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**ABSTRACT**

This publication describes awards made in the National Science Foundation's Division of Science Education Development and Research in FY 1980, FY 1979, and in earlier years. Two indices are contained in the first section. The first index is a rotated title index to every award in the publication. Every significant word in each title is an entry point into the index. The second index is a standard keyword/phrase index for FY 1980 awards only, using ERIC descriptors as well as proper names. All projects awarded in FY 1980 in the Development in Science Education (DISE) and Research in Science Education (RISE) programs are listed in the second section. A summary description of each project is provided, along with the names and addresses of principal investigators, amount of funding, duration of the project, discipline, target audience, and descriptors. Projects are listed alphabetically by state and institution within each program, RISE and DISE. Titles and principal investigators of RISE and DISE projects funded in FY 1979 are provided (alphabetically by state and institution) in the third section. Separate lists of principal investigators by state and institution for 1979 and 1980 and an alphabetical list of principal investigators are provided in appendices. (Author/JN)

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# Source Book of Projects Science Education Development and Research

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Fiscal Year 1980  
With References to Earlier Years



NATIONAL SCIENCE FOUNDATION  
Directorate for Science and Engineering Education  
Division of Science Education  
Development and Research

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SE-80-81

This publication presents a description of awards given by the Division of Science Education Development and Research (SEDR) during Fiscal Year 1980, including award amounts. All references made in this document to actual award amounts are subject to adjustment by financial statements prepared by NSF at the close of Fiscal Year 1980.

Division-initiated funding actions excluded from this report are:

Purchase Orders  
Funds for Personnel (Intergovernmental Personnel Act)  
International Travel Awards

Awards which received support from organizations within or outside the Division show the source of that support.

The following definitions apply:

"Award" refers to financial support given in the form of a grant, contract, or other arrangement, depending upon the nature of the research or development work to be completed and the terms of performance.

"Principal Investigator" refers to the individual designated by the awardee (and approved by NSF) who is responsible for the scientific or technical direction of the project.

"Institution" refers to any college, university, public or private laboratory, industry, or other organization, whether operating for profit or on a non-profit basis, as well as State and local governments and Federal organizations.

NOTE: Data for this report were taken from program records and therefore may differ from official National Science Foundation source documents which are generated from the Management Information System data base containing different inclusions/exclusions.

The reader is reminded the primary source of further information on a project is the Principal Investigator in each instance, who may be reached at the academic address given.

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## FOREWORD

The National Science Foundation's Science and Engineering Education Directorate has the responsibility for enhancing the vitality of all levels of science and engineering instruction across the Nation. The two major goals of the Directorate are:

- o To assure a stable flow of the most talented students into careers in the sciences, with particular reference to increasing the participation of minorities and women; and
- o To help all citizens increase their basic understanding of science and its contributions to the quality of life.

Science education research and development support are two of the principal mechanisms the Foundation uses to implement the goals. The aim of this support is to develop new knowledge and new means for improving science and engineering education. Innovation, transferability, and potential for widespread impact are especially characteristic of development projects, while usable results are important to the research program.

The purpose of this document is to promote awareness of and interest in recent activities in science and engineering education development and research. We hope it is useful to a variety of groups including developers and researchers, future proposers to the Foundation, and teachers of science at all levels.

Walter L. Gillespie  
Acting Assistant Director  
for Science and  
Engineering Education

## INTRODUCTION

The objectives of the Division of Science Education Development and Research (SEDR) are to develop new means for improving science education at all levels, and to further basic understanding of science teaching and learning. Progress is sought by:

- o Developing innovative technologies, instructional materials, methods of instruction, and ways to increase participation in science; and
- o Generating new knowledge and theory as a basis for improvements in science education.

The quality of life increasingly depends on science and its related technology. The health of science, in turn, depends on the quality of science education. Due to rapid changes in science and society, science education must be continually modified through development and research. Both are needed to introduce new knowledge of the educational process, to prepare people for new science-related tasks and problems, to translate scientific knowledge into a form that can be understood and learned, and to capitalize upon new insights into the way we learn. Both development and research in science education are needed to assure that people will be able to cope with and enjoy the benefits of our technologically based society.

The Science Education Development and Research Division in fiscal year 1980 and fiscal year 1981 is targeting several areas of emphasis which relate directly to the goals stated in the Foreword for the Foundation's Directorate for Science and Engineering Education.

For both development and research these areas of emphasis include:

- o Science Literacy—and the Relation of Science to Society,—To assist all citizens in coping with and enjoying both our technological society and the natural world, and to understand the relationships at the interface of science and society.
- o Career Access - With special concern for participation of minorities, women, and the physically handicapped, to assure a stable flow of talented individuals into science careers, and to maintain their effectiveness through continuing education.

- o **Technology in Science Education** - To exploit the potential of the rapidly advancing information technologies for improving science (especially mathematics) learning, and to help people use these technologies effectively.
- o **Early Adolescence** - This age group is also highlighted in the above three areas of emphasis because of the importance and past neglect of junior high school science instruction. It is at this age that most U.S. children receive their last formal science instruction.

Also pervading both development and research activities is an increasing concern with efforts to disseminate knowledge generated by these activities to those responsible for science and engineering education. This document is made available as one response to this concern. It is expected that the information it contains will be interesting to a spectrum of persons concerned with science and engineering education at all levels.

Joseph I. Lipson  
Division Director

## USING PUBLICATION SE 81-80

This publication describes awards made in the National Science Foundation's Division of Science Education Development and Research in Fiscal Year 1980, in Fiscal Year 1979, and in earlier years.

### Section I. *Indexes.*

This section contains two indexes. The first index is a rotated title index to every award in this publication. Every significant word in each title is an entry point into the index. For example, the title "Factors Influencing Mathematics Participation of Highly Able Mexican-American Adolescents" would appear eight times in the index, once at each of the meaningful words. This index gives subject access to the awards through their title words, and unlike usual subject indexes, supplies the reader with the key word in context.

The second index is a standard key-word/phrase index for FY 1980 awards only. The FY 1980 awards contained in Section II have been assigned key words and phrases from the *Thesaurus of ERIC Descriptors*, as well as some additional terms, such as proper names.

The indexes are keyed to descriptions of related projects contained in Sections II and III. It should be noted that summary descriptions are provided of projects awarded in FY 1980 (Section II), but only titles are shown of projects awarded in FY 1979 and earlier (Section III).

### Section II. *Projects awarded in Fiscal Year 1980 in the Development in Science Education (DISE) Program and the Research in Science Education (RISE) Program.*

A summary description of each project is provided, along with the name and address of the Principal Investigator, the amount of funding, and the duration of the project. DISE Program project descriptions begin on page 39; RISE Program project descriptions begin on page 114. Projects appear alphabetically by State and Institution within each program, RISE and DISE.

### Section III. *Projects awarded in Fiscal Year 1979 and in earlier years in the Development in Science Education (DISE) Program and the Research in Science Education (RISE) Program.*

The title of the project and the name and address of the Principal Investigator are provided.

DISE Program project titles begin on page 161; RISE Program project titles begin on page 186. Projects appear alphabetically by State and Institution within each program.

**Appendix A. Fiscal Year 1980 Awards, Principal Investigators by State and Institution.**

This appendix is provided as an index to location of projects. It is an alphabetical listing of States, and under each State are given the Institutions and Principal Investigators whose projects were awarded during FY 1980.

Page references direct the reader to summary descriptions of projects contained in Section II.

**Appendix B. Fiscal Year 1979 and Earlier Years' Awards, Principal Investigators by State and Institution.**

Like Appendix A, this appendix is provided as an index to location of projects. It is an alphabetical listing of States and under each State are given the Institutions and Principal Investigators whose projects were awarded during FY 1979 and earlier years, under the DISE and RISE Programs.

Page references direct the reader to titles of projects contained in Section III.

**Appendix C. Principal Investigators, Alphabetically.**

This section is provided as an additional index to projects awarded in FY 1980, in FY 1979, and in earlier years.

**Section I**

**Rotated Title Index  
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**Key Word/Phrase Index  
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**Section II**

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**Project Descriptions and Principal Investigators  
by Program, and State and Institution**

## Early Learning (Grades 2-3) of Geometry and Logic, Using Microcomputers

Ann Piestrup  
Advanced Learning Technology  
13800 Skyline Boulevard  
Woodside, CA 94062

Young children can learn mathematics in a playful, interactive manner using today's microcomputers. Games, inquiry learning sequences, and puzzles can be programmed on a low-cost, powerful computer with color graphics, natural sounding speech, music, and a variety of input devices. Children can use a joystick, a graphics tablet, a light pen, and a special children's keyboard to explore mathematics concepts.

The project will develop microcomputer software which will enable children aged 7 and 8 to discover geometry concepts and to develop logical thinking. The microcomputer programs will be paced and sequenced to provide a dynamic learning environment for young children.

Some computer programs will be prepared in three versions: with standard English, Black standard English, and Spanish voice prompts. Teachers' manuals for each program will be written in Spanish and English. The programs will be designed for gifted children as prototypes of a mathematics enrichment curriculum on microcomputers. Commercial publication will be sought.

AMOUNT: \$130,000\*  
AWARDED: 709-10-80  
TERMINATES: 02-28-82

AWARD NUMBER: SED80-12510  
NSF PROGRAM MANAGER:  
Mary Ann Ryan  
PROGRAM: Development in  
Science Education

DISCIPLINE: Software Systems/Computer Science  
Mathematics Education  
TARGET AUDIENCE: Grades 2-3  
DESCRIPTORS: Elementary School Mathematics; Mathematics Curriculum; Mathematics Instruction; Computer Assisted Instruction; Microcomputers; Instructional Technology; Educational Games; Computer Graphics; Logical Thinking; Geometry; Multilingualism; Questioning Techniques

\* Funded in part by the National Institute of Education.

## Science Intervention Programs for Girls: Follow-up Study and Evaluation Kit

Sheila Humphreys  
Mills College  
Math/Science Network  
Oakland, CA 94613

The project is composed of development and research components related to evaluation of the effectiveness of intervention programs designed to increase girls' science interest and participation. The project will be carried out in conjunction with the Expanding Your Horizons conference program sponsored by the Bay Area Math/Science Network. The program is now in its fifth year of operation.

The research component of the project will consist of a study of conference participants' attitudes, follow-up activities, and career and educational plans. The study will be conducted by means of a post-conference mail questionnaire. Participants will be surveyed either 6 or 9 months after attendance at the conference (two samples). Approximately 25-30 percent of 4,000 expected participants will be surveyed.

The development component will consist of the development, evaluation, and dissemination of an evaluation kit for organizers of similar intervention programs. The kit will contain information, instrument samples, and a model for implementing effective program evaluation.

AMOUNT: \$90,200\*  
AWARDED: 08-08-80  
TERMINATES: 02-28-83

AWARD NUMBER: SED80-16785  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Multidisciplinary Sciences  
Mathematics, General/Mathematical Sciences  
TARGET AUDIENCE: Females; Grades 5-12  
DESCRIPTORS: Females; Womens Education; Science Interests; Evaluation; Intervention;  
Science Careers; Surveys; Questionnaires; Evaluation Methods; Student  
Attitudes; Longitudinal Studies

\* Funded in part by the Research in Science Education (RISE) Program.

## ComputerTown, USA - Bringing Computer Literacy to the Entire Community

Ramon M. Zamora  
People's Computer Company  
P.O. Box E  
1263 El Camino Real  
Menlo Park, CA 94025

A computer literacy project, ComputerTown USA, was developed in 1979 to give 27,000 residents of the Menlo Park, California community an opportunity to have direct experience with a microcomputer. The effort to date has been a grass roots, low-cost, volunteer-based project to bring technology to both children and adults. It utilizes the resources of the public library, recreation center, local business locations, and donated hardware and software. In the next three years the project intends to expand its goals to encourage computer literacy beyond the Menlo Park community. Plans include the following: (1) continued publication and distribution of a monthly bulletin; (2) an expanded set of courses and workshops for children and adults; (3) establishment of computer literacy experiences in community locations outside the public library; (4) presentations of papers and workshops on the project at major library and education conferences; and (5) development of a descriptive model to encourage other communities to establish their own versions of the project. Evaluation plans involve quarterly examinations of community residents and statistics on user publication. The model will be assembled as an implementation package which will be disseminated through community centers. Monthly bulletins and implementation packages will be forwarded to 500 libraries nationwide.

AMOUNT: \$224,100  
AWARDED: 09-10-80  
TERMINATES: 02-29-84

AWARD NUMBER: SED80-15964  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

DISCIPLINE: Computer Science  
TARGET AUDIENCE: Children; Adults; General Public  
DESCRIPTORS: Computers; Computer Science Education; Computer Literacy; Public Libraries; Community Programs; Adult Education; Community Services; Microcomputers

## **Visual Geometry and Mathematics Cognition for Beginning College Science Students**

**Kristina Hooper**  
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1156 High Street  
Santa Cruz, CA 95064

Mastery of basic concepts in mathematics is essential to gain access to the scientific and technical professions. But many students—especially women, re-entry, and minority students—enter higher education with math deficiencies. Skills in visualization and translating between visual and verbal forms (critical prerequisites to much of math cognition) often are ignored in traditional, verbally dominated math instruction. These skills can be strengthened by using computers to present the visual aspects of math through interactive graphics and to provide training in visualizing patterns and then transforming them to symbolic forms.

