, movable line feeds, and digital data acquisition and processing equipment. The center also has a small permanent staff of scientists, engineers, and technicians who are available to assist visiting scientists and observers.

Eligibility

All qualified U.S. scientists and, on occasion, foreign visitors have access to NAIC facilities, instrumentation, and services, on a competitive basis, subject to priorities based upon the scientific merit of the proposed research, the capability of the instruments to do the work proposed, and the time available.

Additional Information

Communications should be addressed to: Director, National Astronomy and Ionosphere Center, Cornell University, Ithaca, N.Y. 14850.

Kitt Peak National Observatory

THE NATIONAL SCIENCE FOUNDATION supports the Kitt Peak National Observatory (KPNO), which makes available optical telescopes, observing equipment, and research support services to qualified scientists.

The headquarters of KPNO is in Tucson, Ariz.; observing facilities are located at an elevation of 6,800 feet on Kitt Peak, a mountain 10 miles southwest of Tucson. KPNO is supported under the terms of a contract between the Foundation and the Association of Universities for Research in Astronomy, Inc.

KPNO provides the U.S. scientific community with facilities for research in stellar, solar, and planetary astronomy. The facilities consist primarily of ground-based telescopes and the auxiliary equipment necessary to observe astronomical objects in the optical and infrared regions of the electromagnetic spectrum. The observatory is a visitor-oriented facility that assures visiting astronomers of 60 percent of the observing time on the telescopes.

The major astronomical instruments at Kitt Peak consist of: the new 4-meter telescope, a 2.1-meter general-purpose reflector optimized for observing in the infrared, a 1.3-meter cassegrain reflector for photometric and infrared studies, two 92-centimeter reflectors for direct photography and photoelectric photometry, a 92-centimeter coude feed associated with the 2.1-meter telescope, two 41-centimeter telescopes used primarily for photoelectric photometry, and a 31-centimeter Schmidt. A 1.5-meter solar telescope is available for solar and planetary observations. The recently completed solar vacuum telescope and magnetograph is used for mapping magnetic fields of the Sun.

KPNO has a staff of resident scientists, engineers, and technicians who are available to assist visiting scientists and observers.

Eligibility

KPNO makes observing time on each instrument available for the use of visiting scientists. All qualified U.S. scientists and, on occasion, foreign visitors may use the instruments, subject to priorities based on the scientific merit of the proposed research, the capability of the instruments to do the work, and the available time.

Additional Information

Communications should be addressed to: Director, Kitt Peak National Observatory, 950 North Cherry Avenue, P.O. Box 26732, Tucson, Ariz. 85726.

Cerro Tololo Inter-American Observatory

THE NATIONAL SCIENCE FOUNDATION supports the Cerro Tololo Inter-American Observatory (CTIO), an astronomical research center whose optical telescopes and related facilities are available to qualified scientists from the United States, Chile, and elsewhere in North and South America. Using telescopes made available by the Federal Government and other organizations, CTIO provides astronomers with the opportunity to observe those parts of the Southern Hemisphere skies that are not visible or not adequately observable from the United States.

The observing facilities of CTIO are located on a 7,200-foot mountain in the foothills of the Andes Mountains about 300 miles north of Santiago, Chile. The administrative headquarters is in the coastal city of La Serena, about 60 miles away. CTIO is supported under the terms of a contract between the Foundation and the Association of Universities for Research in Astronomy, Inc., which also operates the Kitt Peak National Observatory (KPNO). Close ties are maintained with the University of Chile.

Major astronomical instruments at Cerro Tololo include: a 1.5-meter, a 1.0-meter on loan from Yale University, a 92-centimeter, a 61-centimeter Schmidt on loan from the University of Michigan, a 61-centimeter originally established jointly with the Lowell Observatory, and two 41-centimeter telescopes. A 4.0-meter telescope that is nearly identical to the KPNO 4.0-meter will be available in 1975.

Cerro Tololo has a small permanent staff of scientists, engineers, and technicians who are available to assist visiting scientists and observers.

Eligibility

Most of the observing time at Cerro Tololo is used by visiting astronomers. Qualified scientists may use the instruments subject to priorities based on the scientific merit of the proposed research, the capability of the instruments to do the work proposed, and the available time.

Additional Information

Communications should be addressed to: Director, Kitt Peak National Observatory, 950 North Cherry Avenue, P.O. Box 26732, Tucson, Ariz. 85726.

National Radio Astronomy Observatory

THE NATIONAL SCIENCE FOUNDATION supports the National Radio Astronomy Observatory (NRAO), through which Government-owned radio astronomy facilities are made available to qualified scientists. The NRAO staff assists visiting scientists with the large radio antennas, receivers, and other equipment needed to detect, measure, and identify radio waves from outer space.

Headquarters for NRAO is in Charlottesville, Va.; observing facilities are located primarily in Green Bank, W. Va. NRAO is supported under the terms of a contract between the Foundation and Associated Universities, Inc. (AUI), a nonprofit corporation.

Major research facilities at NRAO include a 140-foot highly precise, fully steerable radio telescope; an interferometer consisting of three fully steerable 85-foot telescopes with a portable 42-foot telescope for remote operation; and a 300-foot radio telescope steerable in declination (latitude) only. A 36-foot radio telescope operating at millimeter wavelengths is located at the Kitt Peak National Observatory near Tucson, Ariz. NRAO has a staff of resident scientists, engineers, and technicians.

NRAO has also provided the design for the Very Large Array (VLA) Radio Telescope Facility to be constructed by AUI on the Plains of San Augustin near Socorro, N. Mex., over the next several years. This major new astronomical instrument will utilize an array of 27 radio telescopes, each 82 feet in diameter, to obtain celestial radio images comparable to the photographic images obtained with the largest optical telescopes.

Eligibility

NRAO makes observing time on each instrument available for the use of visiting scientists. All qualified U.S. scientists and, on occasion, foreign visitors may use the instruments, subject to priorities based on the scientific merit of the proposed research, the capability of the instruments to do the work proposed, and the time available.

Additional Information

Communications should be addressed to: Director, National Radio Astronomy Observatory, Charlottesville, Va. 22901.

National Center for Atmospheric Research

THE NATIONAL SCIENCE FOUNDATION supports the National Center for Atmospheric Research (NCAR) which serves as a focal point for an expanding national research effort in the atmospheric sciences. NCAR offers support services, fellowships, and research facilities to qualified scientists working in the field of atmospheric research.

Headquarters and major laboratories of NCAR are located in Boulder, Colo. Research activities and operations are worldwide. Support of NCAR is provided under the terms of a contract between the Foundation and the University Corporation for Atmospheric Research, a nonprofit corporation.

Research programs of NCAR include investigation of the earth's atmosphere, of the physics of the Sun, and of the regions between the Sun and Earth. NCAR facilities in support of NCAR and of visiting scientists include a National Scientific Balloon Facility at Palestine, Tex., a Computing Facility at Boulder, and an Aviation Facility at Broomfield, Colo.

In addition to conducting its own research programs, NCAR participates in a number of atmospheric research efforts conducted by Government agencies, university scientists, and research groups on a national or international scale. Major efforts include development of computer simulation of atmospheric global circulation patterns and convective cloud processes, measurement of chemical constituents of the atmosphere, theoretical studies and observations of solar-terrestrial phenomena, investigation of the atmospheric conditions responsible for the formation of hailstorms, and development of techniques to abate hail formation. More than 600 scientists, engineers, technicians, and support personnel comprise the NCAR staff.

Eligibility

Visiting scientists study and conduct research at NCAR under fellowships and research programs. NCAR facilities are available to qualified scientists, subject to scheduling considerations.

Additional Information

Communications should be addressed to: Director, National Center for Atmospheric Research, P.O. Box 1470, Boulder, Colo. 80302.

V. INTERNATIONAL COOPERATIVE SCIENTIFIC ACTIVITIES

The Foundation encourages and supports U.S. scientific participation in international science programs and activities that promise maximum benefit to the U.S. science effort.

It is Foundation policy to foster the interchange of information among scientists in the United States and foreign countries, initiate and support scientific activities in connection with matters relating to international cooperation, support basic research abroad (in special cases) as a supplement to the national research effort, and provide support to U.S. institutions for research which is to be conducted abroad.

Programs described in this chapter are administered by the Office of International Programs (OIP) and complement other Foundation activities in support of scientific research and science education. OIP welcomes inquiries about any of the programs listed and encourages U.S. scientists and engineers to discuss with this office plans and new approaches to international cooperation in science.

OIP is a component of the Directorate for National and International Programs.

United States-Australia Cooperative Science Program

THE NATIONAL SCIENCE FOUNDATION awards grants to support the participation of U.S. scientists in the United States-Australia Cooperative Science Program. Australian funds support Australian scientists participating in the program.

Three types of projects are supported in the program:

- Scientific seminars or workshops
- Visiting scientists
- Joint research projects.

A brochure describing the United States-Australia Cooperative Science Program is available from the Foundation.

Eligibility

Those eligible to submit proposals are colleges and universities, nonprofit institutions, professional societies, and individual scientists. Governmental scientific organizations may also participate but generally have to provide their own funding. An informal inquiry to the Foundation is recommended prior to the submission of a formal proposal. All projects must be approved by the Foundation and the Department of Science in Australia.

Deadlines

Proposals may be submitted at any time; approximately 6 months are needed for consideration.

Additional Information

Communications may be addressed to: United States-Australia Cooperative Science Program, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Republic of China Cooperative Science Program

THE NATIONAL SCIENCE FOUNDATION awards grants to support the participation of U.S. scientists in the United States-Republic of China Cooperative Science Program. Chinese funds support Chinese scientists participating in the program.

Three types of projects are supported in the program:

- Joint research projects.
- Visiting scientists.
- Scientific seminars.

A brochure describing the United States-Republic of China Cooperative Science Program is available from the Foundation, together with guidelines for submitting proposals.

Eligibility

Those eligible to submit proposals are colleges and universities, nonprofit research institutions, professional societies, and individual scientists. The program is aimed primarily at the academic scientist; however, others may be considered. An informal inquiry to the Foundation should be made before a formal proposal is submitted. All projects must be approved by the Foundation and the National Science Council in Taipei.