This project will develop prototype materials for a precalculus-level course in Visual Geometry at the introductory college level. As preparation for materials development, the project will perform the following: (1) analyze the current difficulties and attitudes of students interested in science careers but without the normal self-confidence and preparation; (2) develop techniques for evaluating and improving skills in spatial visualization and visual-verbal translations; (3) collect and characterize the impact on students of current materials in visual problem solving and geometry; (4) assay the introductory science curriculum of UCSC for the demands placed on math understanding; and (5) develop specifications for computer equipment needed for interactive visual instruction. Expected outcomes include documented techniques for a “new generation” of learning materials, example materials, and insights into the role of visual modes of representation in math cognition and in overcoming problems some students have in beginning science college courses.

**AMOUNT:** \$235,174  
**AWARDED:** 06-13-80  
**TERMINATES:** 12-31-82

**AWARD NUMBER:** SED79-19778  
**NSF PROGRAM MANAGER:**  
Gregg Edwards  
**PROGRAM:** Development in  
Science Education

**DISCIPLINE:** Geometry/Mathematical Sciences

**TARGET AUDIENCE:** College Freshmen; Females; Minorities  
**DESCRIPTORS:** Mathematics Instruction; Mathematics Materials; Skill Development;  
Undergraduate Study; Geometry; Cognitive Processes; Visualization;  
Problem Solving; Computer Graphics; Computer Assisted Instruction

## Mathematics Network Curriculum Project for Middle School Teachers and Students

Diane Resek  
San Francisco State University  
1640 Holloway Avenue  
San Francisco, CA 94132

This project, for the introduction of microcomputers into the middle school mathematics curriculum, has three objectives: the development of seven curriculum prototypes (Units), a model for the teachers, and the development/implementation of a computer communications system (Network) to bring together the separate classrooms. The computer activities will stem from classroom activities that utilize the manipulation of real objects and/or the activities of the students themselves. Each Unit incorporates five elements: games; simulations; classroom activities; data storage, retrieval and processing; and interclassroom interaction. Dynamic software will be developed to provide both structure and freedom for student manipulation of data and interaction with the mathematical content and concepts. The Network will provide for interaction of students and classrooms with each other, teachers with each other, and all of these with the university data base. The interaction will enhance participation and motivation of both students and teachers. The project will disseminate information at professional meetings and will explore the possibilities of commercial publication of the materials.

AMOUNT: \$130,811\*  
AWARDED: 09-17-80  
TERMINATES: 02-28-83

AWARD NUMBER: SED80-12465  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education/National  
Institute of Education

DISCIPLINE: Software Systems/Computer Science  
Mathematics Education  
TARGET AUDIENCE: Grades 5-9  
DESCRIPTORS: Mathematics Curriculum; Middle Schools; Data Bases; Teacher  
Education; Computer Programs; Interaction; Educational Technology;  
Games; Simulation; Information Processing; Mathematics Materials;  
Microcomputers

\* Funded in part by the National Institute of Education.

## A Science Course for Youth in Informal Settings: Learning to Experiment

Alan J. Friedman  
University of California at Berkeley  
Lawrence Hall of Science  
Berkeley, CA 94720

This project will develop a compact science program for use in non-school settings (e.g., camps, scout troops, youth groups, parks, and museums). The program is designed to teach early adolescents to understand controlled experiments. The science program includes an eight-lesson class for children aged 10-14, along with written materials for the student (*Experimenter's Guide*), for the leader (*Leader's Guide*), and for the training of new leaders (*One-Day Workshop Guide*). In addition, project staff will refine evaluation instruments developed during the pilot study that will provide a measure of change in students' understanding of controlled experiments.

The user of these materials will be able to present a course entitled *Learning to Experiment* and to evaluate its effects upon student understanding of controlled experiments. In addition, the written materials will enable users to conduct a one-day workshop for the training of new leaders who do not have a formal science education background.

Formative evaluation of the curriculum materials will be conducted throughout the development process of the three-year project. Summary evaluation will examine the effectiveness of the written materials for students and leaders.

The experiments used in the project all involve model rockets.

AMOUNT: \$120,640  
AWARDED: 03-18-80  
TERMINATES: 12-31-83

AWARD NUMBER: SED79-18976  
NSF PROGRAM MANAGER:  
Carl J. Naegele  
PROGRAM: Development in  
Science Education

DISCIPLINE: Problem Solving/Education  
Aeronautical Engineering  
TARGET AUDIENCE: Grades 7-9  
DESCRIPTORS: Science Experiments; After School Education; Youth Agencies; Science  
Materials; Scientific Methodology; Nonschool Educational Programs.

## Modules for the Development of Reasoning in Mathematics (Grades 7-9)

Robert Karplus  
University of California at Berkeley  
Lawrence Hall of Science  
Berkeley, CA 94720

This 18-month project will develop and test four two- to three-week modules that will enhance mathematical reasoning of early adolescent students. The modules will concentrate on aspects of mathematics which require the following reasoning skills: problem solving, estimation, graphing, relations among variables, data interpretation, and probability. These skills have little emphasis in currently used junior high school mathematics programs. The design and teaching approach will be in accord with developmental principles of learning that emphasize active participation by the learners. The modules are intended to increase mathematical literacy, produce a more favorable attitude toward mathematics, and prepare students more effectively for high school algebra courses. Formative evaluation from female students and members of minority ethnic groups will receive special attention so that the modules will address the needs of these students without being aimed exclusively at them.

This project is the first phase of a planned two-phase program to develop 15 modules. In the second phase, 11 additional modules would be written, and all 15 modules would be field tested nationwide. Commercial publication of the materials will be sought.

AMOUNT: \$238,600  
AWARDED: 06-02-80  
TERMINATES: 09-30-82

AWARD NUMBER: SED79-26662  
NSF PROGRAM MANAGER:  
Raymond J. Hannapel  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences  
TARGET AUDIENCE: Grades 7-9  
DESCRIPTORS: Mathematics; Junior High School Students; Skill Development;  
Mathematics Instruction; Instructional Materials; Problem Solving;  
Curriculum Enrichment; Student Participation; Attitude Change

# Elementary Mathematics Concepts with Calculators: Microcomputer-Based Modules for Teachers, Parents and the Public

John David Miller  
University of California at Berkeley  
Lawrence Hall of Science  
Berkeley, CA 94720

This project will develop a pilot instructional program designed to promote the use of hand calculators in fourth, fifth, and sixth grade mathematics. The delivery system will consist of three highly interactive microcomputer-based programs to be used with a microcomputer located in the school where it is accessible to teachers and the public. This program will enable teachers to begin using many kinds of calculators together with any regular mathematics text. A subset of this instruction will explain to parents and the general public the uses of calculators in the classroom and will enlist their support for the program. The module will be tested with 12 teachers in two schools and by a museum exhibit where it will be used by the general public. The evaluation will be formative with emphasis on teacher feedback. Information will be collected on content, necessary supporting material, time and frequency of use of the module, and impact of the modules on classroom use of the calculator. The principal product of this pilot project will be demonstration of the viability of the concept. Dissemination will occur through professional groups, the State Department of Education, and an NSF program for dissemination of information in science.

AMOUNT: \$98,027  
AWARDED: 04-29-80  
TERMINATES: 04-30-82

AWARD NUMBER: SED79-19000  
NSF PROGRAM MANAGER:  
Harold J. Stolberg  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics Education  
TARGET AUDIENCE: Grades 4-6  
DESCRIPTORS: Computer Assisted Instruction; Elementary School Mathematics;  
Mathematics Curriculum; Instructional Technology; Educational  
Technology; Computers; Hand Calculators; Microcomputers

## Role Models for Adolescent Girls in Science and Mathematics

Jane Permaul  
University of California at Los Angeles  
405 Hilgard Avenue  
Los Angeles, CA 90024

The goal of this project is to develop, test, and disseminate information about an easily replicable model program that will increase science/math career awareness among junior high school girls, especially girls from schools with large ethnic minority populations.

Twenty-four female UCLA undergraduate science majors (including a high proportion of minority women) will be selected and trained to offer themselves as role models in junior high schools. After receiving 20 hours of training, the students will form five teams, and each team will lead science career workshops for girls at four schools. Each undergraduate will give 24 additional hours of service in appropriate formats, such as participation at science club meetings or work with the school guidance counselor. The project will be formally evaluated.

Project results will be documented and disseminated through the production and distribution of a descriptive booklet, a tape-slide presentation, conference presentations, and publication in professional journals.

AMOUNT: \$30,690\*  
AWARDED: 08-08-79  
TERMINATES: 02-28-81

AWARD NUMBER: SED79-19023  
NSF PROGRAM MANAGER:  
Mary Ann Ryan  
PROGRAM: Development in  
Science Education

DISCIPLINE: Science Education  
TARGET AUDIENCE: Grades 7-9; Females; Minorities  
DESCRIPTORS: Adolescents; Females; Womens Education; Role Models; Role Perception; Career Awareness; Information Dissemination; Science Careers; Science Interests

\* Cumulative amount. Fiscal Year 1980 award: \$2,790.

## An Instructional Model in Human Genetics for High School Students

Faith M. Hickman  
Biological Sciences Curriculum Study Company  
P.O. Box 930  
Boulder, CO 80306

The goal of this project is to design, develop, evaluate, and disseminate a module in human genetics for high school students. This module will be a self-contained curriculum that has the flexibility to provide from four to six weeks to a full semester of integrated classroom instruction.

The proposed module will introduce students to both the problems and the potentials of human genetics as illustrated through extant mechanisms of prenatal diagnosis, genetic counseling, genetic screening, family planning, and treatment of heritable disorders. The module will be interdisciplinary, allowing it to be integrated into the existing curriculum. It will replace more traditional plant and animal genetics in the science curriculum and provide timely social/value issues for analysis in the social and behavioral sciences.

Content will be communicated through a variety of instructional strategies including transparencies, study card sets, a filmstrip or sound-slide program, and instructional games. Foremost will be discussion and laboratory investigations. Readings for the module will be presented in a "magazine" format. Teachers' materials will provide detailed day-by-day "lesson plans" and strategies for presenting each activity, for individualizing the instruction, and for facilitating student learning.

Extensive review and field testing of materials will involve a wide variety of subject matter specialists, teachers, and parents. Commercial publication is planned as the primary means of dissemination.

AMOUNT: \$212,911  
AWARDED: 05-21-80  
TERMINATES: 11-30-82

AWARD NUMBER: SED79-18983  
NSF PROGRAM MANAGER:  
Raymond J. Hannapel  
PROGRAM: Development in  
Science Education

DISCIPLINE: Genetics/Life and Medical Sciences  
TARGET AUDIENCE: Grades 9-12  
DESCRIPTORS: Curriculum Development; Genetics; Human Development; High School Students; Biology; Discussion (Teaching Technique); Heredity; Science Materials

## Development of Problem Solving Skills in Physics/Electrostatics

Neil Ashby  
University of Colorado  
Boulder, CO 80309

Instructional materials for solving electrostatics problems in introductory physics courses at the college level will be developed. These materials will teach how experts and good students go about solving problems—how they come up with possible approaches to solutions, and how they reject early approaches which don't seem to be working. During the first year, some recent experimental methods developed by researchers of the psychology of problem solving will be applied to describe the skills and ideas that experts and good students use in thinking about specific problems. These include the following: analogies used to analyze each type of electrostatic problem; what particular cues are looked for to confirm or reject the usefulness of those analogies; and which background concepts of physics are used for what type of problems. During the second year, sample instructional materials will be developed and used with beginning students to teach these skills. A few lessons will be programmed in the BASIC language for use with an inexpensive microcomputer to evaluate the effectiveness of computer-aided instruction in scientific problem solving.

AMOUNT: \$72,935  
AWARDED: 04-15-80  
TERMINATES: 11-30-82

AWARD NUMBER: SED79-19012  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Solid State Physics  
TARGET AUDIENCE: Undergraduates  
DESCRIPTORS: Instructional Materials; Physics Instruction; Computer Assisted  
Instruction; Material Development; Problem Solving; Scientific  
Methodology; Microcomputers

## Personal Computers and Cross-Age Instruction

Marc Swadener  
University of Colorado  
School of Education  
Boulder, CO 80309

Cross-age tutoring and the use of personal computers will be combined to enhance the level of basic mathematics skills of low-achieving sixth graders and to increase the number of students enrolling in high school math and science courses. The project will evaluate the use of microcomputers as instructional tools and develop effective applications in education. The plan includes identification of 60 low-achieving sixth grade students and 60 non-math/science oriented, able tenth grade students. Half of each group will be randomly assigned to control groups. During the first semester of the program, 30 tenth graders will study specific areas of math weakness of 30 sixth graders and will develop microcomputer courseware for them. Each tenth grader will tutor one sixth grader during the second semester, using and further developing courseware. A tested instructional strategy, a curriculum for high school students, and computer software will be produced. Interviews with students, tutors, and teachers will be conducted as part of the evaluation process. Program effectiveness will be measured by achievement tests for sixth graders, problem solving tests for sixth and tenth graders, and change in enrollment in 11th grade science and math courses. Dissemination of results will take place at national conferences and in professional journals. Computer software will be available for publication.