Deadlines

Proposals may be submitted at any time; approximately 6 months are needed for consideration.

Additional Information

Communications may be addressed to: United States-Republic of China Cooperative Science Program, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

East Europe Cooperative Science Programs: Romania, Hungary, Czechoslovakia

THESE PROGRAMS ARE OFFERED to foster and support scientific and technological cooperation on a bilateral basis between the United States and each of the cooperating countries. The programs are conducted and coordinated between the National Science Foundation and comparable organizations in the cooperating countries.

Under these programs, research-oriented cooperative activities may be conducted and supported in any branch of science and technology, including basic and applied aspects of the natural sciences and mathematics, the engineering sciences, and the social sciences, and including interdisciplinary or problem-oriented areas. Support is offered for three types of activities:

(1) **Cooperative research**—projects designed jointly by, and to be conducted collaboratively between, a principal investigator of the United States and a principal investigator of the cooperating foreign country. Proposals are submitted by an American institution to the National Science Foundation and by the institution of a foreign investigator to the coordinating agency in his country.

(2) **Seminars**—meetings of small groups of scientists of the United States and of the foreign country, jointly designed and convened by American and foreign co-organizers. A seminar may be held in the United States or in the cooperating foreign country. Proposals are submitted by the American co-organizer or his institution to the National Science Foundation and by the foreign co-organizer through his institution to the coordinating agency in his country.

(3) **Scientific visits**—visits of short duration for the purpose of planning cooperative scientific activities or conferring about cooperative scientific activities; also, with Romania, visits of longer duration for purposes of research, study, or lecturing. The application of an American scientist to visit one or more of the cooperating countries is submitted by him to the National Science Foundation; the application of a foreign scientist to visit the United States is submitted by him or by his institution to the coordinating agency in his own country.

Eligibility

American institutions eligible to participate in these programs include universities and colleges, professional societies, academies of sciences, and other nonprofit scientific organizations of the private or public sectors. Support is available for American scientists who are U.S. citizens or who have at least 5 years of professional employment beyond the doctorate in U.S. institutions and are currently affiliated with an eligible U.S. institution. American scientists employed by profit-making organizations are not eligible for support.

Additional Information

The brochure COOPERATIVE SCIENCE PROGRAMS: ROMANIA, HUNGARY, CZECHOSLOVAKIA, BULGARIA; COOPERATIVE RESEARCH, JOINT SEMINARS, SCIENTIFIC VISITS is available from the Foundation.

Communications may be addressed to: East Europe Cooperative Science Programs, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-France Exchange of Scientists Program

THE NATIONAL SCIENCE FOUNDATION and the Centre National de la Recherche Scientifique jointly sponsor an exchange of scientists for study or research in the mathematical, physical, chemical, engineering, biological, and social sciences, including economics. Awards are not made in the medical sciences or in education or business fields.

Eligibility

Eligible individuals are citizens or nationals of the United States and France who will have earned a doctoral degree or its equivalent normally not more than 5 years prior to the commencement of the exchange visit. Eligible institutions are, for American candidates, any appropriate nonprofit French institution. Appropriate nonprofit institutions are institutions of higher education; government research institutes, laboratories, or centers; and privately sponsored nonprofit institutes. The period of the exchange visit is normally between 5 and 15 months. French candidates may obtain information and application materials from the Centre National de la Recherche Scientifique. American candidates may obtain information and application materials from the address below.

Additional Information

Communications may be addressed to: United States-France Exchange of Scientists Program, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-India Exchange of Scientists Program

THE NATIONAL SCIENCE FOUNDATION administers the participation of U.S. scientists and engineers in a program of short-term exchanges with India for the purpose of exchanging scientific information and planning future scientific cooperation. In India the program is administered by the Council of Scientific and Industrial Research. These organizations are jointly responsible for approving each exchange visit. The National Science Foundation pays only travel costs of U.S. scientists to and from India. Within India, expenses are covered by the local hosts. A brochure describing this program is available from the Foundation.

Eligibility

Individual senior scientists and engineers are eligible to submit proposals. The evaluation of requests is based on the applicant's professional qualifications and the merit of the proposed activity in India.

Deadlines

Proposals may be submitted at any time.

Additional Information

Communications should be addressed to: United States-India Exchange of Scientists, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Israel Binational Science Foundation

THE UNITED STATES-ISRAEL BINATIONAL Science Foundation (BSF) came into existence under an agreement between the two Governments, signed on September 27, 1972. It establishes a program of cooperative scientific research and related activities to be conducted principally in Israel, to be financed with Israeli currency, and involving scientists and institutions of the United States and Israel. Activities must be of mutual interest to the United States and Israel and concerned with science and technology for peaceful purposes. Activities dealing with scientific and technological information are also considered.

The BSF is operated with the interest from a fund contributed to equally by both countries. The U.S. contribution represents U.S.-owned Israeli currency, chiefly resulting from payments by the Government of Israel for surplus agricultural commodities sold under Public Law 83-480.

The interests and activities of the scientific agencies of the U.S. Government in BSF are coordinated through the Department of State. U.S. institutions may submit proposals in either of the following ways:

(1) Directed to a scientific agency of the U.S. Government having a mission related to the subject of the proposal. The agency forwards it to BSF with comments concerning the relevance of the proposal to the mission of the agency; judgments as to its scientific merit are the responsibility of BSF. NSF encourages the submission of proposals of high quality which complement or otherwise relate to research supported under NSF programs.

Such proposals may be addressed to:

Office of International Programs
(U.S.-Israel Binational Science Foundation)
National Science Foundation
Washington, D.C. 20550

Phone: (202) 632-5796

(2) Directed to the following address:

U.S.-Israel Binational Science Foundation
P.O. Box 7677
Jerusalem, Israel

Proposals submitted directly to BSF will later be referred by it to the U.S. Government for comment.

Deadlines

Although proposals may be submitted at any time, funding decisions are made in February of each year. To allow sufficient time for evaluation, proposals should be submitted in time to reach BSF no later than July 1 of the preceding year.

Additional Information

Inquiries about the preparation of proposals of interest to the National Science Foundation may be addressed to NSF at the address shown above. Single copies of the BSF form "Application for Research Grant" may be obtained from the same address.

The program described above is a program of the United States-Israel Binational Science Foundation and should not be confused with National Science Foundation programs. Consequently, institutions and investigators should be aware that standard NSF proposal and award guidelines and procedures are not applicable.

United States-Italy Cooperative Science Program

THE NATIONAL SCIENCE FOUNDATION coordinates the participation of U.S. scientists and institutions in the United States-Italy Cooperative Science Program.

The objectives of the program are to promote cooperation between scientists of the two countries for peaceful purposes and to provide additional opportunities for them to exchange ideas, skills, and techniques; to attack problems of particular mutual interest; to work together in unique environments; and to utilize special facilities.

Types of projects included in this program are:

(1) Joint research projects.
(2) Exchange of scientists, in connection with approved projects.
(3) Seminars to exchange information and plan cooperative research.

Each activity in the program involves participation by scientists of both countries and requires approval by the Foundation and by the Consiglio Nazionale delle Ricerche, the executive agencies responsible for carrying out the terms of the agreement in the United States and Italy. Nothing in the agreement is intended to prejudice other arrangements for scientific cooperation between the two countries.

Funds for the support of the activities of American scientists may come from any U.S. source, which includes but is not confined to the regular research support programs of the Foundation. In addition, limited OIP program funds are available for the support of visiting scientists, the organization of binational seminars, and for developmental cooperative research grants. Proposals are submitted to the appropriate funding agency or institution in accordance with its normal procedures. At the same time, the U.S. investigator sends a copy of his proposal to the address below, together with a copy of the joint application form, signed by him and the Italian principal investigator. A brochure describing the United States-Italy Cooperative Science Program is available from the Foundation, together with instructions and guidelines for submitting proposals.

Additional Information

Communications should be addressed to: United States-Italy Cooperative Science Program, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Japan Cooperative Science Program

THE NATIONAL SCIENCE FOUNDATION awards grants to support the participation of U.S. scientists in the United States-Japan Cooperative Science Program. Japanese funds support Japanese scientists participating in the program.

Three types of projects are included in the program:

- Cooperative research in all areas of the natural sciences.
- Scientific seminars.
- Visiting scientists.

A brochure describing the United States-Japan Cooperative Science Program is available from the Foundation, together with guidelines for submitting proposals.

Eligibility

Those eligible to submit proposals are colleges and universities, nonprofit research institutions, professional societies and individual scientists. The program is aimed primarily at the academic scientist; however, others may be considered. All projects must be approved by the Foundation and the Japan Society for the Promotion of Science.

Deadlines

Proposals for cooperative research may be submitted at any time; approximately 6 months are needed to consider a proposal. Proposals for seminars between October 1 and March 31 must be received by the preceding February 28; for seminars between April 1 and September 30, the receipt date is the preceding August 31. Proposals for visits to Japan beginning between any July 1 and June 30 period must be received by July 1 of the preceding year.

Additional Information

Communications should be addressed to: United States-Japan Cooperative Science Program, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Latin America Cooperative Science Programs

THESE PROGRAMS ARE OFFERED to foster and support scientific cooperation on a bilateral basis between the United States and several Latin American countries. The National Science Foundation coordinates the participation of U.S. scientists in these programs under Agreements of Scientific and Technical Cooperation with the appropriate counterpart agencies in the countries involved. Formal agreements for which the National Science Foundation is responsible have been signed with Argentina, Brazil, and Mexico. Other countries in Latin America may also be considered.

Under these programs, research-oriented cooperative activities may be conducted and supported in any branch of science, unless specifically limited by mutual agreement between the coordinating agencies. Support is offered for three types of activities:

Cooperative research—projects designed jointly by and conducted collaboratively between principal investigators from the United States and from the cooperating foreign country. Proposals are submitted by a U.S. institution to the National Science Foundation and by the institution of a foreign investigator to the coordinating agency in his country.