AMOUNT: \$84,917  
AWARDED: 05-08-80  
TERMINATES: 02-28-83

AWARD NUMBER: SED79-18974  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics Education; Software Systems/  
Computer Science  
TARGET AUDIENCE: Grades 6-10  
DESCRIPTORS: Mathematics Instruction; Mathematics Materials; Computer Assisted  
Instruction; Cross Age Teaching; Curriculum Development; Low  
Achievement; Elementary School Students

## Teaching Materials in Microbiology for Community and Junior Colleges

Helen L. Bishop  
American Society for Microbiology  
1913 Eye Street, NW  
Washington, DC 20006

The rapid increase in student enrollment and the growth of academic programs in community and junior colleges have created a need for instructional materials in microbiology. The American Society for Microbiology (ASM) Board of Education and Training, through its Committee on Undergraduate and Graduate Education, will organize bodies of microbiological knowledge so that teachers in community and junior colleges can extract and use portions according to their needs. Four units will be developed: Introductory Microbiology, Medical Microbiology, Microbial Physiology, and Microbial Genetics. Each unit is to be organized into topic outlines followed by essential laboratory and enrichment information.

In the first phase, a steering committee composed of teachers from community and junior colleges and from degreegranting institutions established guidelines for the project. In the second phase, two drafts of the actual units were produced by four study groups selected by the steering committee. The study groups were composed of community and junior college teachers currently teaching microbiology, content specialists, and an education expert. The draft units were reviewed by a large group of content specialists and teachers identified by the steering committee.

In this, the third phase, the units will be revised to final form, edited, printed, and made available for purchase as individual publications--in accordance with the approved dissemination plan.

AMOUNT: \$159,130\*  
AWARDED: 09-08-77  
TERMINATES: 06-30-81

AWARD NUMBER: SED77-18459  
NSF PROGRAM MANAGER:  
Raymond J. Hannapel  
PROGRAM: Development in  
Science Education

DISCIPLINE: Microbiology/Life and Medical Sciences  
TARGET AUDIENCE: Two Year College Students  
DESCRIPTORS: Microbiology; Physiology; Genetics; Instructional Materials; Teaching  
Methods; Curriculum Guides; Teaching Guides

\* Cumulative amount. Fiscal Year 1980 award: \$82,800.

## Mathematics in Society: Multimedia Materials for 8th-10th Grade Students

John Jobe  
The Mathematical Association of America, Inc.  
1529 Eighteenth Street, NW  
Washington, DC 20036

The project will develop and disseminate multimedia materials to inform eighth to tenth grade students about careers involving mathematics and the limitations on career options which result from math avoidance. The materials, to be entitled "Mathematics at Work in Society (MAWIS)," will include four videocassettes, each covering a different career area, and a student workbook. The videotapes will provide specific illustrations of careers which require substantial use of mathematics. The workbook will contain information on other careers, suggested activities related to the contents of the videotapes, and a direct discussion of "math avoidance." A major goal and focus of the MAWIS materials will be to convince adolescents, especially young women and minority students, that they can and should study mathematics appropriate for their intended careers; in short, to combat mathematics anxiety and avoidance.

The materials will be disseminated through existing MAA secondary school lectureship programs and through 29 regional MAA offices.

AMOUNT: \$118,400  
AWARDED: 08-11-80  
TERMINATES: 05-31-82

AWARD NUMBER: SED80-08438  
NSF PROGRAM MANAGER:  
Harold J. Stolberg  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences  
TARGET AUDIENCE: Grades 8-10  
DESCRIPTORS: Mathematics; Womens Education; Careers; Multimedia Instruction;  
Career Education; Career Choice; Secondary School Mathematics;  
Adolescents; Minority Groups; Career Planning; Mathematics Anxiety

## **A Strategy/Action Program for Re-Entry of Women in Science**

**Bernard J. Bulkin**  
Polytechnic Institute  
of New York  
333 Jay Street  
Brooklyn, NY 11201

This is a project to train colleges and universities to implement successful strategies for facilitating retraining of post-baccalaureate women and their re-entry into science and engineering careers. The project collects and builds on findings of several NSF-supported projects that explored the re-entry of women into science careers. It provides a variety of forms of assistance to other institutions interested in developing their own re-entry programs.

A consortium of three institutions (Polytechnic Inst. of NY, Univ. of Dayton, CA State Univ. at Northridge) will be formed. This consortium will conduct three Regional Re-entry Training Seminars for 30-100 colleges and universities. A paradigm for recruiting student participants, designing curricula, building counseling and support services, and developing a plan for placement of the students will be presented at each seminar. In designing the seminars, the project will employ the latest research findings on effective diffusion and on the adaptation of innovative strategies, and test this research on a new problem under conditions which will allow careful evaluation of the results.

A number of small (\$1,000-\$3,000) "incentive awards" will be given to stimulate and facilitate initiation of locally appropriate re-entry programs.

The proposal addresses the DISE mandate of increasing access to science careers for women and of disseminating successful models.

The project will be jointly supported by FIPSE and NSF.

**AMOUNT:** \$124,415\*  
**AWARDED:** 09-17-80  
**TERMINATES:** 08-31-82

**AWARD NUMBER:** SED80-20923  
**NSF PROGRAM MANAGER:**  
Mary Ann Ryan  
**PROGRAM:** Development in  
Science Education

**DISCIPLINE:** Engineering Education; Science Education  
**TARGET AUDIENCE:** Minorities; Handicapped; Females

**DESCRIPTORS:** Physical Disabilities; Womens Education; Females; Postsecondary Education; Minority Groups; Engineering Education; Science Education; Career Choice; Information Dissemination; Science Careers

•Funded through award to Fund for Improvement of Post-Secondary Education (FIPSE) of the Department of Education.

# Instruction for Problem Solving Using the Microcomputer in High School Mathematics

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University of Florida  
College of Education  
360 Norman Hall  
Gainesville, FL 32611

This project will develop a body of prototype instructional materials (computer programs plus supplementary printed materials) for use with a microcomputer to teach non-routine and "real world" problem solving in high school mathematics courses. The effectiveness of these materials in promoting growth in the problem solving ability of students will be studied.

The content emphasis in the mathematical problems will be on geometry, so that the graphics capability of the microcomputer will be used to advantage, and on number theory to capitalize on its iterative capability and the powerful calculator mode. Active participation by interaction with the computer will be emphasized. It will be possible, for example, to generate diagrams or to alter or manipulate existing figures and to select from among several possible paths to a solution. Hints or cues will be given to problem solvers who begin along a path but are unable to continue.

Materials will be submitted to consultants for critical evaluation. The final programs will be demonstrated at professional meetings of mathematics teachers. Progress reports and materials will be disseminated initially to the mathematics education community.

AMOUNT: \$110,322  
AWARDED: 07-18-80  
TERMINATES: 10-31-82

AWARD NUMBER: SED80-12466  
NSF PROGRAM MANAGER:  
Mary Ann Ryan  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics, General/Mathematical  
Sciences  
TARGET AUDIENCE: Grades 9-12  
DESCRIPTORS: Problem Solving; Geometry; Number Concepts; Mathematics  
Instruction; Computer Assisted Instruction; Computer Graphics;  
Secondary School Mathematics; Microcomputers

## A Prototype System to Deliver Continuing Education to Engineers

J. David Waugh  
Association for Media-Based Continuing Education for  
Engineers (AMCEE)  
Georgia Institute of Technology  
Savant Building, Room 212  
Atlanta, GA 30332

AMCEE, a consortium of 21 engineering universities, was formed to provide off-campus graduate and continuing education in engineering through the media of television and videotape. The organization is non-profit and operates on a national level. Services include distribution of videotape courses from member institutions, production (with private funds) and distribution of videotape short courses, conferences and symposia developed by AMCEE, and a computer-based information service on continuing education programs from a wide variety of sources. Continuation of organizational support is sought until revenue from these services enables AMCEE to be self-sustaining.

An information service, sponsored by AMCEE, will provide practicing engineers with data on "live" short courses and media-based "packaged" courses collected from universities, technical societies, trade associations, industrial and proprietary firms, video-publishing houses, and State and Federal Government agencies. The data collection is maintained in a word-processing computer, and information can be retrieved through a computer search. Satellite delivery is also being considered. Guidelines for program evaluation and production of ITV instruction in studio classrooms are being prepared by the AMCEE Industrial Research Committee in a two-year study.

AMOUNT: \$316,620  
AWARDED: 07-30-80  
TERMINATES: 01-31-84

AWARD NUMBER: SED80-14211  
NSF PROGRAM MANAGER:  
Harold J. Stolberg  
PROGRAM: Development in  
Science Education

DISCIPLINE: Engineering Education  
TARGET AUDIENCE: Scientists; Engineers  
DESCRIPTORS: Engineering Education; Professional Continuing Education; Professional Education; Educational Technology; Television; Videotape Recordings; Information Services; Consortia; Graduate Education; Information Dissemination; Information Processing

## **Microcomputer-Based Strategies for Mathematics in Junior High and High School**

**Les A. Karlovitz**  
Georgia Institute of Technology  
School of Mathematics  
225 North Avenue  
Atlanta, GA 30332

This project will develop computer programs called IDPs (interactive demonstration programs) for use on microcomputers capable of generating high resolution video graphics to treat key topics in traditional junior high and high school mathematics courses—primarily general mathematics, algebra, geometry, and calculus. The programs will apply the technology to the tasks of computation, graphical display, and simulation in order to clarify and explain the subject matter. The classroom component of the project is complemented by a laboratory component in which students experiment individually with the programs and carry on related activities.

The primary product of the project will be the demonstration of a teaching model which makes use of computer programs for classroom demonstration and laboratory use in mathematics courses. The programs themselves, which will be available when the project is completed, will be designed to achieve many goals: (1) bring ideas and numbers together more effectively for the understanding of mathematical concepts and procedures; (2) promote classroom participation by virtue of the interactive nature of the programs; (3) provide multiple viewpoints and contexts for the treatment of the given topic; and (4) allow for a useful redistribution of the teachers' time. Teachers from the Atlanta public school system will be actively involved in the planning and development of the IDPs to ensure the quality and effectiveness of the programs. A distribution network for the materials will be provided by the Southeastern Consortium for Minorities in Engineering. The project is designed for future expansion to other courses and grades and to a large geographical area.

**AMOUNT:** \$88,800\*  
**AWARDED:** 07-14-80  
**TERMINATES:** 10-31-82

**AWARD NUMBER:** SED80-12649  
**NSF PROGRAM MANAGER:**  
Mary Ann Ryan  
**PROGRAM:** Development in  
Science Education

**DISCIPLINE:** Mathematics, General/Mathematical Sciences  
Software Systems/Computer Science  
**TARGET AUDIENCE:** Grades 7-12; Minorities

**DESCRIPTORS:**

**Mathematics Education; Computer Assisted Instruction; Educational Technology; Teaching Techniques; Programmed Instructional Materials; Microcomputers; Secondary School Mathematics; Junior High School Students; Computer Graphics**

- **Funded in part by the National Institute of Education.**

## Space-Centered Activity Kit for Junior High Science Instruction

Thomas C. Campbell  
Illinois Central College  
Peoria, IL 61635

The project will develop and field test a science curriculum kit for junior high schools featuring four or five physical science lessons. Each lesson will relate to a different single-concept Skylab film, from a series of 12 films produced and marketed by the American Association of Physics Teachers.

The physical science lessons, designed for use either with existing science curriculum materials or alone, will incorporate the learning concepts of Jean Piaget. The complete teaching kit is scheduled to become available concurrently with NASA plans to implement the Space Shuttle Program; renewed interest in space travel is foreseen as providing impetus for children to learn the basic physical science principles applied in the kit. Cited here are examples of titles of films on which the lessons will be based: *Human Momenta*, *Games Astronauts Play*, *Human Mass Measurement* and *Gyroscopes*. Films are available in the Super 8mm silent technicolor cartridge format and are of proven classroom use.

Formative evaluation of the curriculum materials will be conducted throughout the development process of the two-year project. Summary evaluation will assess the project's impact on content mastery, student motivation, and development of reasoning. Commercial production and distribution of the project will be sought for 1981.

AMOUNT: \$25,700  
AWARDED: 02-06-80  
TERMINATES: 01-31-83

AWARD NUMBER: SED79-18986  
NSF PROGRAM MANAGER:  
Carl J. Naegele  
PROGRAM: Development in  
Science Education

DISCIPLINE: Science Education; Space Physics  
TARGET AUDIENCE: Grades 7-9  
DESCRIPTORS: Physical Sciences; Science Education; Space Sciences; Curriculum Design; Instructional Films; Piaget

## **Computer Graphics Technology as a Visualization Tool for Teaching Modern Optical Theory in High School and College Physics**

Raymond G. Wilson  
Illinois Wesleyan University  
Bloomington, IL 61701

The technology of computer graphics is to be applied to make the predictions of modern optical theory—Fourier Optics—visually comprehensible and conceptually understandable to high school and college physics students. Using a dedicated small desktop computer and plotter, a collection of three-dimensional diagrams illustrating all the phenomena associated with wave radiation as it interacts with surfaces or passes through optical systems will be produced. Examples will be chosen which are applicable across the disciplinary lines of physical sciences, biomedical science, and engineering. Detailed tutorial and pedagogical text materials also will be provided. They will be developed with the particular user in mind and will be systematically keyed, where appropriate, to the user's discipline, level, work, and background.