Seminars—meetings of small groups of scientists of the United States and of the foreign country, jointly designed and convened by U.S. and foreign co-organizers. A seminar may be held in the United States or in the cooperating foreign country. Proposals are submitted by the U.S. co-organizer or his institution to the National Science Foundation and by the foreign co-organizer through his institution to the coordinating agency in his country.

Scientific visits—visits of short duration for the purpose of planning cooperative scientific activities or conferring about cooperative scientific activities; also, visits of longer duration for purposes of research. The application of a U.S. scientist to visit one or more of the cooperating countries is submitted by him to the National Science Foundation; the application of a foreign scientist to visit the United States is submitted by him or by his institution to the coordinating agency in his own country.

Eligibility

U.S. institutions eligible to participate in these programs include universities and colleges, professional societies, academies of sciences, and other nonprofit scientific organizations of the private or public sectors. Support is available only for U.S. scientists who are citizens of the United States or who have at least 5 years of professional employment beyond the doctorate in U.S. institutions and are currently affiliated with an eligible U.S. institution. U.S. scientists employed by profit-making organizations are not eligible for support.

Additional Information

Communications should be addressed to: United States-Latin America Cooperative Science Programs, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

United States-Spain Cooperative Science Program

THE NATIONAL SCIENCE FOUNDATION, through a special program funded by the Department of State, provides U.S. support to Spanish projects in science and technology under the terms of an Agreement between the Governments of the United States and Spain. The present Agreement terminates in September 1975; a new Agreement is expected to succeed it.

The program's objectives are to strengthen Spanish science and technology by making available U.S. scientific and technological resources, both human and material.

Project proposals, which must originate in Spain, are presented by the Government of Spain to the Government of the United States annually, through diplomatic channels, and are then reviewed by the National Science Foundation with the Directorate General for International Technical Cooperation of the Spanish Ministry of Foreign Affairs for feasibility.

Types of projects included in the program are:

- Joint seminars, held in the United States or Spain
- Cooperative research between U.S. and Spanish scientists
- Study travel and training of Spanish scientists in the United States.

Eligibility

The present Agreement calls for cooperation in all fields of science, engineering, and technology; urban and environmental studies; and agriculture.

U.S. scientists are welcome to participate in seminars and cooperative research projects supported by the program and are encouraged to correspond directly with Spanish scientists and make their interest known. Only projects which are officially approved by the Government of Spain and forwarded through the U.S. Embassy in Madrid can be considered for support.

Additional Information

Communications should be addressed to: United States-Spain Cooperative Science Program, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

International Science Studies Program

THE PRINCIPAL GOAL OF the International Science Studies Program is to develop a body of critical information about the mechanisms, problems, and benefits of international science activities. Through this program, a limited number of studies concerned with research, science education, science administration, and science organization in various regions and countries will be supported. It is anticipated that these studies will contribute to the intellectual and scholarly resources in the field of international science.

Eligibility

Proposals may be submitted by colleges, universities, and nonprofit institutions. Normally, applicants are required to share the cost of any proposed activity. Contractual arrangements may be made with profitmaking organizations for the performance of work for which they are uniquely qualified.

Additional Information

Communications should be addressed to: International Science Studies Program, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

Scientists and Engineers in Economic Development Program

THE NATIONAL SCIENCE FOUNDATION, through a special program funded by the Agency for International Development (AID), will provide support for individual U.S. scientists and engineers to apply their experience to problems of development in 39 countries currently receiving assistance from AID.

The program's objectives are to enable U.S. scientists and engineers to share experiences with their counterparts in developing countries who formulate and conduct specific research and education programs contributing in a direct way to economic development in their countries; establish long-term collaborative relationships between U.S. and foreign institutions; and increase the capability of scientific and technical institutions in developing countries.

Types of projects included in this program are:

(1) **Research/Teaching Grants**—An individual may apply through his institution for support to enable him to conduct research or teach for 9 to 12 months in an academic institution of a developing country. Grants may provide stipend plus air travel allowance for scientists and dependents. Local costs in the foreign country must be met by the host institution.

(2) **International Travel Grants**—An individual may apply for an International Travel Grant to engage in research or teaching in institutions of developing countries for a period not to exceed 9 months. Grants will provide the cost of economy class air travel plus a small amount of incidental expenses. Per diem and local costs must be provided by the host institution.

Eligibility

Applicants are limited to scientists and engineers from U.S. academic institutions with at least 5 years of postdoctoral or equivalent experience in teaching or research and who will return to their institutions on completion of the project.

Proposals will be considered in the following fields: engineering, physical sciences, earth sciences, biological sciences, social sciences, and science education.

Evidence of the host institution's support for the proposed project must be shown.

Additional Information

Communications should be addressed to: Scientists and Engineers in Economic Development Program, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

VI. SCIENCE EDUCATION

The major objectives of the NSF Science Education Program are to:

- Help assure the Nation of an appropriate variety, flexibility, quality, and number of scientific and technological manpower with greater participation of minorities and women.

- Improve science education to meet the needs of a broader range of students and to increase substantially the number of persons who make effective use of the processes and results of science in their work and personal lives whether or not they are engaged in scientific or technical occupations; and understand public issues involving science and technology.

- Improve the effectiveness and efficiency of science education through the application of improved programs involving modern educational technologies; new instructional strategies and methodologies; and knowledge gained from research on the processes of learning and education.

- Finds ways to increase the impact and effectiveness of the Foundation's Science Education Programs through research, problem assessment, and experimental projects which can point to necessary future program directions.

Program activities are structured around five major themes:

- Improvement of Education for Careers in Science
- Development of Science Literacy
- Increasing the Efficiency of Educational Processes
- Problem Assessment and Experimental Projects
- Support of Graduate Students.

The following summary provides a perspective of the objectives of each of these themes and a brief description of the related program elements. The descriptions are not intended to be guides for the preparation of proposals; such guides should be requested separately and are referenced in each description. The great majority of proposals for projects to improve education in the sciences received by the Foundation are submitted by colleges and universities on behalf of their staff members. Proposals may also be submitted by nonprofit organizations such as professional, scientific, and educational societies; research institutes and

aboratories; and educational consortia. Proposals from individuals acting independently of institutional sponsorship, State or local school systems, and industrial (profit-making, commercial) organizations have not normally been direct recipients of Foundation support for projects to improve science education. Prospective proposers should consult the specific program guide for preparation of proposals regarding details of eligibility. In requesting guidelines, send a separate postcard for each publication desired and identify by brochure number and title. Requests should be addressed to:

National Science Foundation
Forms and Publications Unit
Washington, D.C. 20550.

Other inquiries related to the respective programs should be sent to the staff unit referenced in each program description.

Improvement of Education for Careers in Science

THE CENTRAL OBJECTIVE IS to help assure an appropriate number, variety, flexibility, and quality of professional scientific and technological manpower, with greater participation by ethnic minority groups and women, to meet the Nation's needs. Programs are addressed not only to the problem of maintaining the quality of training in the traditional science disciplines but also to the development of new instructional patterns and new instructional programs, single- or interdisciplinary, leading to a wider variety of scientific and technical career options for individuals ranging from secondary school graduates to graduate degree-holders.

The following programs are included:

- Secondary School Program
  - —Materials and Instruction Development
  - —Instructional Improvement Implementation
- Alternatives in Higher Education Program
  - —Alternative Degree Programs
  - —Development of Instructional Materials and Modes
  - —Science and Engineering Technician Education
  - —College Faculty Workshops
  - —Faculty Research Participation
  - —Instructional Scientific Equipment Program
  - —Senior Foreign Energy Scholars
- Continuing Education for Scientists and Engineers
- Student-Oriented Program
  - —Student Science Training (for high ability secondary students)
  - —Undergraduate Research Participation (for undergraduate students)
  - —Student-Originated Studies (for undergraduate and graduate students)
- Ethnic Minorities and Women in Science
  - —Minority Institutions Science Improvement
  - —Experimental Projects and Problem Assessment

SECONDARY SCHOOL PROGRAM

The primary objective is improvement of science courses and curricula offered at the secondary school level to give high school students the best possible foundation for science- or technology-related careers. There are two main lines of attack.

Materials and Instruction Development

Support is provided for major course development and curriculum improvement projects of national import which will produce entire course packages or modules which can be flexibly fitted into existing or new courses. The package may include, in addition to the basic text, auxiliary materials such as laboratory exercises and investigations, teacher education materials and strategies, and supplementary audio-visual materials. The objective is to enhance the capability of the educational system to interact with learners in ways that will maximize educational benefits. Other kinds of activities are also supported including, but not limited to, generation of guidelines for curricula through conferences and seminars, analysis of curriculum materials, development of resource centers for teachers, and research into the learning process.

Proposals may be submitted at any time. Prospective proposers are required to describe their projects in a preliminary proposal so that the Foundation can determine whether a formal proposal can be considered. For proposal submission guidelines, request brochure MATERIALS AND INSTRUCTION DEVELOPMENT, PRE-COLLEGE (E-75-3).

Instructional Improvement Implementation

Activities associated with improving classroom instruction will be directed toward the implementation of new course materials in the classroom. Attention will be focused on working with key individuals and with groups of schools and school systems. All activities, including in-service teacher education, will be directed toward fostering successful implementation of major curriculum and course developments in school systems. Attention will generally be given to new approaches developed with Foundation support. However, assistance will be provided for implementation of educational programs developed through non-NSF-supported activities when thorough, comprehensive evaluations support their effectiveness. The decision to support an implementation project will be governed, primarily, by the quality of the material and by its demonstrated potential for gaining wide acceptance. Other criteria will also be applied in assessing the merits of the proposed implementation plans, including the extent of commitments of schools and associated institutions, the appropriateness of the instructional staff, cost effectiveness of operating plan to achieve desired results, etc.

Each proposal will be expected to designate those aspects of the implementation process which are its primary concern. These might include familiarization with alternative curricula or approaches; exploration in depth of a selected curriculum for committed users; training of resource teams for long-term dissemination and maintenance; installation in a significant segment of a school system; or some other formulation of an implementation scheme most appropriate for a given local situation.