Substantive input from potential users and experts will be actively sought. Satisfactory test materials can be photo-reproduced, and information regarding the products will be disseminated through physics, electrical engineering, mathematics, biological, and certain medical journals. The project is designed to produce materials for commercial distribution.

AMOUNT: \$38,600  
AWARDED: 07-23-80  
TERMINATES: 01-31-83

AWARD NUMBER: SED80-21473  
NSF PROGRAM MANAGER:  
Carl J. Naegele  
PROGRAM: Development in  
Science Education

DISCIPLINE: Optics/Physics  
Software Systems/Computer Science  
TARGET AUDIENCE: Grades 9-12; Graduate Students; Undergraduates  
DESCRIPTORS: Computer Graphics; Computer Assisted Instruction; Optics; Physics  
Instruction; College Students; Secondary School Students; Instructional  
Materials; Curriculum Enrichment; Fourier Optics

## Prototype Microcomputer Courseware for Teaching High School Algebra

Sharon Dugdale  
University of Illinois  
Urbana, IL 61801

This project will develop microcomputer courseware to teach basic algebra concepts to secondary students (grades 9-12). Materials will be developed to teach recognition of general functional relationships and graphing of linear and quadratic equations. The materials will use an "intrinsic models" approach. This approach uses motivating activities which are direct expressions of the underlying mathematics, such as games based on the mathematical principles involved.

The materials will be designed for and tested on a color graphics microprocessor-based system which uses a standard color television set and a floppy disk for program storage. This hardware has capabilities which can be expected to be widely available within a few years.

AMOUNT: \$111,300  
AWARDED: 07-23-80  
TERMINATES: 06-30-82

AWARD NUMBER: SED80-12449  
NSF PROGRAM MANAGER:  
Harold J. Stolberg  
PROGRAM: Development in  
Science Education

DISCIPLINE: Algebra or Number Theory/Mathematical  
Sciences; Software Systems/Computer  
Science  
TARGET AUDIENCE: Grades 9-12  
DESCRIPTORS: Algebra; High School Students; Mathematics Materials; Mathematics  
Curriculum; Secondary School Mathematics; Computer Assisted  
Instruction; Programmed Instruction; Mathematical Models; Computer  
Graphics; Motivation Techniques

## Engineering Education Materials for Computer Aided Manufacturing (ECAM)

Randall P. Sadowski  
Purdue University  
Department of Industrial Engineering  
West Lafayette, IN 47907

This project will lay the foundations of an ongoing system of instructional materials on the principles and methods of computer-aided manufacturing for university students, educators, and practicing professionals in industrial, mechanical, and manufacturing engineering.

The project will perform the following: develop a taxonomy of basic concepts in the computer-aided manufacturing area; enlist broad university, industrial, and technical society participation; establish participant incentives; establish a national steering committee and task forces for preparation of materials; define curricular areas and delivery modes materials developed; develop formal evaluation methods; begin and maintain an educational journal for publication of materials; develop approximately 300 lecture units of materials; test materials in classroom and continuing education environments; and evaluate the material and overall impact of the project.

The project builds on the work of a previous and similar project at Purdue which has produced (in draft) instructional materials covering about 200 introductory lectures on the concepts in manufacturing engineering. These materials will be revised and combined into the new system.

Future phases, depending on satisfactory progress and review of a new proposal, will enlarge and disseminate the system being developed in prototype in this phase.

AMOUNT: \$263,722  
AWARDED: 08-27-80  
TERMINATES: 03-31-83

AWARD NUMBER: SED80-20447  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Computer Systems Design; Industrial  
Engineering  
TARGET AUDIENCE: Undergraduates; Graduate Students; Professional Continuing Education  
Students  
DESCRIPTORS: Engineering Education; Instructional Materials; Manufacturing;  
Computer Oriented Programs; Educational Technology; Information  
Dissemination; Curriculum Evaluation; Engineering Technology

## Demonstrations in Experimental Psychology for Junior High Schools

Fred L. Yaffe  
Washburn University of Topeka  
Department of Psychology  
Topeka, KS 66621

The major objective of the project is to provide a cost-effective system for presenting scientifically based psychology education programs to junior high students by developing a model program. The first phase of the program is the development of an "itinerant psychology fair." The psychology fair model is intended to generate an interest in the science of psychology through an experimental, hands-on medium. The "Fair" will be taken to junior high schools and youth organizations in the 20-county area in Northeast Kansas.

The principal investigator and his assistants will develop demonstrations which will exemplify various areas of experimental psychology such as the following: sensory processes; perception; learning; motivation and emotion; human learning and memory; animal learning; developmental and abnormal psychology; personality and intelligence assessment; and physiological psychology.

AMOUNT: \$118,648  
AWARDED: 05-08-80  
TERMINATES: 11-30-82

AWARD NUMBER: SED79-18967  
NSF PROGRAM MANAGER:  
Raymond J. Hannapel  
PROGRAM: Development in  
Science Education

DISCIPLINE: Experimental Psychology  
TARGET AUDIENCE: Grades 7-9  
DESCRIPTORS: Expositions; Experimental Psychology; Junior High Schools;  
Demonstration Programs; Demonstration Projects; Exhibits; Science  
Fairs

## Development of a Microcomputer Network and Courseware for Teaching Chemical Engineering Design

Brice Carnahan  
CACHE Corporation  
77 Massachusetts Avenue  
Cambridge, MA 02139

Chemical engineering greatly impacts on the productivity of our society because of its high technology content; exploitation of this content depends on the (now computer-aided) design of semi-automated plants. In this project, a nonprofit consortium of academic and industrial chemical engineering groups will use the rapidly expanding technology of the personal computer as a vehicle for more efficiently teaching chemical engineering design. Three kinds of products are anticipated: (1) 10 prototypic, interactive, personal computer programs and associated educational materials that focus on engineering design and problem solving; (2) an instructional monitoring system, used on the student's computer, which keeps track of student progress and difficulties, poses questions and retains the answers for the instructor's analysis, and also provides information that will guide revision of the instructional materials; and (3) a network of software developers which will make possible a means to share future development costs and electronically distribute new programs and data.

These products will be field tested in graduate, undergraduate, and continuing education settings in order to develop materials that will be widely useful.

The products will be compared for cost effectiveness to alternative approaches of software development and exchange. It is expected that this project may serve as a model for the development and exchange of computer courseware in other fields of science and engineering.

AMOUNT: \$127,940  
AWARDED: 06-18-80  
TERMINATES: 11-30-82

AWARD NUMBER: SED79-19609  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Chemical Engineering; Software  
Systems/Computer Science  
TARGET AUDIENCE: Undergraduates  
DESCRIPTORS: Programmed Instructional Materials; Curriculum Development;  
Computer Programs; Engineering Education; Information Dissemination;  
Microcomputers; Chemical Engineering

## Technology and the Individual - A School TV Series for Adolescents

Minaruth Galey  
Eastern Regional Council for Educational Television  
131 Clarendon Street  
Boston, MA 02116

A curriculum for teaching the interrelationships of science, technology, and society will be developed for 4.5 million pupils in grades 7-12 and their 137,000 teachers in eastern states. Designed to help secondary pupils become effective citizens, the project will focus on the following: (1) the development of a technical literacy; (2) the impact of technology on the individual and on society; and (3) the effects of social factors and actions on technology. The curriculum will consist of an instructional television series of 12 videotaped 20-minute programs and instructional materials for teachers. Program topics will cover consumerism, displaced workers, automation, fuel alternatives, health, population patterns, food technology, communication, Western and Eastern cultures, transportation, city growth, and information processing. The series will be designed for teachers of social studies, industrial arts, and other appropriate subjects. Inservice activities will familiarize teachers with the subject and methods of teaching it. Curriculum specialists in each state will plan and conduct evaluation procedures. Dissemination will be through state departments of education and educational television stations. Following final evaluation and revision of the program, national distribution will be initiated.

AMOUNT: \$192,700  
AWARDED: 09-04-80  
TERMINATES: 02-28-82

AWARD NUMBER: SED80-14104  
NSF PROGRAM MANAGER:  
Mary Ann Ryan  
PROGRAM: Development in  
Science Education

DISCIPLINE: Social Science/Education  
TARGET AUDIENCE: Grades 7-12  
DESCRIPTORS: Curriculum Development; Technological Advancement; Social  
Responsibility; Social Influences; Scientific Literacy; Citizenship  
Education

## **Modules and Monographs in Undergraduate Mathematics and Its Applications Project (UMAP)**

Ross L. Finney  
Education Development Center, Inc.  
55 Chapel Street  
Newton, MA 02160

The Undergraduate Mathematics Application Project (UMAP) has two primary goals: (1) develop a system of innovative materials in applications of mathematics; and (2) develop a consortium of individuals who will continue to create and use these materials. The present materials inventory is 273 modules and 24 monographs; approximately 30 modules and three monographs will be added each year. UMAP has a publication contract with Birkhauser Boston, Inc., to publish its materials including the UMAP journal. To facilitate the formation of a community, the UMAP Consortium, composed of more than 2,000 individuals from over 1,000 U.S. institutions interested in teaching applications of mathematics, has been formed. A major task of UMAP over the proposed grant period is to establish this Consortium as an independent, self-supporting organization. This project, which was established in 1976, is an ongoing effort to respond to the increasing application of mathematics in a variety of professional fields.

AMOUNT: \$440,404  
AWARDED: 09-02-80  
TERMINATES: 02-28-83

AWARD NUMBER: SED80-07731  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics Education  
TARGET AUDIENCE: Undergraduates  
DESCRIPTORS: Consortia; Educational Cooperation; Interinstitutional Cooperation;  
Mathematics Instruction; Mathematics Materials; Mathematical  
Applications; Instructional Innovation

## Administrative Activities Related to NSF-Supported Curriculum Materials

Jerry D. Murphy  
Education Development Center, Inc.  
55 Chapel Street  
Newton, MA 02160

The distribution of more than 100 titles of text materials and over 600 films developed by EDC with NSF funding will be administered and managed. NSF-imposed accounting activities will be followed and appropriate reporting procedures carried out with respect to royalty income. An itemized analysis of cost of administration and income anticipated will be prepared. Categories of support include contract and publication administration and administration of film materials.

In addition, the project will complete a cost/benefit analysis for administration of NSF-supported EDC curricular materials and prepare a plan for decontrol and divestiture of interest in projects whose continued administration is no longer of public benefit.

AMOUNT: \$238,582\*

AWARDED: 10-19-78

TERMINATES: 04-30-82

AWARD NUMBER: SED78-20121.A01,  
A02

NSF PROGRAM MANAGER:

Raymond J. Hannapel

PROGRAM: Development in  
Science Education

DISCIPLINE: Science Education

TARGET AUDIENCE: National Science Foundation

DESCRIPTORS: Program Administration; Information Dissemination; Textbook  
Publication; Instructional Films; Copyrights; Contracts; Instructional  
Materials; Cost Effectiveness

\* Cumulative amount. Fiscal Year 1980 award, amendments 01 and 02: \$157,144.

## **Application of Dimensional Analysis to Middle School Mathematics Using Microcomputer and Print Materials**

Judah L. Schwartz  
Education Development Center, Inc.  
55 Chapel Street  
Newton, MA 02160

This project will develop a collection of tested mathematical word problems which will be available both in printed form with graphics and in the form of interactive computer programs for use with a microcomputer. The problems will be set in contexts that are interesting to junior high school students. The approach to problem solving will be based on the technique of dimensional (semantic) analysis commonly used in university-level physics and engineering.

A core group of six to ten teachers in the Boston area will collaborate closely with project staff in the development of materials and will test materials initially. A larger group of 50 teachers with access to microcomputers in several urban areas around the country will then receive all materials and have complete discretion as to their use. Evaluation will be based on the extent to which these teachers voluntarily use the materials provided and the responses of the teachers and their students after using them. The project will also produce a report presenting insights gained on the following issues in the course of developing and testing the materials: (1) the generation of a computer-based curriculum in mathematics and other subjects; (2) the interaction of printed and computer-based materials; (3) computer-generated printed materials custom tailored to particular student interests; (4) the attitudes of teachers toward the present and future roles of computers in education; and (5) the training of teachers to use computers for their own ends, both as professional teachers and as functioning adults in society.