Deadlines

The deadline for submission of proposals is August 1. For proposal submission guidelines, request brochure INSTRUCTIONAL IMPROVEMENT IMPLEMENTATION (E-75-4).

Additional Information

Communications may be addressed to: Division of Pre-College Education in Science, National Science Foundation, Washington, D.C. 20550.

ALTERNATIVES IN HIGHER EDUCATION PROGRAM

In order to encourage and facilitate change in higher education to meet changing requirements for academic training, this program will support the creation and testing of alternative undergraduate and graduate programs in science and technology that will provide the professional skills needed in today's society, and will assist in the development of new modes of delivering education and the exploration of economical alternatives for introducing new program options into the existing system of higher education. AHE represents a major Foundation effort focusing on the development of quality science education that will give students greater flexibility and a broader range of career choices than former programs that were largely single-discipline oriented. This activity is designed to test alternatives to meet these needs and will pursue seven separately identified approaches.

Alternative Degree Programs

Support will be provided to colleges and universities for design and implementation of curriculum prototypes that, as alternatives to typical basic science research-oriented baccalaureate, master's or Ph.D. degrees, lead to a wider variety of career options in areas of recognized national need. Institutions may propose entirely new undergraduate or graduate degrees or the restructuring of existing degree programs. In either case, a

significant element of experimentation must be present, resulting in a meaningful departure from traditional degree programs.

Development of Instructional Materials and Modes

One of the major avenues for the improvement of higher education in science in the past has been the development of curricular materials for use in a traditional lecture-recitation-laboratory format. NSF priorities are now shifting toward newly emerging, problem-relevant subject areas, and toward the search for more effective and efficient modes of delivery. Thus, the focus of this element of AHE will be on the creation of modules, courses, curricula, or instructional sequences in newly significant science- or engineering-based problem areas, and on studies of novel delivery systems for both on-campus and off-campus instruction.

There is considerable flexibility in project format or topic, including experimentation with alternative instructional modes, with new materials aimed at development of problem-solving competencies, with applications of modularization and self-pacing, and with independent study. Only those projects that demonstrate the likelihood of use on a national scale will be supported. Preliminary proposals are required.

Deadlines

Proposals may be submitted at any time. Request brochure number E-74-5 for guidelines for the submission of proposals for Alternative Degree Programs and Development of Instructional Materials and Modes.

Science and Engineering Technician Education Program

The primary objective of this program is the development, demonstration, and evaluation of a limited number of new or alternative collegiate-level programs that provide for the education of technical personnel to support scientific and engineering activities. Prototype programs should provide technical personnel with a sound scientific and technical basis for continuing professional growth throughout life, an ability to adapt to future technological advances, and job entry skills for productive employment in scientific and engineering activities. Priority will be given to projects which emphasize the basic core of scientific and mathematical principles underlying technical applications and various combinations of carefully selected specialized subject areas which are responsive to recognized, national manpower requirements for technical support personnel. To minimize duplication of effort, existing or pending basic science core materials will be modified and used whenever available. All program and materials will be developed in flexible formats that assure ease of adoption by the various institutions engaged in technical education and will incorporate, whenever possible, actual or simulated practice of the technical specialty.

Deadlines

Proposals may be submitted at any time. Request brochure E-74-18, SCIENCE AND ENGINEERING EDUCATION PROGRAM.

College Faculty Workshops

The focus of College Faculty Workshops is also on the creation of modules, monographs, courses, curricula, or instructional sequences in newly significant science or engineering areas. The project format, however, is the development of these instructional materials and modes with the aid of practicing college faculty. College

faculty are selected to contribute their talents as teachers and their knowledge of the requirements and capabilities of students to the work of research scholars in creating and testing curricular materials for undergraduate students of science.

Deadlines

Proposals may be submitted at any time. Request brochure number E-71-6, COLLEGE FACULTY WORKSHOPS.

Faculty Research Participation

The Faculty Research Participation Program provides opportunities for college and university teachers to participate during the summer in the ongoing activities of laboratories engaged in research on problems of national interest and concern. In this cooperative venture, academic faculty engage in work carried on at research laboratories of industrial organizations, independent research laboratories or institutes, and laboratories maintained by Government agencies. The purpose of the Faculty Research Participation Program is to encourage and assist teachers in reevaluating the relevance of their science instruction to the needs and requirements of students and society. Proposals are invited from the commercial and governmental facilities offering the research opportunities; supported projects are announced to interested academic faculty in an annual DIRECTORY OF FACULTY PARTICIPATION.

Deadlines

Request brochure number E-75-17 for guidelines for the submission of proposals for Faculty Research Participation. The deadline for receipt of proposals under this program is October 1, 1974. Request brochure number E-75-23, DIRECTORY OF FACULTY RESEARCH PARTICIPATION, for an announcement of research opportunities available in 1975.

Instructional Scientific Equipment

The Instructional Scientific Equipment Program assists in improving undergraduate science education by providing partial support for the acquisition of scientific equipment required in implementing an improved or new undergraduate instructional program in one or more of the sciences. Universities, colleges, and 2-year colleges in the United States or its territories that are introducing improved courses of instruction in the sciences at the undergraduate level are eligible for support by this program. Grants are made on a matching fund basis in which the grantee provides at least 50 percent of the cost of the equipment.

Deadlines

Request brochure number E-75-15 for guidelines for submission of proposals for Instructional Scientific Equipment. Deadline for receipt of proposals under this program is December 13, 1974.

Senior Foreign Energy Scholars

As part of an effort to increase the scope and depth of energy-related research, development, and educational activities, the Senior Foreign Energy Scholars Program will provide partial assistance to selected U.S. doctoral-level institutions to enable approximately 20 distinguished foreign scientists to share their expertise in energy-related fields during a period of residence in the United States. A significant additional benefit anticipated is increased cooperation within the international scientific community. Since so few opportunities can be offered in this program, groups of two or

more institutions that associate together to share in the presence of a distinguished visitor are encouraged to submit a cooperative proposal.

Senior Foreign Energy Scholars are expected to carry out at their host institutions activities plans in energy-related fields in the mathematical, physical, medical, biological, engineering, and social sciences. In this program, energy-related fields are limited to those non-nuclear areas such as coal and oil shale, solar energy, and geothermal energy in which the institution has a very strong base of expertise on which to build.

Deadlines

Request brochure number E-75-38 for guidelines for submission of proposals for academic institutions wishing to sponsor a Senior Foreign Energy Scholar. The deadline for receipt of proposals under this program is January 15, 1975.

Additional Information

Communications concerning Alternative Degree Programs, Development of Instructional Materials and Modes, and Science and Engineering Technician Education may be addressed to: Materials and Instructional Development Section, Division of Higher Education in Science, National Science Foundation, Washington, D.C. 20550.

Communications concerning College Faculty Workshops, Faculty Research Participation, and Instructional Scientific Equipment may be addressed to: Instructional Improvement Implementation Section, Division of Higher Education in Science, National Science Foundation, Washington, D.C. 20550.

Communications concerning Senior Foreign Energy Scholars may be addressed to Senior Foreign Energy Scholars Program, Division of Higher Education in Science, National Science Foundation, Washington, D.C. 20550.

CONTINUING EDUCATION FOR SCIENTISTS AND ENGINEERS PROGRAM

The objective is to find effective ways to continue the professional education of scientists and engineers in the nonacademic labor force. With the steadily increasing rate of accumulation of scientific and technical knowledge has come an increasing rate of obsolescence, at great economic and social cost to employers, employees, and the Nation. Economically feasible means must be found to afford to the scientist and engineer in the labor force opportunities to keep up-to-date and to do it in a cost-effective manner. Development of appropriate subject matter and delivery systems which give promise of increasing the availability, utility, and effectiveness of continuing education will be supported, with the principal focus being on experimental projects rather than on the support of proven mechanisms.

Deadlines

Proposals may be submitted at any time. Request brochure number E-71-5, ALTERNATIVES IN HIGHER EDUCATION, for guidelines for the submission of proposals. (See also, Problem Assessment and Experimental Projects on page 64.)

Additional Information

Communications may be addressed to: Instructional Improvement Implementation Section, Division of Higher Education in Science, National Science Foundation, Washington, D.C. 20550.

STUDENT-ORIENTED PROGRAM

The Student-Oriented Program has two closely related goals: (1) to provide talented students with science learning opportunities above and beyond those normally available in most formal science education programs in the Nation's schools and colleges; and (2) to increase the variety of instructional modes and of institutional patterns of instruction by demonstrating to both students and faculties the capacity of students to be motivated by independence and thus to accept greater responsibility for planning and carrying out their own learning activities.

Students learn easily and well when they feel that the need to learn is in harmony with their own self-interest and sense of what is important. A central mechanism for developing this feeling of connection between academic studies and the real world is to organize instruction around problems which a student can perceive as being significant, problems which are stated in ways which allow a young person to recognize and understand, from his own perspective, the nature and importance of those problems.

To provide experiences beyond those normally available to students, and at the same time, to bring the potential benefits of more open-ended, less tightly guided instruction directly to the attention of those who determine teaching patterns, the Foundation supports the active participation of students with faculty in specially designed instruction and or investigative work. In the various types of projects, the role of the faculty ranges from central and directive to strictly advisory, but in all cases the projects should stress increasing independence and responsibility for the student.

The Foundation invites submission of proposals for support of three types of activity directed toward achieving the primary goal stated above.

Student Science Training (SST) (for high ability secondary students)

SST will continue to support summer science programs, established by academic institutions and nonprofit laboratories, aimed at testing the aptitude of outstanding secondary school students for science by bringing them into direct contact with teachers and research scientists of recognized competence who can provide them with educational experiences in science and mathematics beyond those available in the usual high school courses.

Deadlines

Proposal deadline is October 11, 1974. Request brochure E-75-7, STUDENT-ORIENTED PROGRAM, for guidelines for submission of proposals.

Undergraduate Research Participation (URP) (for undergraduate students)

URP projects are aimed at providing experiences, through participation in research, that will enable undergraduate students to grow in independence, and will at the same time demonstrate the potential of this kind of activity as an adjunct to or as a replacement for traditional formal classroom instruction.