AMOUNT: \$156,101  
AWARDED: 08-18-80  
TERMINATES: 09-30-82

AWARD NUMBER: SED80-12611  
NSF PROGRAM MANAGER:  
Mary Ann Ryan  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics/Mathematical Sciences  
TARGET AUDIENCE: Grades 7-9

**DESCRIPTORS:**

**Mathematics; Computer Graphics; Educational Technology; Computer Assisted Instruction; Microcomputers; Secondary School Mathematics; Mathematics Curriculum; Teacher Attitudes; Curriculum Development; Junior High School Students; Problem Solving; Teacher Response**

# LOGO (A Computer Language) Methods in Science Education Using Low Cost Home Computers

Seymour A. Papert  
Massachusetts Institute of Technology  
77 Massachusetts Avenue  
Cambridge, MA 02139

Previous research and development work has created a computer language and a computer based learning environment that allow children to learn computer programming while acquiring skills in mathematics, science, and problem solving. This work has been tested under realistic conditions in public schools and demonstrated to be accessible to students of low academic achievement and of anti-mathematical turn of mind as well as providing a new challenge to the mathematically successful.

This project will adapt these methods to new computers and develop teaching materials which will allow widespread use of these methods. Features of the new computers will be taken advantage of to expand the range of content of the learning units to include more physics and biology in addition to the mathematics emphasized in the last round of work with students.

The project will accomplish the following tasks: (1) develop and adapt new activities from the current LOGO educational environment based on high resolution to the present generation of low-cost home computers making use of lower resolution video-based graphics; (2) develop and revise activities in the areas of physics and biology—both as initial projects for beginners and as “advanced topics” for junior high school students who have had an introduction to LOGO programming; (3) prepare teachers’ guides, background information, and student booklets, covering both introductory and advanced topics; and (4) provide a full implementation of a mini-LOGO for at least one presently available low-cost computer. In addition, a manual will be provided for the adaptation of subsets of LOGO to any presently available low-cost computer.

AMOUNT: \$200,600  
AWARDED: 10-29-79  
TERMINATES: 04-30-82

AWARD NUMBER: SED79-19033  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

DISCIPLINE: Computer Science/Computer Systems Design  
Problem Solving/Education

**TARGET AUDIENCE:** Grades 7-9  
**DESCRIPTORS:** Computer Oriented Programs; Computer Assisted Instruction;  
Educational Technology; Educational Media; Computer Science  
Education; Computer Graphics; Interdisciplinary Approach

## Interest Worlds: Precollege Mathematics in a Computer Culture

Seymour A. Papert  
Massachusetts Institute of Technology  
77 Massachusetts Avenue  
Cambridge, MA 02139

This project will develop an alternative to the traditional uniform mathematics curriculum. The new model of education will be computer-based "interest worlds." These interest worlds will serve as significant routes into the achievement of "computer literacy" on a broad scale. The project is guided by a key idea: If people have developed a serious interest and significant expertise in some activity and its associated body of knowledge, then it should be possible to design computer systems that help them pursue that activity and at the same time draw on their expertise and emotional attachment to support mathematics learning.

Four interest worlds will be developed: Words World, Games World, Music World, and Animation World. The interest worlds will be tested in a six-week summer program for 24 mid-elementary to junior high school youngsters.

AMOUNT: \$165,434\*  
AWARDED: 07-30-80  
TERMINATES: 07-31-82

AWARD NUMBER: SED80-12648  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics Education; Computer Systems  
Design/Computer Science  
TARGET AUDIENCE: Grades 4-9  
DESCRIPTORS: Computer Assisted Instruction; Computer Science Education;  
Mathematics Curriculum; Computer Oriented Programs; Instructional  
Innovation.

\*Funded in part by the National Institute of Education.

## **Reasoning Development: In-Service Training for Middle School Science Teachers**

Richard D. Konicek  
University of Massachusetts  
Amherst Campus  
Amherst, MA 01003

This project will develop in-service training for middle or junior high science teachers. Modules which include a manual and a series of training tapes will be produced for the following purposes: (1) to help science teachers in their communication skills with students about observed scientific phenomena; (2) to help teachers gain insights into student thinking styles, information processing and pre concept formation; and (3) to help teachers apply this information toward designing or modifying science curricula and/or improved teaching styles.

The modules, to be developed by teachers and the staff, will employ a video training technique and will focus on elements of curriculum development, communication theory, and adolescent cognitive theory.

A second phase of the project, for which future funding will be requested, is the dissemination of the project to potential users. This phase will include leadership workshop conferences.

AMOUNT: \$55,562  
AWARDED: 09-8-80  
TERMINATES: 06-30-82

AWARD NUMBER: SED80-10776  
NSF PROGRAM MANAGER:  
Carl J. Naegle  
PROGRAM: Development in  
Science Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Teachers; Grades 5-9  
DESCRIPTORS: Science Teachers; Science Education; Junior High Schools; Middle Schools; Science Curriculum; Teaching Styles; Videotape Recordings; Concept Formation; Communication Skills; Cognitive Processes; Inservice Teacher Education

## Support Centers for Microcomputer Applications in Science Education

Karl E. Zinn  
High/Scope Educational Research Foundation  
600 North River Street  
Ypsilanti, MI 48197

This project will address the needs of science teachers, interested parents, administrators, science museum staff, and developers of science education materials and programs for up-to-date information and person-to-person advice concerning the many applications of microcomputers and related technologies to science education at all levels. The project will develop a series of workshops and instructional materials, computer systems and associated software, and information files necessary to set up a local microcomputer resource center. These materials will be tested in a dozen centers to ensure ease of national replication and should help new centers get started. The local centers will serve their clients through hands-on demonstrations, consultation, and workshops, as well as through a resource library containing computer programs, online catalogs, and audiovisual materials. The content of the resource library will orient and guide users on the general range of uses of computers in science education, programs available for specific course objectives, how to write courseware, how to choose and maintain hardware, and on other sources of help and information. The project will be in ongoing communication with both local and national developers of computer applications and with other information dissemination centers. Information sharing will be facilitated by use of computer teleconferencing. Thus, the project will foster the development of a network of local dissemination centers, which could continue after grant funds are spent.

AMOUNT: \$199,900  
AWARDED: 05-21-80  
TERMINATES: 10-31-82

AWARD NUMBER: SED79-20124  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Software Systems/Computer Science;  
Multidisciplinary Sciences  
TARGET AUDIENCE: Teachers; Grades K-12; Undergraduates; Graduate Students; College  
Instructors; Education Administrators

**DESCRIPTORS:**

**Computer Assisted Instruction; Resource Centers; Information  
Dissemination; Microcomputers; Educational Technology; Information  
Systems; Science Materials; Science Instruction; Data Bases; Information  
Retrieval; Online Systems**

## Problem-Oriented College Physics Instruction

Peter Signell  
Michigan State University  
East Lansing, MI 48824

This project will put the physics curriculum (usually taught in service courses) into a form—often computer-managed—that will allow college students, professional engineers, biology researchers, and others to more quickly isolate and obtain the precise instruction they need for solving specific problems and classes of problems. The new modular form will also allow the instructional materials system to quickly capture new knowledge and new instructional insights and to be easily disseminated electronically to save costs, time, and energy.

The project will link its physics modules to the applied science and mathematics modules being produced by other NSF projects in order to form a comprehensive instructional network for problem solvers.

The project's physics modules will incorporate instruction in problem solving and science learning strategies based on recent research findings. It will incorporate specific materials produced in prior NSF projects, employ recently developed field testing strategies to ensure instructional designs that actually work, and field test the materials at a number of other institutions. Many of these materials will be useful at the high school level.

In a final phase, to follow this one, the project is to be taken over by a user-producer consortium and made self-sustaining.

The project builds on work done in a prior grant which has in draft form some 500 instructional module manuscripts covering most of the undergraduate physics curriculum, and which has developed computer-aided systems for review, revision, and field-management of the modules.

AMOUNT: \$482,100  
AWARDED: 09-08-80  
TERMINATES: 03-31-83

AWARD NUMBER: SED80-20272  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Physics, General  
TARGET AUDIENCE: Grades 9-12; Undergraduates; Graduate Students

**DESCRIPTORS:**

**Physics Curriculum; Computer Assisted Instruction; Programmed Instructional Materials; Problem Solving; Physics Instruction; Curriculum Development; Consortia; Information Dissemination; Educational Technology; College Science; Information Networks**

## Adaptable Microcomputer Graphics for Undergraduate Life Science Instruction

James D. Spain  
Michigan Technological University  
College of Sciences and Arts  
Department of Biological Sciences  
Houghton, MI 49931

This is a project to develop user-adaptable microcomputer graphics software for undergraduate life science instruction. This is the first phase of an overall program to develop, evaluate, and disseminate single-concept interactive graphics packages for instruction in general biology and ecology using a microcomputer. Twenty packages will be developed under this grant; an additional 20 will be proposed for Phase II. In order to encourage broad utilization, each package will deal with a single concept or biological system. This will maximize adaptability of packages to a variety of courses and instruction situations. The adaptability will be further enhanced by writing the programs in BASIC, using a modular structure with each step fully documented. Users' guides will provide theory, learning objectives, program organization, and other information to augment program adaptability and make it possible for instructors to fit their interests and expertise, irrespective of previous programming experience. The interactive graphics strategy uses a mathematical model to generate simulation data that are displayed in an easily understood graphical form.

AMOUNT: \$125,484  
AWARDED: 05-14-80  
TERMINATES: 10-31-82

AWARD NUMBER: SED79-19051  
NSF PROGRAM MANAGER:  
Raymond J. Hannapel  
PROGRAM: Development in  
Science Education

DISCIPLINE: Software Systems/Computer Science  
Biology, General/Life and Medical Sciences  
TARGET AUDIENCE: Undergraduates  
DESCRIPTORS: Computer Assisted Instruction; Computer Graphics; Educational  
Technology; Biology Curriculum Materials; Ecology; Microcomputers;  
Science Instruction; Learning Modules

## Instructional Materials for Computer Literacy

Ronald E. Anderson  
Minnesota Educational Computing Consortium  
Division of Special Projects  
2520 Broadway Drive  
St. Paul, MN 55112

Instructional materials will be developed to encourage computer literacy among secondary school students. These materials will consist of 25 individual learning packets which can be integrated into current mathematics, science, and social science programs, or used for separate courses in computer science. Since attitudes, skills, and factual information are considered equally important aspects of computer literacy, the content materials will consider applications and impacts as well as hardware, software, and programming. Each learning packet will contain background material, student activities, text material, and, in some instances, computer-based learning activities. Individual teacher guides and an overall guide to the set for aid in curriculum planning will be included.

Formative evaluation will start with one-on-one testing and interviews followed by pilot tests conducted in 14 classrooms in seven states. Results of student pre- and post-tests and content review by technical experts will be analyzed before final revision and publication. Information will be disseminated through the mailing of 1,200 descriptive brochures, journal articles, and conference presentations.

AMOUNT: \$286,175\*  
AWARDED: 04-18-80  
TERMINATES: 03-31-83

AWARD NUMBER: SED79-18987  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

DISCIPLINE: • Computer Science/Education  
TARGET AUDIENCE: Grades 7-9  
DESCRIPTORS: Computer Science Education; Instructional Materials; Curriculum  
Development; Computer Assisted Instruction; Mathematics Instruction;  
Science Instruction; Social Sciences; Secondary School Students;  
Interdisciplinary Approach

\*Funded in part by the Research in Science Education (RISE) Program.

## Microcomputer Instructional Units (for 11th and 12th Grade Mathematics) Using Simulation of Mathematical Modeling.

Lynn Arthur Steen  
St. Olaf College  
Northfield, MN 55057

Three prototype instructional units will be developed for microcomputers, each using simulation of mathematical modeling as a vehicle with which students can explore the geometrical and physical bases of mathematical relationships. The simulation programs will employ color graphics (with a graphic input pad) to illustrate physical and geometrical processes. Students will use the programs as experiments, trying different parameters and conditions, in order to collect data and formulate conjectures. The program packages will permit students to test their conjectures for consistency with the simulations and will suggest exploration of possible sources of error. The materials will be tested in high school, college, and in adult continuing education classes.

Each program package will be a self-contained instructional unit on some topic illustrating mathematics ordinarily encountered in grades 11 and 12. Each will be accompanied by a supplementary pamphlet suggesting problems, projects, and further reading.

AMOUNT: \$54,184\*  
AWARDED: 07-09-80  
TERMINATES: 06-30-83

AWARD NUMBER: SED80-12463  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

DISCIPLINE: Software Systems/Computer Science  
TARGET AUDIENCE: Grades 11-12  
DESCRIPTORS: Mathematical Models; Mathematics Instruction; Secondary School  
Mathematics; College Mathematics; Computer Graphics; Computer  
Assisted Instruction; Educational Technology; Microcomputers;  
Simulation; Geometric Concepts; Autoinstructional Aids

\* Funded in part by the National Institute of Education.

## Out of School Science for Pre-Adolescent / Adolescent Children and Their Parents

Eugene D. Gennaro  
University of Minnesota  
370 Peik Hall  
Minneapolis, MN 55455

Five short informal science courses will be developed and evaluated. These courses will be inquiry oriented, designed specifically for middle school children and their parents, and will be taught at community settings such as zoos, museums, planetariums, and nature centers. Parents and children will be provided with home activity packets that they can do together. Course topics will supplement what is being taught in science in the middle and junior high schools.

The project is divided into four phases: (1) developing instructional materials; (2) teaching the courses with suburban participants; (3) revising courses and teaching courses again with urban participants; and (4) final revision of instructional materials and the production of six manuals (an overview manual and five teacher's manuals) and children-parent materials. The overview manual will give strategies for initiating similar informal science courses in other communities. The teacher's manuals will offer examples of instructional materials, including materials and strategies that can be used in other communities.