Proposals may be submitted in any scientific discipline, but within those disciplines or specialties in which energy-related research is feasible, highest priority will be given to

projects that fall within the Foundation's definition of "energy-related general research." The fields of science identified as energy-related are listed in the Student-Oriented Program announcement.

Deadlines

Proposal deadline is September 20, 1974. Request brochure E-75-7, STUDENT-ORIENTED PROGRAM, for guidelines for submission of proposals.

Student-Originated Studies (SOS) (for undergraduate and graduate students)

The general aim of SOS is much the same as that of URP—the provision of student experience in independent, self-directed study, and demonstration of the effectiveness of such study as an adjunct to or replacement for traditional, formal course work—but the mechanism is different. In SOS, the projects are wholly student-originated and student-managed, with faculty in a strictly advisory role, in contrast to URP, in which the faculty plays a guiding role and the student participates as a junior colleague. While the program has been addressed primarily to undergraduate (with some graduate students permitted in principally undergraduate groups), it will now be open also to groups of graduate students. The general requirement is that the studies be conducted by multidisciplinary groups and be concerned with problems of the physical, biological, or social environment.

Deadlines

Proposal deadline is November 15, 1974. Request brochure E-75-7 STUDENT-ORIENTED PROGRAM, for guidelines for submission of proposals.

Additional Information

Communications may be addressed to: Office of Experimental Projects and Programs, National Science Foundation, Washington, D.C. 20550.

ETHNIC MINORITIES AND WOMEN IN SCIENCE

The objectives of EMWS are to study and test educational mechanisms and to support experimental models aimed at discovering and promoting more effective methods of increasing the flow of women and ethnic minority group members into careers in science. The program will move along two lines:

(a) support for college science improvement, to establish model operating science education programs designed to surmount the roadblocks hindering the movement of ethnic minority group members into careers in science; and

(b) support to academic institutions or education-related organizations to assist in developing a better understanding of the nature and origin of the roadblocks to science careers for women and minorities and in designing methods of overcoming these obstacles.

Minority Institutions Science Improvement

The program of Minority Institutions Science Improvement is to assist in developing the undertapped resources available in ethnic minorities by increasing the involvement of minorities in scientific careers. Support is provided to 2- and 4-year institutions of higher education whose enrollment is predominantly Black, Native American, and or Spanish-speaking to assist in removing or overcoming impediments

to the involvement of their students in scientific activities and in strengthening or developing effective instructional procedures preparing their students in science. Institutions are expected to develop plans for improving their capabilities of serving the science educational needs of their minority students. Support is provided to an individual institution proposing a science improvement plan for that institution, or to a consortium of two or more institutions defining common problems and finding it both advantageous and cost-effective to propose a cooperative science improvement plan for the consortium.

Deadlines

Request brochure number E-75-8 for guidelines for the submission of proposals for Minority Institutions Science Improvement. Proposals may be submitted at any time.

Problem Assessment and Experimental Projects

Support is also provided for problem assessment studies and experimental projects concerned with improving the movement of women and minority group members into careers in science. Information regarding these activities is included in the discussion of Problem Assessment and Experimental Projects found on page 64.

Deadlines

Proposals may be submitted at any time. Request brochure E-75-8, MINORITY INSTITUTIONS SCIENCE IMPROVEMENT, for guidelines for submission of proposals.

Additional Information

Communications may be addressed to: Division of Higher Education in Science, National Science Foundation, Washington, D.C. 20550.

Development of Science Literacy

IN DEVELOPING SCIENCE LITERACY, the goal is to increase substantially the number of persons who are able to make use of the methodology of science, as well as the results of scientific discovery, in their work and personal lives, whether or not they are engaged in scientific or technical occupations.

As our society becomes more and more technologically based, more and more people are becoming engaged in activities or in making decisions that require a scientific or technical background, and there is an increasingly wide range of jobs at all levels for which science training is highly useful, if not essential.

Concurrently, the Nation is making the benefits of more education available to more of its citizens. Our schools are now accommodating almost the entire school age population and are thus faced with an increasing diversity of talents, capabilities, and career aspirations. To meet the needs of these students, a wider variety of teaching materials must be developed. There must be available teaching materials that can be matched to the learning abilities of both the theoretically inclined student who learns readily from the printed page and the more practically oriented student who learns best from "hands-on" materials and tangible models.

The Development of Science Literacy activity is subdivided into two elements: an Elementary School Program and a Secondary School Program. The common objectives include the development and implementation of materials which:

- Offer a meaningful introduction to the fields concerned
- Are based on topics of inherent interest to children or teenagers
- Require a "hands-on" learning approach
- Serve as a sound foundation for later educational experiences
- Offer superior educational returns for little or no increase in investment
- Can be used without long-term reorientation of school personnel

These two programs, which are directed at students who may or may not choose careers in science, will operate within a format essentially the same as that of the science career-oriented Secondary School Program described under Improvement of Education for Careers in Science (see page 53.)

Deadlines

Materials and Instruction Development, Pre-College. Proposals may be submitted at any time. Preliminary proposals are required. Request E-75-3 for guidelines for the submission of proposals.

Instructional Improvement Implementation. The deadline for submission of proposals is August 1. Request E-75-4 for guidelines for submission of proposals.

Additional Information

Communications should be addressed to: Division of Pre-College Education in Science, National Science Foundation, Washington, D.C. 20550.

Increasing Efficiency of Educational Processes

THE OBJECTIVE OF THESE activities is to improve effectiveness and efficiency in science education. Two major approaches to attaining a better balance between costs and productivity are planned. The first concentrates upon the development and instructional application of technological devices such as computers and television, under Technological Innovation in Education. The second approach, which is supported under Educational Program Restructuring, focuses on a few major models of new approaches to the organization, management, delivery, and content of education.

TECHNOLOGICAL INNOVATION IN EDUCATION

Support is provided for the development and innovative application of computing and related communication technologies in education. The objectives of this program activity are pursued through three separate program elements:

- **Technology and Systems,** which provides support for the development of technology and techniques applicable to education and for projects focused on the testing and evaluation of special systems.

- **Applications and Courseware,** which supports projects aimed at the development, testing, and evaluation of innovative applications, new instructional concepts, and courseware in selected disciplines, and the development of mechanisms to disseminate and facilitate the widespread use of these products and concepts.

- **Special Projects,** which supports projects designed to explore and develop the use of modern communication technologies for effective and efficient instruction.

Deadlines

Proposals may be submitted at any time. Because extensive planning is usually involved in project development of these types, interested persons should discuss their ideas with program staff before submitting proposals. For guidelines for submission of proposals, request brochure E-74-9, TECHNOLOGICAL INNOVATION IN EDUCATION.

EDUCATIONAL PROGRAM RESTRUCTURING

The Educational Program Restructuring activities are experiments designed to lead to major changes, rather than to relatively minor modifications, in the way education is done, with the goal of improving the effectiveness and efficiency of the educational process. To this end, support will be provided to assist in the design, development, and evaluation of a few major experimental models of new approaches to the organization, management, delivery, and content of science education. Emphasis will be placed on design and development for results that can be evaluated and documented. The aim is the production of generalizable and transportable results.

Program areas of focus for the near future are as follows.

Restructuring the Undergraduate Learning Environment (RULE)

RULE aims to support comprehensive change of college or university undergraduate science instructional programs. Priority will be given to those projects which more nearly affect the student's complete learning environment. Since changes of the scope envisioned will sometimes necessarily include nonscience areas, where appropriate, proposals will be considered jointly with the National Endowment for the Humanities.

Pre-Service Education of Teachers of Science (PSTE)

Support will be provided for the development and dissemination of model programs for the pre-service education of teachers of pre-college-level science.

State, Regional, or Urban Systems of Science Education (SYSTEMS)

Support will be provided for experiments and demonstrations to provide models of new approaches to the coordination of efforts of schools, colleges, universities, State and local government, and private agencies in selecting a specific objective as a target for education reform, and developing and executing a coordinated, collaborative plan for achieving it.

Deadlines

Proposals may be submitted at any time. Because extensive planning is usually involved in project development of these types, interested persons should discuss their ideas with program staff before submitting proposals. For guidelines for submission of proposals, request brochure E-75-10, EDUCATIONAL PROGRAM RESTRUCTURING.

Additional Information

Communications may be addressed to: Office of Experimental Projects and Programs, National Science Foundation, Washington, D.C. 20550.

Problem Assessment and Experimental Projects

To INCREASE THE EFFECTIVENSS and impact of NSF (and other) programs directed toward the improvement of science education, support is provided for studies and experimental projects directed toward a variety of problems—some identified by NSF and some by individuals outside the Foundation. Studies should be designed to provide understanding of and perhaps to propose possible solutions to some of the more pressing current or foreseen problems of science education. Experimental projects are expected to try out or test techniques or educational formats that may provide cost-effective solutions to identified problems in science education.

The following areas have been identified by NSF staff for problem assessment studies:

- Studies of barriers to implementation of newly developed materials and modes of instruction at the pre-college and post-secondary levels, and of ways to overcome them.
- Studies of new and effective ways of maintaining intellectual vitality of college and university faculty members, in the face of leveled-off college enrollments and reduced faculty turnover.
- Studies of the current state and or effectiveness of continuing education for practicing scientists and engineers.
- Studies (supplementing those currently funded by NSF) of barriers to the movement of women into careers in science and technology.
- Studies (supplementing those currently funded by NSF) of barriers to the movement of ethnic minority group members into careers in science and technology.
- Studies of ways to provide science education to persons typically outside the formal education system.
- Studies of ways to introduce student science project activity into high schools during the regular school year.

Those who may be interested in conducting studies in one or more of the above areas are invited to send a postcard (a separate card for each study) expressing that interest.

The following areas have been identified by NSF staff for experimental projects:

- Projects to develop ways to increase the availability of high school student project activity as part of, or as an adjunct to, the school's formal academic year activity.
- Projects (supplementing those currently funded by NSF) to develop and test ways to increase the number of ethnic minority members in careers in science.
- Projects to develop and test effective ways to provide science education to persons typically outside the formal education system.
- Projects to develop improved techniques of evaluation of science education programs.

Those who may be interested in conducting experimental projects in one or more of the above areas are invited to send a postcard (a separate card for each project) expressing that interest.

Postcards expressing interest in the above areas for studies and experimental projects should be directed to the address listed below. For general information about how to submit proposals for studies and experimental projects related to problems other than those identified above, request brochure E-74-11, FIELD-INITIATED STUDIES AND EXPERIMENTAL PROJECTS.

Additional Information

Communications should be addressed to: Office of Experimental Projects and Programs, National Science Foundation, Washington, D.C. 20550.

Support for Advanced Study

THE PRIMARY OBJECTIVE OF the Foundation's program of support for advanced study is to assure that the Nation's most talented graduate students in the sciences obtain the education necessary to become a cadre of first-line researchers needed by our technologically based society. The Graduate Fellowship Program is instrumental in this objective.

Another objective is training of scientific and engineering manpower specifically to help meet the Nation's energy problems. The Energy-Related Traineeships and Postdoctoral Energy-Related Fellowships support this objective.

GRADUATE FELLOWSHIPS

It is expected that in fiscal year 1975 the nationally competitive Graduate Fellowship Program will provide approximately 500 new 3-year fellowships, to be awarded to beginning graduate students. In addition, approximately 1,000 prior-year awardees will be supported. The competition is open only to citizens or nations of the United States. This competition is administered for the Foundation by the National Research Council.

For the program announcement (E-75-12) write to:

Fellowship Office
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20118

The deadline for this program is December 2, 1974.

FACULTY FELLOWSHIPS IN SCIENCE APPLIED TO SOCIETAL PROBLEMS

Approximately 90 fellowships for tenures of 3 to 9 months are planned for award in fiscal year 1975 to help faculty members in junior and community colleges, colleges, and universities broaden their perspectives in the applications of science to the problems of our society. The competition is open only to citizens or nationals of the United States who are at the time of application a member of the science teaching faculty of a U.S. institution of higher education. For the program announcement (E-75-37) write to the Division of Higher Education in Science, National Science Foundation, Washington, D.C. 20550. The deadline for receipt of applications in this program is February 7, 1975.

POSTDOCTORAL ENERGY-RELATED FELLOWSHIPS

Approximately 90 fellowships for tenures of 6 to 12 months are planned for award in fiscal year 1975 to recent postdoctorals who have demonstrated a special aptitude for research and who have an interest in energy-related problems. The competition is open only to citizens or nationals of the United States. For the program announcement (E-75-37) write to the National Research Council at the address given above. The deadline for receipt of applications in this program is December 6, 1974.

ENERGY-RELATED GRADUATE TRAINEESHIP PROGRAM

Energy-related graduate traineeships are offered to help meet the Nation's emerging needs for scientific and professional manpower especially trained in energy-related work. In 1975, approximately 80 new traineeships will be awarded for graduate study of energy-related problems.

Doctoral-granting institutions may obtain information concerning the program by writing for brochure number E-75-20; the deadline for receipt of institutional proposals is December 1, 1974. An announcement of institutions receiving awards will be available from the Foundation after March 24, 1975. Individuals should apply only after this date, directly to the awardee institutions and not the National Science Foundation.

NATO FELLOWSHIPS IN SCIENCE

At the request of the Department of State, the Foundation administers two fellowship programs for the North Atlantic Treaty Organization (NATO).

NATO Postdoctoral Fellowships. Awards are made to U.S. citizens for full-time postdoctoral-level study in science in countries that are members of NATO (other than the United States) or in other countries which cooperate with NATO. Approximately 50 awards will be made in fiscal year 1975 to outstanding individuals who have recently received (or will soon receive) doctoral degrees in science. Evaluation of applicants is based on their academic records, letters of recommendation, and ability to carry out the activities programs proposed in the applications. This program is designed primarily for applicants who have received their doctorates within the past 5 years. For the program announcement, request brochure E-75-13.

NATO Senior Fellowships in Science. These awards are made to senior U.S. scientists for short visits abroad to study new scientific techniques and developments in countries that are members of NATO (other than the United States) or in other countries which cooperate with NATO. Tenures range from 30 to 90 days, and awards carry travel and per diem allowances. An application must be accompanied by a statement from an appropriate official of the applicant's home institution describing the expected benefits to the institution if the fellowship were awarded. For the program announcement, request brochure E-75-14.

TRAVEL GRANTS FOR NATO INSTITUTES

The Foundation awards travel grants to enable young U.S. scientists to attend certain NATO Advanced Study Institutes. These meetings, held usually during the summer and varying in length from 1 to 8 weeks, permit exhaustive treatment of a given scientific topic. Grants normally cover the cost of the round-trip air fare involved. The directors of the institutes are invited to nominate U.S. citizens for these awards from among those admitted to their institutes, and these individuals are then invited to apply to the Foundation for grants. Therefore, individuals should make their interest in a NATO Travel Grant known to the directors of the institutes they wish to attend. Lists of institutes receiving such support are available from the Foundation annually around March.

Additional Information

Communications should be addressed to: Fellowships and Traineeships Section, Division of Higher Education in Science, National Science Foundation, Washington, D.C. 20550.

VIII. SPECIAL PROGRAMS

Science and Technology Policy Office

THE DIRECTOR OF THE National Science Foundation has been designated the President's Science Adviser and Chairman of the Federal Council for Science and Technology (FCST). In addition, responsibilities formerly assigned to the Office of Science and Technology (OST) have been transferred to him. In this role, the Director is responsible for providing advice and analysis to the President and agencies in the Executive Office of the President on matters involving science policy, and acts as the President's representative in various international scientific and technological activities.

The Director, as Science Adviser, is responsible for:

- Providing advice, consultation, and recommendations on national civilian science and technology policy matters.
- Developing technical options related to the solution of national problems in the civilian area.
- Appraising the overall effectiveness of ongoing Federal and national R&D efforts and recommending policy and program actions toward the achievement of national goals through civilian science and technology.
- Serving as the local point for coordinating Federal R&D programs.
- Interacting with academic and industrial communities on broad matters of science policy so as to further their participation in strengthening U.S. science and technology.
- Providing advice, assistance, and coordination in furthering U.S. international science and technology objectives.

The Science and Technology Policy Office (STPO) has been established in NSF to provide central staff support for the Director in the performance of the above.

The fiscal year 1975 program of outside grant and contract activity will reflect the needs for detailed studies and analyses to support the development of policy options and possible program initiatives. Major thrusts of the program will be twofold: (1) studies of the process of science policy formulation and the methodologies which contribute to this process; and (2) specific analyses of problem areas, data gathering, and development of forecasts and analyses of the consequences of potential policy options. Examples of the types of studies to be anticipated are:

- Determination of the comparative position of the U.S. technology base (sector by sector).
- Determination of the impact of Federal policy on international technology transfer.
- Policy analysis for scientifically based programs where decisions ultimately involve a reconciliation among a number of desired national objectives (economic well-being, environmental quality, favorable balance of international trade, and maintenance of competitive advantage).
- Utilizing modeling and forecasting techniques. Evaluation of the possible impact of scientific and technological policy options.
- Review of selected science policy topics through university science policy groups.
- Analysis of defined policy issues in areas such as materials, environment, ecology, and health.
- Policy studies in intergovernmental science and the role of Federal technology sharing programs.

- Development of new methods of communication between STPO and the national groups representing science and technology policy interests. Means to be explored will include regional forums and symposia with the aid of professional societies, and the National Academies of Science and Engineering.

- Determination of the effectiveness of selected interagency approaches to Federal R&D programs, such as multiple use of R&D facilities and resources.

- Analysis of the consequences of regulatory policies on industrial innovation.

Deadlines

Proposals may be submitted at any time during the year.

Additional Information

Communications should be addressed to: Science and Technology Policy Office, National Science Foundation, Washington, D.C. 20550.

Office of Energy R&D Policy

THE PRIMARY PURPOSE OF this office is to provide to the Director, in support of his role as Science Adviser to the President, an independent source of advice and analysis of energy R&D and other energy-related programs for use by the Executive Office of the President.

The program is designed to assist the Director in the performance of the following functions:

- Providing analysis of specific issues and selected programs related to energy R&D, including energy supply technologies, energy demand and conservation, and energy-related areas of environmental, economic, and sociological research.
- Developing a general systems framework for the evaluation of energy R&D programs, and developing appropriate criteria for assessing the merits of individual technological approaches.
- Identifying and recommending to the Executive Office of the President critical needs in energy R&D.
- Providing independent assessment of environmental, health and safety standards, and identifying necessary additional research to improve standard setting.
- Maintaining awareness of current plans and viewpoints of industry and associations on matters related to energy R&D.
- Determining ways in which universities and other research organizations can make their most effective contribution to energy R&D from a research and manpower viewpoint.

The program will utilize existing data and research sponsored by other agencies and other NSF programs to the maximum extent feasible. Special studies will be conducted and supported, however, to meet the objectives of the program.

Eligibility

The work of this program is performed by a group of analysts responsible to the Office of the Director, and through grants and contracts with universities and other appropriate organizations.

Study proposals which are supportive of the program plans will be considered for awards. The program of studies will be a cooperative effort involving the analytical staff at the Foundation and a limited number of extramural grants and contracts. It should be noted that this program does not fund efforts to undertake energy R&D. Rather, its responsibilities are associated with the determination of what types of energy R&D should be undertaken.

Deadlines

Proposals may be submitted at any time during the year.

Additional Information

Communications should be addressed to: Office of Energy R&D Policy, National Science Foundation, Washington, D.C. 20550.

National R&D Assessment Program

CONSONANT WITH THE EXPRESSED needs of the Executive Office of the President, the Congress, and the National Science Foundation, the Office of National R&D Assessment provides an analytical capability to supply objective analysis and define options available with regard to enhancing the contribution of science technology to the Nation. The program seeks to combine the studies of Government policy options with a fuller understanding of technological innovation processes and the benefits and cost to society flowing from technological innovation.