The courses will be evaluated on the basis of pre- and post-tests of cognitive attainment, attitudinal measures, and student evaluations. Materials will be developed and reviewed by science content experts and curriculum development specialists. After appropriate testing, revision, and evaluation, national distribution through a commercial publisher is planned.

AMOUNT: \$158,400  
AWARDED: 07-28-80  
TERMINATES: 02-28-83

AWARD NUMBER: SED80-07872  
NSF PROGRAM MANAGER:  
Carl J. Naegele  
PROGRAM: Development in  
Science Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Grades 5-8

**DESCRIPTORS:**

**Instructional Materials; Curriculum Enrichment; Middle Schools;  
Intermediate Grades; Junior High Schools; Parent Participation; School  
Community Programs; Community Involvement; Questioning  
Techniques; Field Trips; Experiential Learning; Activity Units;  
Adventure Education; Non-school Educational Programs**

## **Computer Storytelling Mathematics for Pueblo Indian Upper-Elementary Level Students**

Judith A. Hakes  
All Indian Pueblo Council  
1015 Indian School Road  
Albuquerque, NM 87197

This project will develop an alternative, computer-based learning unit in mathematics and science for upper-elementary level Pueblo Indian students. The project will produce and field test a four- to six-week unit entitled "Pueblo Uses of Energy" which fuses mathematical problem solving with science content related to the daily lives of the Pueblo students. The major mode of instruction will be the microcomputer interfaced with a tape recorder. Instructional programs will be designed to introduce content and skills in a storytelling format which capitalizes on a specific learning style of Pueblo culture.

The project will be accomplished in two six-month phases: (1) design; and (2) field development, revision, and dissemination. The computer programs, audio tapes, and printed materials developed will be disseminated through the Education Division of the All Indian Pueblo Council to Bureau of Indian Affairs schools and other educational programs. Materials will also be available at the American Indian Bilingual Education Center at the University of New Mexico. Results of the project will be presented in journal publications.

**AMOUNT:** \$59,444\*  
**AWARDED:** 09-19-80  
**TERMINATES:** 02-28-82

**AWARD NUMBER:** SED80-12482  
**NSF PROGRAM MANAGER:**  
Mary Ann Ryan  
**PROGRAM:** Development in  
Science Education

**DISCIPLINE:** Mathematics, General/Mathematical Sciences  
**TARGET AUDIENCE:** Grades 4-9  
**DESCRIPTORS:** American Indian Education; Computer Programs; Mathematics; Science; Computer Assisted Instruction; Educational Technology; Instructional Materials; Story Telling; Curriculum Development; Bilingual Education; Biculturalism; Adolescents; Interdisciplinary Approach; Minority Groups; Pueblo Indians

\*Funded in part by the National Institute of Education.

## Development of Instructional Films in Ethology—"Behavior of the Ring Dove"

Rae Silver  
Barnard College  
606 West 120th Street  
New York, NY 10027

This project will produce three coordinated versions of a teaching film on the behavior of the ring dove, emphasizing the relationship of endocrinal functions to its biological cycles and behavioral patterns. These three versions will be targeted, respectively, toward the following: (1) precollege nature study/biology; (2) undergraduate biology and comparative psychology/graduate level endocrinology and ethology; and (3) a general public environmental education film for TV distribution. With all film footage requirements pre-identified, sufficient film can be exposed in a single trip to the remote location, unused footage being earmarked for national cinematographic archives.

Associated and concurrent studies into improved production and utilization efficiencies include the following: (a) basing the entire plan on a preliminary study by educational film utilization experts who will identify existing related films to prevent unplanned duplication; define the educational needs, teacher attitudes, and target audiences; and pre-plan the educational strategy for the entire complex of films before shooting begins to minimize production costs; (b) coordinating this group's findings with scientific expertise and film-making skills to achieve an ideal mix of scientific accuracy, film quality, and educational impact; (c) experimenting with combinations of strategies to maximize market penetration and improve cost effectiveness; and (d) documenting and evaluating each step in a manner calculated to show how to increase the education returns from investments in teaching films.

AMOUNT: \$260,000\*  
AWARDED: 09-21-77  
TERMINATES: 04-30-82

AWARD NUMBER: SED77-12124  
NSF PROGRAM MANAGER:  
Raymond J. Hannapel  
PROGRAM: Development in  
Science Education

DISCIPLINE: Biology, General/Life and Medical Sciences  
TARGET AUDIENCE: General Public

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Section II 85

**DESCRIPTORS:**

**Film Production; Instructional Films; Animal Behavior; Educational  
Television; Extension Education; Audiovisual Communications; Biology;  
Ethology**

\*Cumulative amount. Fiscal Year 1980 award: \$67,000.

## Professional Competencies Development in the Undergraduate Engineering Curriculum

Jean LeMee  
The Cooper Union for the Advancement  
of Science and Art  
The School of Engineering  
Cooper Square  
New York, NY 10003

This project will design, develop, and evaluate the first stage of a model curriculum in which engineers are trained to understand and communicate the broad, social-humanistic context in which society's technological problems occur. The goals of this curriculum are based on a two-year planning project in which faculty, academic administrators, and industrial engineers surveyed a wide range of attempts to clearly specify, in the form of competencies, those skills necessary to be an effective practicing engineer.

In the first phase of this project a number of assessment instruments developed by the American College Testing Service were utilized to develop a portion of the proposed curriculum focused on skills in problem solving, ethics and values, and communication. Cooper Union faculty worked with experts in instructional development, competency-based curricula, and educational evaluation to accomplish the following tasks: (1) state competence levels and develop assessment criteria; (2) prepare appropriate learning activities, study guides and teaching materials to enable students to meet competence criteria; (3) train faculty who will use these materials in four existing traditional engineering courses; and (4) develop formative and summary assessment instruments.

During the second project phase, project staff will develop four more courses, evaluate the impact of courses on students, and provide workshops to other engineering institutions which desire to adopt resultant material and/or techniques.

AMOUNT: \$259,500\*  
AWARDED: 08-28-79  
TERMINATES: 02-28-83

AWARD NUMBER: SED79-19004  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Engineering Education  
TARGET AUDIENCE: Undergraduates

**DESCRIPTORS:**

Engineering Education; College Science; Science Education;  
Humanization; Social Values; Technological Advancement; Social  
Responsibility; Minimum Competencies; Professional Continuing  
Education

\*Cumulative amount. Fiscal Year 1980 award: \$142,600.

## Microcomputer Courseware to Develop Insight into Arithmetic Using Perceivable Algorithms

Caleb Gattegno  
Educational Solutions, Inc.  
80 Fifth Avenue  
New York, NY 10011

The project presents a new way of using microcomputers for teaching mathematics. The prototype will be field tested with first and second graders and early adolescents (middle school age) in predominantly minority public schools in New York City. The ultimate target audience will be elementary and middle school students. The approach to be used is based on learning through insight rather than drill. The computer is used to generate insight in students by interacting with them in such a way that their attention is focused on mathematical relationships and transformations.

Prototype courseware for generating insight and skill in numeration, addition, and subtraction will be produced, field tested, and refined.

AMOUNT: \$52,000  
AWARDED: 09-03-80  
TERMINATES: 07-31-82

AWARD NUMBER: SED80-12612  
NSF PROGRAM MANAGER:  
Harold J. Stolberg  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences  
Software Systems/Computer Science

TARGET AUDIENCE: Grades 1-8

DESCRIPTORS: Computer Assisted Instruction; Elementary School Mathematics;  
Mathematics Instruction; Arithmetic; Algorithms; Middle Schools;  
Adolescents; Mathematical Concepts; Microcomputers; Minority Group  
Children

## A Computer Based Annotated List of Laboratory Experiments in College Chemistry

Stanley C. Bunce  
Rensselaer Polytechnic Institute  
Troy, NY 12181

This project will survey all articles published in the *Journal of Chemical Education* describing laboratory experiments in chemistry, prepare an annotated list of experiments in the form of a computer file, develop a program for searching that file, and make both the list and the computer file and program generally available at cost of reproduction.

A computerized annotated list will be useful to instructors planning or revising laboratory courses in chemistry and to instructors and students searching for experiments of a particular type suited for individual or "project" type experiments. It will make it possible to search quickly and effectively approximately 1,000 articles published in 30 years in the *Journal of Chemical Education* for experiments of a particular type. It will permit calling from a master list all articles with certain combinations of features (for example, all experiments involving kinetic studies of chemical reactions of organic compounds that are suitable for second year students). The annotated list will also state what special apparatus, unusual reagents, or hazards may be involved, and what background is required of the student.

AMOUNT: \$14,900  
AWARDED: 06-11-80  
TERMINATES: 03-31-83

AWARD NUMBER: SED79-23685  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Chemistry, General  
TARGET AUDIENCE: College Instructors; Undergraduates  
DESCRIPTORS: Chemistry; Science Education; Chemistry Instruction; Literature Reviews; Annotated Bibliographies; Computer Programs; Laboratory Experiments; Laboratory Equipment; Science Laboratories; Laboratory Techniques; Data Bases; Information Retrieval; Online Systems

## Improving Spatial Skills in Pre-College Mathematics through Computer Graphics

Edith H. Luchins  
Rensselaer Polytechnic Institute  
Mathematical Sciences Department  
Troy, NY 12181

This project will develop and test experimental educational materials intended to improve mathematical problem solving by training students in spatial visualization and orientation. Spatial skills have been shown to be good predictors of mathematical performance and grades in mathematics courses and to be important in certain occupations. Among modern technologies, computer graphics has special potential as a tool in spatial visualization and orientation training. This project will develop and produce software (which will be available at the end of the project) to generate a variety of instructional courseware.

Students will interact with subject matter using individual computer graphics systems. The computer programs will evaluate student responses and adapt the training sequence.

Moreover, this software will enable teachers to design new training experiences without special knowledge of computing. Testing of materials will be done at a public and a private high school. Pre- and post-training testing of spatial and mathematical abilities will be administered to experimental and control subjects. Since sex differences in spatial abilities have been reported widely, the project will compare the changes in spatial skills shown by males and females.

AMOUNT: \$124,769\*  
AWARDED: 08-06-80  
TERMINATES: 07-31-82

AWARD NUMBER: SED80-12633  
NSF PROGRAM MANAGER:  
Mary Ann Ryan  
PROGRAM: Development in  
Science Education

DISCIPLINE: Software Systems/Computer Science;  
Mathematics Education  
TARGET AUDIENCE: Grades 9-12

**DESCRIPTORS:**

**Computer Assisted Instruction; Computer Graphics; Problem Solving;  
Mathematics Instruction; Mathematical Concepts; Spatial Perception;  
Orientation**

**\*Funded in part by the National Institute of Education.**

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## A World Model for Undergraduate College Classroom Use

Barry B. Hughes  
University of Denver  
Graduate School of  
International Studies  
University Park  
Denver, CO 80210

Transferred from:  
Case Western Reserve  
University  
Cleveland, OH

The project focuses on the development of a world model of global development processes suitable for use in undergraduate college classrooms. A computer simulation will be accompanied by a student manual designed to link the model to further study. General objectives of the project are to communicate to students basic information about global development and global interdependence and to motivate students to explore further the interrelatedness of science, technology, and the important social/value issues of the day.

The initial phase of effort now under way (funded by the Cleveland Foundation) involves development of the basic model and preparation of the manual. The second phase consists of refinement of the model and accompanying manual and pilot testing of the total package at several sites.

The final model, the International Forecasting System (IF), includes the following features: (1) representation of the world in nine regions; (2) a population model; (3) an economic model; (4) an agricultural model; (5) an energy model (6) a set of environmental variables; and (7) other variables representing policy choices, technological developments, and other unknown variables.

The manual used for much of the teaching must introduce students to the subject matter, provide basic substantive information and theory, explain how to use the computer model, and motivate students to do further work.

Great care is being taken to ensure portability of the products. The computer software will be designed so it can be used on microcomputers. Dissemination is expected to take place via major computer program distribution centers and by commercial publication.

AMOUNT: \$76,100  
AWARDED: 07-11-80  
TERMINATES: 02-28-82

AWARD NUMBER: SED80-07313  
NSF PROGRAM MANAGER:  
Raymond J. Hannapel  
PROGRAM: Development in  
Science Education

DISCIPLINE: Political Science/Social Sciences;  
Software Systems/Computer Science  
TARGET AUDIENCE: Undergraduates

**DESCRIPTORS:**

**Simulation; World Problems; Interdisciplinary Approach; Futures (of Society); Instructional Materials; Computer Assisted Instruction; Global Approach; World Affairs; International Studies**

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## The Use of Microcomputers for Mathematics Instruction in Grades 1-4

William H. Kraus  
Wittenberg University  
Springfield, OH 45501

This project will develop 10 to 15 computer games to be used as supplements to mathematics instruction in grades one through four. The computer will be used as a learning center in the classroom. The games to be developed are based on typical game strategies used with older students: practice in skills; applications of mathematics; and problem solving. Games will be designed for both small and large group use. The mathematical content of the programs would cover the 10 basic skill areas identified by the National Council of Supervisors of Mathematics. Development of the program would stress the following: (a) appropriateness of mathematical content; (b) ease of program use; and (c) use of color graphics and animation for increased motivation, user involvement, and effectiveness of communication. Elementary teachers will be involved in the development of the programs, and the programs will be field tested in public schools.