The activities of the program include:

- Encouraging research that will provide greater insight into technological innovation and how it can contribute to national purposes;
- Supporting research that will empirically verify hypotheses and uncover cause-effect relationships useful to public policy decisionmakers;
- Preparing analytical summaries of past and current research findings on R&D technological innovation;
- Supplying objective analyses of policy options related to R&D technological innovation.

The program consists of three elements as described below. All three elements are interrelated in their concern for understanding processes, measuring effects, and analyzing policy implications associated with technological innovation.

Government and Technological Innovation. This program element examines the effects of Government activities on the amount, rate, and direction of technological innovation (including R&D). The purpose is to provide a base for analyzing Government involvement in technological innovation and to identify Government policy options and practices which might increase the contribution of science and technology to the Nation. Emphasis is on analysis and assessment of relationships between policies, socioeconomic conditions, and the processes of technological innovation from the perspective of Government policy options and decisionmaking.

Current research topics fall into the following categories:

- Government Decisionmaking Allocation of Resources
- Patents, Antitrust, and Market Structure
- Regulation and Innovation
- Topic Policy Studies in Areas of National Concern

Socioeconomic Effects of Technological Innovation. This program element identifies, measures, and examines the socioeconomic effects of technological innovation. It seeks to improve the conceptual framework and techniques available to identify and measure the socioeconomic variables and relationships needed to assess policy problems and options involving technological innovation. This element stresses increasing the empirical information about the effect of technological change on specific socioeconomic conditions.

Current research topics fall into the following categories:

- Private and Public Returns from Technological Innovation (including distribution of returns, contributions to productivity, and magnitude of inputs)
- Effects of International Technology Flows and Levels on U.S. Economic Welfare
- Technological Change and the Supply of and Demand for Materials
- Individual Well-Being and Technological Change

Processes of Technological Innovation. This program element examines similarities and differences in the way research and development and innovation occur in civilian sectors of the economy. The purpose is to improve the understanding of the variables that influence those processes, including the effects of private and public involvement. Emphasis is on studies of the decisions and activities underlying innovation.

Current research topics fall into the following categories:

- Innovation Processes in the Private Sector
- Innovation Processes in the Public Sector
- Comparative Studies of Innovation Processes in the Public and Private Sectors
- The Individual in Innovation Processes

Eligibility

The work of this program is performed by a group of analysts, responsible to the Office of the Director, and through grants and contracts with universities and other appropriate organizations.

Study proposals which are supportive of the program plan are considered for awards. The program of studies is a cooperative effort involving the analytical staff at the Foundation and a limited number of extramural grants and contracts (about 25 per year).

Profitmaking and other organizations are eligible to participate in the National R&D Assessment Program on the same basis as academic and nonprofit organizations.

Deadlines

Proposals may be submitted at any time during the year. Approximately 3 to 6 months should be allowed for review and decision.

Additional Information

A detailed program plan and additional criteria for proposal preparation and submission are available from the Office of National R&D Assessment, National Science Foundation, Washington, D.C. 20550.

Ethical and Human Value Implications of Science and Technology

THE ETHICAL AND HUMAN Value Implications of Science and Technology Program was established in 1973. A primary aim of the program is to identify and analyze the ethical and human value aspects of new developments in science and technology at the earliest possible time. It is also concerned with the related questions of the nature of values, the ways in which science and technology are affected by the values of external groups, and the ethical and value components (if there are any) of science and technology themselves. Only original projects can be considered for support, but they must be built on a working familiarity of the work which has already been done in this area. By the very nature of the problems involved, most approaches will have to be multidisciplinary, involving social scientists, natural scientists, engineers, historians, philosophers, and lawyers, to name some of the most obvious groups.

In addition to continuing its unilateral support of projects in this area, the National Science Foundation is prepared to support worthy and appropriate scholarly activities in this field in collaboration with the National Endowment for the Humanities (NEH). Activities to be considered for support include research and other forms of scholarly investigation, course and curriculum development, conferences, colloquia, and similar activities. All projects should show promise of national impact. It must be emphasized that this program will support only *studies* of the kinds of topics specified above. No support can be given to projects (or components of projects) concerned with the formulation, enactment, or implementation of value-based policies or regulations.

The NSF and the NEH have established procedures which will enable them to work in close collaboration in this program. Proposals for research or other activities in this field may be submitted either to the NSF or NEH, depending on their primary orientation. If the subject of inquiry falls within the physical or social sciences or some branch of technology, or if the approach to be used is primarily scientific, the proposal would be more appropriate for NSF. If the subject of inquiry is primarily humanistic or if the approach is primarily philosophical or historical, the proposal would be more appropriate for NEH. To some extent, the disciplines of the investigators and the relative presence or absence of quantitative factors may also serve as a guide. Through coordination between the two foundations, proposals may be transferred from one to the other as indicated by the subject matter, availability of funds, etc. In appropriate instances, there may be joint funding of approved proposals.

Eligibility

Universities, colleges, and nonprofit organizations may submit proposals for consideration. However, in this program, pre-submission discussion with appropriate staff of either foundation is considered desirable.

Deadlines

Proposals may be submitted at any time; however, processing of proposals usually requires 4 to 8 months.

Additional Information

Proposers should consult NSF Important Notice No. 48 and appropriate NSF brochures such as GRANTS FOR SCIENTIFIC RESEARCH, ANNOUNCEMENT OF EDUCATION PROGRAMS, and or guidelines for the Research Applied to National Needs Program.

Communications should be directed to: Ethical and Human Value Implications of Science and Technology Program, National Science Foundation, Washington, D.C. 20550.

Institutional Grants for Science Program

THE NATIONAL SCIENCE FOUNDATION awards grants for broad institutional use to colleges and universities, based on Federal research awards from any one of the Federal departments or agencies reporting obligations to the Committee on Academic Science and Engineering. These are flexible funds for use at the discretion of the institution to strengthen and balance science programs of research and education. The funds may not be used for indirect costs.

Eligibility

Institutions eligible to apply for grants under the Institutional Grants for Science Program are colleges and universities receiving Federal research awards, excluding those of the Public Health Service, during the latest fiscal year (July 1—June 30) for which data is available. Grants made by the Foundation through its programs of Undergraduate Research Participation, and Student-Originated Studies also establish eligibility for Institutional Grants and are included in the base for their computation.

Deadlines

The application deadline for this year's program is December 15, 1974. Grants will be announced in February 1975.

Additional Information

Communications should be addressed to: Institutional Grants for Science Program, Division of Higher Education in Science, National Science Foundation, Washington, D.C. 20550.

International Travel Grants

THE NATIONAL SCIENCE FOUNDATION awards international travel grants to assist scientists to go abroad for one of the following purposes:

(1) Attending international scientific congresses and meetings;

(2) Obtaining or exchanging information in the areas of basic research, science education, science information or information relating to international scientific programs and associated activities;

(3) Cooperating in international scientific activities.

International travel is defined as all travel outside the United States and its possessions, Canada, and Puerto Rico.

NSF each year selects certain meetings, in areas of particular interest to the Foundation, for which participant support may be granted.

International travel grants made to individuals are based on, and normally limited to, the equivalent cost of jet-economy air transportation from the city where the traveler resides, or is employed, to his destination abroad and return. A per diem may be paid when an individual is traveling as a representative of the U.S. Government, an international organization, or a U.S. scientific organization functioning as a national member of an international organization. Travel must be by U.S. flag carriers, except in special circumstances.

Eligibility

Requests for international travel grants may be submitted by individual U.S. scientists or by nonprofit organizations (usually professional societies). When a request is submitted by an individual U.S. scientist, NSF form 192, Application for International Travel Grant, available from the Foundation, should be used.

Deadlines

Approximately 2 months are required to process requests, but those for travel to meetings should be submitted 4 months in advance because evaluation of requests normally occurs several months before the meeting date.

Additional Information

Communications may be addressed to the appropriate office: Division of Biological and Medical Sciences; Division of Engineering; Division of Environmental Sciences; Division of Mathematical and Physical Sciences; Division of Social Sciences; Division of Materials Research; Division of Computer Research; Office of Science Information Service; Office of International Programs; Office for the International Decade of Ocean Exploration; Office of Polar Programs; Division of Higher Education in Science; or Research Applications Directorate; National Science Foundation, Washington, D.C. 20550.

Scientific Conference Grants

THE NATIONAL SCIENCE FOUNDATION awards grants to support conferences, symposia, and workshops held in the United States that bring together leading scientists who are pioneering in new or incompletely explored fields of science.

The Foundation does not provide support for regular meetings of scientific societies. Support for special conferences should be requested only if regular meetings of professional societies do not provide the necessary forum.

Eligibility

Proposals for support for scientific conferences may be submitted by U.S. colleges and universities, nonprofit research institutions, or scientific or professional societies. Concomitant support by several Federal agencies or private organizations is permissible.

Deadlines

Proposals for Scientific Conference Grants may be submitted at any time, but at least 6 months before the projected conference date.

Additional Information

Communications may be addressed to the following divisions or offices as appropriate: Division of Biological and Medical Sciences; Division of Engineering; Division of Environmental Sciences; Division of Mathematical and Physical Sciences; Division of Social Sciences; Division of Materials Research; Division of Computer Research; Office of Science Information Service; Office for the International Decade of Ocean Exploration; Office of Polar Programs; Office of International Programs; Office for Climate Dynamics; or Research Applications Directorate; National Science Foundation, Washington, D.C. 20550.

Special Foreign Currency Programs

THE NATIONAL SCIENCE FOUNDATION makes awards to support scientific activities overseas which will incur costs payable in the currencies of Burma, Egypt, Guinea, India, Pakistan, Poland, and Tunisia. These awards are in two categories: grants for research, science education, and related activities; and contracts for procurement of scientific and technological information. They utilize foreign currencies which the Treasury Department has determined to be in excess of the established requirements of the United States.

Research, Science Education, and Related Activities—Three main classes of activity are included in this program: cooperative research and science education projects, international travel, and visiting scientist activities. A principal purpose of the program is to obtain for scientists and institutions of the United States the benefits of cooperation with their counterparts in participating countries.

The Foundation brochure NSF SPECIAL FOREIGN CURRENCY PROGRAM, SUPPORT FOR RESEARCH, SCIENCE EDUCATION, AND RELATED ACTIVITIES, INFORMATION FOR U.S. SCIENTISTS describes the classes of activity supported and provides other information. A companion publication, subtitled INFORMATION FOR SCIENTISTS IN PARTICIPATING COUNTRIES, is also available. The program provides necessary *supplemental* dollar support to U.S. institutions for activites which directly enhance the benefits of U.S. participation; requests for *principal* dollar support by U.S. institutions may be included in proposals for consideration by other program offices of NSF.

Foreign Science Information—In fulfilling its responsibility for coordinating the needs of U.S. Government agencies, the Foundation contracts with organizations in participating countries for delivery of scientific and technological information to the United States. Contracts cover translating, abstracting, indexing, reviewing, and publishing in English of significant foreign scientific literature. The preparation and publication of surveys, directories, guides, and other reference aids on foreign scientific and technical information resources—literature, institutions, scientists—is also undertaken under contract.

The following sections on eligibility and deadlines refer only to **Research, Science Education, and Related Activities.**

Eligibility

Organizations eligible to submit project proposals are nonprofit higher educational institutions, scientific institutes, scientific and technical societies, and similar organizations, chartered to conduct business in the United States or the participating country. Scientists affiliated with such organizations may apply for support for international travel or visiting scientist activities.

Agreement on the objectives, content, and scope of a cooperative project should be reached by U.S. and foreign scientists before they submit proposals. Consultation or correspondence with the Office of International Programs by prospective U.S. or foreign proposers prior to submission of a formal proposal is recommended. Formal proposals should be prepared in accordance with the requirements outlined in the relevant NSF brochures. Project proposals to be funded in foreign currency must be approved by the government of the participating country; the scientific institution in that country which is co-sponsor of the project initiates the request for approval

Deadlines

Proposals for activities to be funded by foreign currency may be submitted at any time. Approximately 6 months are required to consider a project or visiting scientist proposal; 5 months are required to consider a proposal for an international travel grant.

Proposals for the support of costs of organizing a conference or symposium should be submitted 8 to 12 months in advance to allow time for the organizer to inform key participants concerning the NSF decision.

Additional Information

Communications should be addressed to: Special Foreign Currency Section, Office of International Programs, National Science Foundation, Washington, D.C. 20550.

Requests for information about the availability of materials produced under the Foreign Science Information Program should be addressed to National Technical Information Service, U.S. Department of Commerce, Springfield, Va. 22151.

These programs are managed by the Directorate for National and International Programs.

Science Information Service

THE NATIONAL SCIENCE FOUNDATION'S Office of Science Information Service (OSIS) awards grants and contracts to improve the process of scientific and technical communication. OSIS supports research and development projects designed to improve scientific and technological information services. Its functions are limited to support of research, development, demonstration, coordination, and policy development projects.

Support may be provided from the Office of Science Information Services for the following:

- Studies that provide guidance for improved management of scientific and technical information services within the public and private sectors, including studies of the economics of information transfer.
- Improvements which facilitate cost-effective science information networks capable of providing access to worldwide research results.
- Operational experiments that promote the use of scientific and technical information within the R&D environment.
- Research on information sciences, including both theory and applied aspects.

The Foundation's brochures IMPROVING ACCESS AND USE OF SCIENTIFIC AND TECHNICAL INFORMATION and GRANTS FOR SCIENTIFIC RESEARCH should be consulted for more specific information about the Foundation's science information programs and instructions for submitting proposals.

Eligibility

Institutions eligible to submit proposals are professional scientific and technical societies, universities and colleges, and profit and nonprofit organizations. Organizations that plan to submit proposals are encouraged to discuss their ideas informally with the appropriate staff members before preparing formal proposals.

Industry's capabilities are important to nationwide operating information systems. Participation may involve design and development of general-purpose computer programs, document delivery systems, and new processes for scientific publication. Industry participation will be sought, but no funds will be provided for the purchase of major capital equipment.

Deadlines

Proposals may be submitted at any time; approximately 3 months are required to consider a proposal.

PLEASE NOTE: The Office of Science Information Service does not:

- Provide support for primary publications or monographs.
- Provide bibliographic or reference services or perform literature searches.
- Furnish copies of publications resulting from research sponsored by NSF or other organizations.
- Hire translators or perform translations of foreign publications.

Additional Information

Communications should be addressed to: Office of Science Information Service, National Science Foundation, Washington, D.C. 20550.

Public Understanding of Science

THE NATIONAL SCIENCE FOUNDATION considers one of its important responsibilities to be the development of a greater public understanding of science. In addition to fostering public understanding of science as part of many grant programs, the Foundation has a special program of Public Understanding of Science seeking to bring direct focus and support to this area. Central to the purpose of this program is the enhancement of citizen knowledge and understanding of both the potentials and limitations in the use of science and technology in meeting current and emerging societal problems.

Proposals are encouraged which relate to one of the following programs, within terms of a single or combined focus.

Information Projects on Science—Proposals to be considered under this general support area should facilitate the dissemination of information on science for the general public. Examples of the types of projects which may be eligible for support are: special purpose films and television programs, science exhibits, traveling demonstration programs, science forums for laymen, and comparable activities.

National, Regional, and Community Programs—Proposals may be submitted for programs in public understanding of science designed to serve either broad or specific audiences of a national, regional, community, or other discrete geographical area. Such programs will normally be multi-purpose in nature and encompass diverse means of communication. Interinstitutional arrangements are particularly encouraged on a matching funds basis.

Research and Methodological Studies—Proposals may be submitted for research or analytical studies of the communications process as it relates to public understanding of science. This category may also include the testing and evaluation of new approaches in communicating scientific information to nonscientists.

Eligibility

Institutions eligible to submit proposals are colleges, universities, and independent, profit and nonprofit organizations.

Deadlines

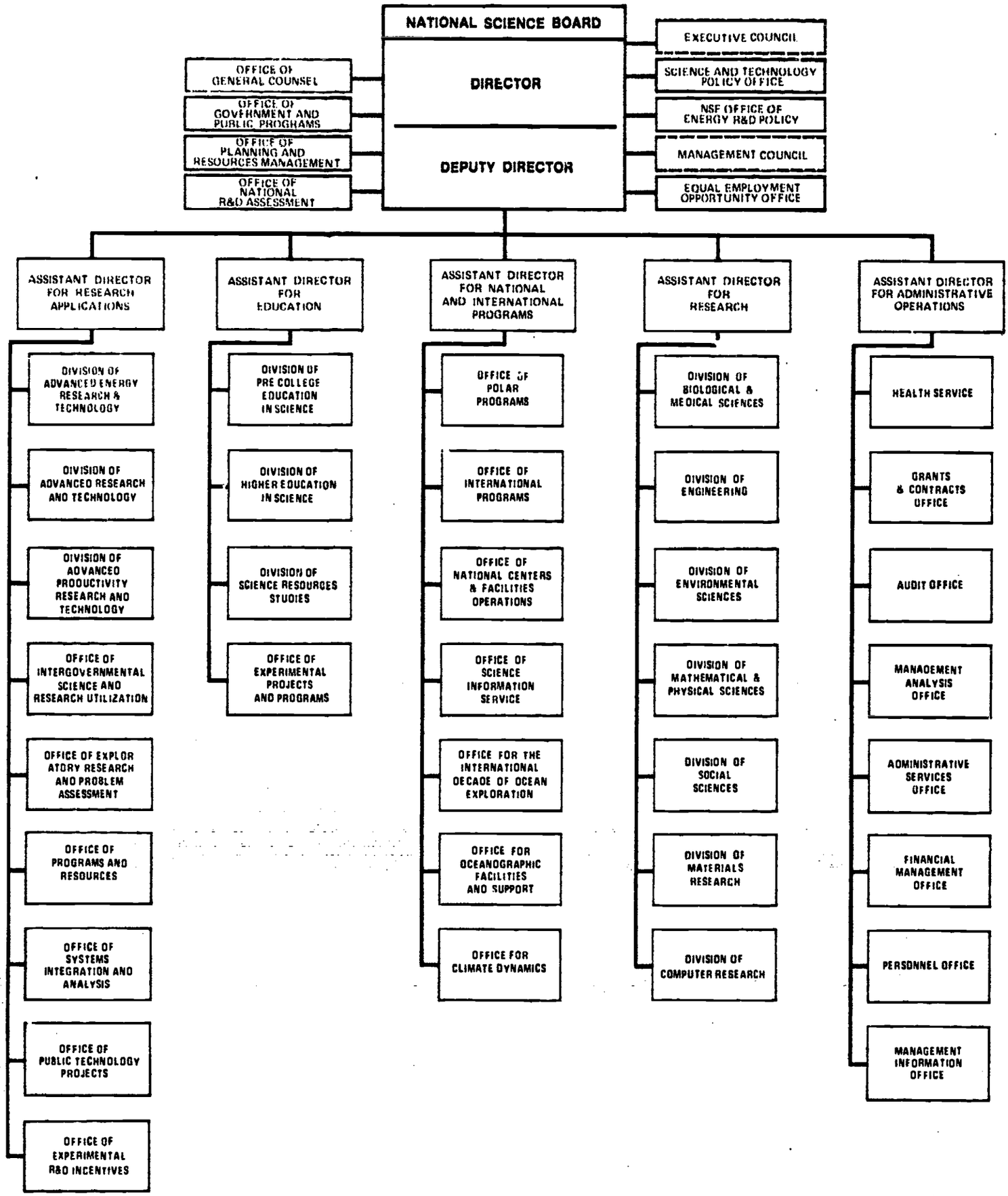
Proposals may be submitted at any time. Project proposals should initially be submitted informally for preliminary review. Processing of formal proposals normally requires at least 3 months.

Additional Information

THE PUBLIC UNDERSTANDING OF SCIENCE brochure describes the process of submitting proposals in more detail. Communications may be addressed to: Office of Public Understanding of Science, National Science Foundation, Washington, D.C. 20550.

This program is administered by the Office of Government and Public Programs.

ORGANIZATION
NATIONAL SCIENCE FOUNDATION



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