AMOUNT: \$25,048\*  
AWARDED: 07-11-80  
TERMINATES: 12-31-82

AWARD NUMBER: SED80-12268  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

DISCIPLINE: Software Systems/Computer Science;  
Mathematics, Elementary/Mathematical  
Sciences  
TARGET AUDIENCE: Grades 1-4  
DESCRIPTORS: Mathematics Instruction; Elementary School Mathematics; Computer  
Assisted Instruction; Educational Games; Learning Centers; Problem  
Solving; Basic Skills; Computer Graphics; Microcomputers

\*Funded in part by the National Institute of Education.

## Pre-College Science/Education Materials on Mt. St. Helens' 1980 Eruption

Michael Fiasca  
Portland State University  
P. O. Box 751  
Portland, OR 97207

This project will assemble an exhaustive, immediate, and on-the-spot collection of high-appeal photos (still, movie, and videotape) which record the Mt. St. Helens' eruptions and will prepare materials which describe their ecological, social, and economic sequels in the Pacific Northwest. The most suitable of these materials will be incorporated into an 80-slide/tape presentation for principal use in high school and junior high school classes, but with probable implications for adult audiences also.

Forty sets of trial materials will be field tested under the supervision of the National Association of Geology Teachers. Following necessary revisions, availability of the materials will be announced nationally through the NAGT and through numerous journals read by teachers and the general public. The materials will be distributed at cost through the Division of Continuing Education of the Oregon State System of Higher Education.

In addition, the collected video materials, supporting field notes, and the like (all captured while this enormous event is actually occurring) will be passed on to the staff of the Crustal Evolution Project which will create an additional module on volcanism for use in that series.

The film-tape presentation, while capitalizing on the drama and popular appeal of the eruptions, will put the events into the larger context of crustal tectonics (volcanism, mountain building, the Cascades Range) and the environmental and social impacts of a volcanic eruption in the midst of a populous region.

AMOUNT: \$17,637  
AWARDED: 07-18-80  
TERMINATES: 06-30-81

AWARD NUMBER: SED80-20737  
NSF PROGRAM MANAGER:  
Raymond J. Hannapel  
PROGRAM: Development in  
Science Education

DISCIPLINE: Geology/Earth Sciences  
TARGET AUDIENCE: Grades 9-12

**DESCRIPTORS:**

**Instructional Materials; Audiovisual Aids; Earth Science; Geology;  
Secondary School Students; High School Curriculum; Curriculum  
Enrichment; Films; Photographs; Videotape Recordings; Slides**

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## **Computer Graphics in a High School Mathematics Laboratory**

John H. Staib  
Drexel University  
Philadelphia, PA 19104

This project will develop a series of microcomputer-based mathematics experiments designed to accompany a high school course in elementary mathematical functions. The experiments will constitute a laboratory course which will make use of interactive computer graphics as a means for developing mathematical insights and for otherwise motivating and enhancing the learning of mathematics. These experiments will be designed to encourage the use of inductive reasoning processes.

A team of mathematicians, mathematics educators, and computer scientists will design, develop, and field test the laboratory course. The team will produce the necessary software, a student laboratory manual with worksheets, and a teacher's guide. The project will be a cooperative one including the school district of Philadelphia. The school district will contribute personnel and make possible a classroom test of the materials.

Results of the project will be presented at local and national professional meetings. The materials will be demonstrated at in-service courses for teachers in the Philadelphia area and will be made available to other school systems and individual teachers throughout the country.

AMOUNT: \$123,000  
AWARDED: 08-14-80  
TERMINATES: 09-30-82

AWARD NUMBER: SED80-12532  
NSF PROGRAM MANAGER:  
Harold J. Stolberg  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics Education  
TARGET AUDIENCE: Grades 11-12  
DESCRIPTORS: Mathematics Curriculum; Educational Technology; Computer Graphics; Laboratory Experiments; Curriculum Enrichment; Computer Assisted Instruction; Secondary School Mathematics; Microcomputers; Induction; Mathematical Concepts

## A Model Computer-Based Interpretive System for Science Museums

Minda Borun

The Franklin Institute Science  
Museum and Planetarium  
20th Street & The Parkway  
Philadelphia, PA 19103

The Franklin Institute will develop a model computer-based interpretive system for the explanation of participatory science-teaching exhibits. A computer-based interpretive system will be designed to enhance present museum exhibits in energy, transportation or optics. The system, which will contain materials on three different reading levels, will enable visitors to browse through a broad range of current information in an interactive format.

The 18-month pilot project will develop, test, and evaluate a data input and interactive information-retrieval program and public-access system. The hardware configurations, data input, and user programs will be designed with sufficient generality to be directly exportable to other museums for use with data based on their own exhibitions. Plans for further dissemination will be formulated during the course of the project.

AMOUNT: \$135,114  
AWARDED: 12-12-79  
TERMINATES: 12-31-81

AWARD NUMBER: SED79-19003  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

DISCIPLINE: Software Systems/Computer Science;  
Computer Systems Design  
TARGET AUDIENCE: General Public  
DESCRIPTORS: Museums; Computer Assisted Instruction; Information Dissemination; Co-  
curricular Activities; Scientific Concepts; Energy; Optics; Transportation;  
Information Retrieval; Data Bases

## **A Microcomputer-Based Laboratory Measurement System for Undergraduate Electrical Engineering Laboratories**

Paul T. Hulina  
Pennsylvania State University  
121 Electrical Engineering East  
University Park, PA 16802

Electrical engineering curricula are being affected dramatically by the microelectronics revolution; this is especially true of electrical engineering laboratory courses. Specialized measurement equipment needed to keep abreast of these new developments has placed a severe strain on already tight budgets. As a response to this situation, the project will develop and evaluate a microcomputer-based measurement system for undergraduate engineering laboratories which enriches modern instrumentation techniques and is available at low cost. The effort will result in the design of a general purpose source and detector (for electrical circuits) which would be coupled to a low-cost microcomputer system. Software would be designed using a higher-level language (BASIC) to imitate a variety of modern instruments needed in an undergraduate laboratory. The results of a preliminary effort indicate that a cost effective system can be developed which will allow for meaningful integration and evaluation in an undergraduate laboratory.

AMOUNT: \$77,600  
AWARDED: 11-08-79  
TERMINATES: 01-31-82

AWARD NUMBER: SED79-18985  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development  
in Science Education

DISCIPLINE: Computer Science; Engineering Education  
TARGET AUDIENCE: Undergraduates  
DESCRIPTORS: Engineering Education; Measurement Instruments; Measurement Techniques; Cost Effectiveness; Instructional Materials; Computer Assisted Instruction; Microcomputers

## Educational Modules for Materials Science and Engineering (EMMSE)

Rustum Roy  
Pennsylvania State University  
Materials Research Laboratory  
University Park, PA 16802

This award is for the third segment of a four-year project to organize a system for the production and dissemination of teaching aids and instructional materials in modular form for Materials Science and Engineering (MSE). During the first two and one-half years, the project has made the following progress: (1) continued the development of five Topic-Area Teams in the major subfields of MSE (these teams have been encouraging the development of materials covering the basic examples of more advanced work as often taught in leading schools); (2) produced and distributed in four volumes 23 peer-reviewed, student-tested instructional modules; (3) started the organization of cognate groups in other countries (the one in Europe has just received its first grant from NATO and will produce materials during the next year); and (4) started up a long-range planning group which will survey past performance, current needs of client groups, and suggest the next steps for system development.

During the next year and a half, the project plans to accomplish the following: (1) continue engaging more of the academics in this field to participate in project activities--especially writing and reviewing materials; (2) produce and distribute another six volumes of modules; (3) continue setting up foreign groups who can contribute instructional modules, especially in those areas in which foreign nationals have superior work; and (4) shift to encouraging individual contributions.

If successful, this project should provide a prototype of a new mode for technology transfer.

AMOUNT: \$493,975\*  
AWARDED: 09-16-77  
TERMINATES: 05-31-82

AWARD NUMBER: SED77-14149.A02  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Science Education; Engineering Education  
TARGET AUDIENCE: Undergraduates; Graduate Students; Engineers; Scientists

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**DESCRIPTORS:**      **Instructional Materials; Engineering Education; Curriculum Enrichment;  
Material Development; Foreign Nationals; Workshops; Learning  
Modules; Information Dissemination**

**\*Cumulative amount. Fiscal Year 1980 award, amendment 02: \$197,395.**

## Educational Modules for Materials Science and Engineering (EMMSE)

Rustum Roy  
Pennsylvania State University  
Materials Research Laboratory  
University Park, PA 16802

This supplemental award is intended to acquire recently developed microcomputer technology to increase the effectiveness of production and distribution of instructional materials for materials science and engineering. Much of the content of this field is presented graphically, and graphical materials have been extremely expensive to prepare. The project will also purchase optical scanning and digitizing equipment to put extant graphical material into electronic form. The project will also purchase a computer and mass storage devices to transform the graphics into formats needed for instruction, and then disseminate the results in digital form (by magnetic tape reels and by telephone lines) to the user audiences. In addition, the new equipment will permit the project to disseminate instructional materials designed for small and highly dispersed, but crucially important, technical specialties—the volume of material, large data bases, and small numbers of students do not make print distribution economical. Several clusters of instructional materials, and associated data, will be prepared and tested in university and industrial continuing education programs.

AMOUNT: \$543,384\*  
AWARDED: 09-16-77  
TERMINATES: 05-31-82

AWARD NUMBER: SED77-14149.A03  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Materials/Engineering  
TARGET AUDIENCE: Undergraduates; Graduate Students; Engineers  
DESCRIPTORS: Instructional Materials; Engineering Education; Instructional  
Technology; Computer Assisted Instruction; Professional Continuing  
Education; Information Dissemination; Computer Storage Devices;  
Digital Computers; Science Materials; Computer Graphics; Data Bases

\*Cumulative amount. Fiscal Year 1980 award, amendment 03: \$49,409.

## Using a Visual Technique to Teach High School Students the Concept of Variables in Polynomials

Joel Baumeyer  
Christian Brothers College  
650 E. Parkway South  
Memphis, TN 38104

This project will assist students who have difficulty in the manipulation of the basic symbols used in introductory algebra. This difficulty leads to a failure to understand the true nature of a polynomial and precludes the further study of mathematics. Four objectives will be attained: (1) the student will learn to use "polyboxes" in order to understand the concept of a variable in a polynomial (the "polybox" is a visual device that replaces the variable "x" in a way that is visually more obvious than standard notation); (2) software for computer programs will be written to use "polyboxes" with a visual display on an interactive display terminal which includes feedback from a small computer; (3) students will use the software in lessons devised as a module for classroom instruction or self-paced instruction to learn the manipulation of basic polynomials and to obtain a better understanding of the nature of a polynomial; and (4) the module, consisting of five lesson plans including the typical teacher aids of performance objectives and tests and written in a programmed learning self-paced mode, will be prepared and packaged. This project is geared to the 11th and 12th grade student taking algebra and/or the junior college student or college freshman taking introductory college algebra. The evaluation and dissemination will take place in a pilot classroom with students and in a workshop with secondary school teachers of algebra. Teachers will evaluate this project relative to the usefulness of the module in their individual classrooms.

AMOUNT: \$34,106  
AWARDED: 09-02-80  
TERMINATES: 02-28-83

AWARD NUMBER: SED80-12518  
NSF PROGRAM MANAGER:  
Harold J. Stolberg  
PROGRAM: Development in  
Science Education

DISCIPLINE: Software Systems/Computer Science;  
Algebra or Number Theory/Mathematical  
Sciences  
TARGET AUDIENCE: Grades 11-12; Two-year College Students; College Freshmen

**DESCRIPTORS:**

**Computer Assisted Instruction; Undergraduates; Algebra; Instructional Materials; Symbols (Mathematics); Mathematical Concepts; High School Students; Concept Formation; Visual Aids; Visual Stimuli**

## Curriculum Analysis and Student Interrogation and Information System

Ernest J. Henley  
University of Houston  
Central Campus  
Houston, TX 77004

This project will produce an information system to permit the shifting from a mode of instruction based on courses to one based on selections from a bank of several thousand modules. These modules are single-concept and lecture-length packages of readings, exercises, and computer programs. This shift is intended to provide opportunities for curriculum planning on a highly individualized basis, for course reorganization based on evidence, and for greatly increased opportunities for independent study and self pacing. A key element is nationally accessible computer-based information and management programs designed for the following purposes: (1) to allow sharing of materials by authors in many universities; (2) to indicate needed materials to prospective authors; (3) to advise students on appropriate learning sequences; and (4) to assist teachers in curriculum restructuring. During the first two years some elements of the system have been created: a Data-Based Management System (accessible to universities through telephone links) has been used to enter the abstracts of 154 modules; a computer-based student advising system on course sequencing is under trial at the University of Kansas; the computer-moderated analysis of alternative learning paths based on sequences of key terms is being simulated.

During the third year of this four-year project, the above programs will be integrated on the basis of a larger collection of materials and trial uses.

AMOUNT: \$225,960\*  
AWARDED: 06-01-77  
TERMINATES: 03-31-81

AWARD NUMBER: SED76-21950  
NSF PROGRAM MANAGER:  
Gregg Edwards  
PROGRAM: Development in  
Science Education

DISCIPLINE: Software Systems/Computer Science  
TARGET AUDIENCE: Undergraduates  
DESCRIPTORS: Information Networks; Dial Access Information Systems; Planning;  
Curriculum Planning; Educational Alternatives; Learning Modules;  
Autoinstructional Aids; Data Bases; Information Retrieval

\*Cumulative amount. Fiscal Year 1980 award: \$50,000

## Using Non-Formal Contexts to Teach Children Science

Howard L. Jones  
University of Houston  
Central Campus  
3800 Calhoun  
Houston, TX 77004

To enhance the interest of adolescents in science, this project will develop 11 supplemental physical science miniunits for use in junior and senior high schools. The units will focus on physics and mathematics concepts associated with experiences in amusement parks and playgrounds. Topics covered in the mini-units include motion, acceleration, relativity, forces, gravity, time, graphing, conservation of energy, and frames of references. Each mini-unit will provide interrelated instruction both in the classroom and in amusement park settings. Teachers' and students' guides, audiovisual materials, and inexpensive measuring devices will be developed for use with each of the mini-units. An additional outcome of the project will be a series of research reports that will focus on the impact of amusement park experiences on adolescents' science knowledge and attitudes. The miniunits will be pilot tested in selected classrooms in Houston and other locations. An ethnographic evaluation of classroom interactions will be applied formatively to aid in the development of instructional materials. It is planned that all materials will be made available commercially. Articles will be submitted to appropriate professional journals.

AMOUNT: \$293,400  
AWARDED: 08-11-80  
TERMINATES: 02-29-84

AWARD NUMBER: SED80-16566  
NSF PROGRAM MANAGER:  
Carl J. Naegele  
PROGRAM: Development in  
Science Education

DISCIPLINE: Physics, General,  
Mathematics, General/Mathematical Sciences  
TARGET AUDIENCE: Adolescents, Grades 7-12  
DESCRIPTORS: Science Activities; Science Materials; Instructional Materials;  
Supplementary Education; Recreational Facilities; Parks; Recreation;  
Physics Instruction; Playgrounds; Mathematical Concepts; Field Trips;  
Experiential Learning; Activity Units; Sensory Experience

## **Mental Errors in Arithmetic Skills: Their Diagnosis and Remediation in Pre-College Students**

C. Victor Bunderson  
WICAT, Inc.  
Learning Design Laboratories  
1160 South State, Suite 10  
Orem, UT 84057

This project will study methods of diagnosing consistent mental errors (termed cognitive bugs) exhibited by students in elementary arithmetic, the frequency and stability of such errors, and ways to remediate the errors using a microcomputer. Three populations will be involved in the study: third to fifth graders in Orem, Utah; fourth to sixth graders in Salt Lake City (including students from the middle class, urban poor, and minority groups); and teenaged juvenile delinquents in Salt Lake City alternative schools. The objectives include the following: (1) to develop cognitive diagnostic models and tests in subtraction, multiplication, and addition of fractions; (2) to obtain data to determine the need for computerized diagnostic testing for each of the three areas; (3) to develop, if the cognitive bugs are frequent enough and stable, microcomputer-based diagnostic tests to follow paper and pencil screening tests; and (4) to develop micro-computer-based remediation programs to structure a remedial interchange between a student and tutor.

The diagnostic and remedial programs will be evaluated in field experiments. The materials will be made available to interested parties upon request. Research findings will be disseminated via presentation at national conferences and publication in professional journals.

AMOUNT: \$141,544\*  
AWARDED: 09-09-80  
TERMINATES: 08-31-82

AWARD NUMBER: SED80-12500  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics, General/Mathematical  
Sciences  
TARGET AUDIENCE: Grades 1-12

**DESCRIPTORS:**

**Error Patterns; Educational Diagnosis; Arithmetic; Learning Problems;  
Remedial Programs; Remedial Arithmetic; Computer Assisted  
Instruction; Diagnostic Teaching; Diagnostic Tests; Microcomputers**

- **Funded in part by the Research in Science Education (RISE) Program.**

## Computer Literacy Guides for Elementary and Junior High Schools

Beverly Hunter  
Human Resources Research Organization (HumRRO)  
Eastern Division  
300 North Washington Street  
Alexandria, VA 22314

This project will enable schools to infuse computer-related skills and knowledge into the traditional curriculum of elementary and junior high school science, social studies, and mathematics. This literacy project will concentrate on the computer, which has become a popular symbol of modern science and technology. The goal is to enable all students, kindergarten through junior high school, to acquire minimal computer-related skills required in their role as citizens in our information-based society.

The project will begin with a national invitational conference coordinated through a related project (SED79-18987) by the Minnesota Educational Computing Consortium (MECC). The conference will further develop course objectives and establish advisory committees.

The MECC project will concentrate on the development of student materials for use as supplementary or course-length modules in middle school or high school. The HumRRO materials are for teachers in grades K-8.

A curriculum kit will be developed and tested. The kit will spell out a developmental sequence of literacy learning outcomes by grade level, subject area, and unit. For each learning outcome, a set of classroom activities and resource materials will be suggested. Guides for equipment planning, teacher training, and implementation of the program will also be developed. The learning outcomes will be defined by a panel of experts. Fifty K-8 teachers and subject specialists will identify scope and sequence. HumRRO staff will prepare the kits. Montgomery County, Maryland, schools will try out the package in the classroom, and monitored field tests will be conducted in two dissimilar school districts. The package will be disseminated through professional societies and will be offered for commercial publication.

AMOUNT: \$216,755  
AWARDED: 04-18-80  
TERMINATES: 09-30-83

AWARD NUMBER: SED79-23684  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in  
Science Education

**DISCIPLINE:** Science Education  
Software Systems/Computer Science

**TARGET AUDIENCE:** Grades K-8

**DESCRIPTORS:** Learning Processes; Learning Activities; Instructional Materials;  
Curriculum Development; Elementary School Curriculum; Computer  
Science Education; Computer Oriented Programs; Science Instruction;  
Mathematics Instruction; Social Studies

## Graphing in High School Level Algebra and Trigonometry for Adults

J. Richard Morris  
Virginia Commonwealth University  
901 West Franklin Street  
Richmond, VA 23284

A software package of 15 to 20 graphing lessons intended for use on a computer graphics terminal will be developed by three members of the Mathematical Sciences Department at Virginia Commonwealth University. This package will be used by students on an individual and personalized basis with the help of a qualified teaching assistant. This software will augment existing courses in elementary algebra, intermediate algebra, and trigonometry. The content of these courses is the same as that found at grade levels 10 through 12. Each lesson in the software package will be written so that the student is an active participant in the graphing process.

Appropriate testing will take place at each stage of development to insure the effectiveness of the graphing lessons. When the software is complete, a control group and an experimental group will be selected from among the groups of students of age 25 or over. Both student achievement and attitude will be assessed. Guidelines established by CONDUIT will be used as a basis of project organization and management. The software and the new knowledge which result from the project will be disseminated.

AMOUNT: \$55,494\*  
AWARDED: 07-09-80  
TERMINATES: 12-31-82

AWARD NUMBER: SED80-12447  
NSF PROGRAM MANAGER:  
Dorothy K. Deringer  
PROGRAM: Development in Science  
Education

DISCIPLINE: Software Systems/Computer Science;  
Mathematics, General/Mathematical Sciences  
TARGET AUDIENCE: Undergraduates; Continuing Education Students  
DESCRIPTORS: Mathematics Education; Algebra; Trigonometry; Computer Assisted  
Instruction; Adult Students; Computer Graphics; Individual Instruction;  
Instructional Materials; Graphs; Microcomputers

\* Funded in part by the National Institute of Education.

## **Geometric Visualization: Dynamic Graphics to Develop Mathematical Perception and Intuition in Pre-Calculus Students**

Gerald L. Isaacs  
Carroll College  
100 N. East Avenue  
Waukesha, WI 53186

This project is a joint effort between Carroll College and the Waukesha Public School System. Its primary purpose is to improve the teaching of pre-calculus courses through the introduction of Geometric Visualization Techniques using the graphics capabilities of low-cost microcomputers and television displays. The approach will be to promote understanding, using geometric representation and interpretation. An equally important goal is to introduce a prototype for designing graphics software to be used throughout mathematics and science education. This software will be designed in such a way as to be easily transported across hardware, graphics devices, and dialects of BASIC. The project revolves around the concept that there are many topics in mathematics that can be better presented and understood with the aid of dynamic graphics. To insure widest possible use, the software will be designed so that the instructor need only turn on the machine and start the program. The package would then present the material in English with appropriate prompts and a clear indication of the options available at each step. The project will be discussed at national meetings, papers will be submitted to professional journals, and the courseware and documentation will be disseminated initially through Carroll College and CONDUIT.

AMOUNT: \$149,327  
AWARDED: 08-22-80  
TERMINATES: 08-31-82

AWARD NUMBER: SED80-12457  
NSF PROGRAM MANAGER:  
Harold J. Stolberg  
PROGRAM: Development in  
Science Education

DISCIPLINE: Mathematics Education;  
Software Systems/Computer Science  
TARGET AUDIENCE: Grades 9-12; Undergraduates  
DESCRIPTORS: Programming; Mathematics Instruction; Secondary School Mathematics;  
Mathematical Concepts; Computer Graphics; Computer Assisted  
Instruction; Televised Instruction; Instructional Technology;  
Microcomputers; Geometric Concepts

## **Factors Influencing Mathematics Participation of Highly Able Mexican-American Adolescents**

Linda M. Oldaker  
Arizona State University  
Tempe, AZ 85281

This study will investigate the social/emotional and cognitive factors influencing decisions of Mexican-American secondary school students to avoid or persist in mathematics training. The team of investigators includes a mathematics educator, a mathematician, and a social scientist. They will design or obtain instruments to measure which factors are influential in a student's decision to persist in mathematics. The study will test the following categories of variables: (1) family-related variables; (2) significant others; (3) career consciousness; (4) attitudes toward mathematics; (5) cognitive styles; and (6) language-related variables. Pertinent demographic and academic data also will be obtained. The sample will consist of 450 students in grades 8, 9, and 10. The data will be analyzed using path analysis techniques to test the degree of influence of decision-related variables. Articles will be prepared for publication in various journals and presented at meetings.

AMOUNT: \$148,966  
AWARDED: 08-15-80  
TERMINATES: 07-31-82

AWARD NUMBER: SED80-17768  
NSF PROGRAM MANAGER:  
Douglas McLeod  
PROGRAM: Research in Science  
Education

DISCIPLINE: Mathematics, General/Mathematical Sciences  
TARGET AUDIENCE: Grades 8-10  
DESCRIPTORS: Mathematics; Secondary School Mathematics; Minority Groups; Mexican-Americans; Student Attitudes; Racial Attitudes; Social Factors; Instrumentation; Career Planning; Cognitive Processes; Mathematics Anxiety

## Research to Promote Science Learning Among Blind Students in Colleges and Universities

Morris Sica  
California State University  
Fullerton, CA 92634

The intent of this project is to ascertain factors which help and factors which hinder blind students' progress in science at the college level. It will proceed in two phases. In Phase I, five blind persons will be trained to conduct interviews with 90 blind students in California colleges. These interviewers will have had some experience in science. Critical incidents that blind students describe as positive will be probed to determine the attributes of instruction judged to be helpful to learning. Instructional methods which seem to hinder the learning process will be identified. Science instructors who have had blind students in their science classes will also be interviewed with a similar objective; namely, to discover the attributes of successful and unsuccessful strategies. A principal consultant to the project is a blind biology teacher. A content analysis of the critical incidents provided by both students and teachers will be the basis for developing characteristics of successful and less successful conditions for science learning by blind students. One product of this research will be a report that identifies the main factors that need to be considered in teaching science to the blind. Some better understanding of how blind students acquire science concepts is expected to emerge. A set of questions to be investigated under more controlled circumstances will be another product of the study. If the results indicate that the proposed methodology is an effective way to do the research, a more extensive study may be proposed.

AMOUNT: \$30,682  
AWARDED: 01-18-80  
TERMINATES: 03-31-81

AWARD NUMBER: SED79-20597  
NSF PROGRAM MANAGER:  
Kathleen M. Fisher  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Handicapped; Undergraduates  
DESCRIPTORS: Blindness; Disabilities; Cognitive Processes; Scientific Concepts; Science Literacy; Learning Problems; Instructional Improvement; Students; Interviews; Evaluation Methods; Handicapped

## Science Education for Women, Minority, and the Physically Handicapped Students in Community Colleges

Arthur M. Cohen  
Center for the Study of Community Colleges  
1047 Gayley Avenue, Suite 205  
Los Angeles, CA 90024

The objective of the project is to describe intervention strategies that will allow colleges to remove barriers and to develop incentives for the participation of minorities, women, and the physically handicapped in science.

This project will study and describe the course-taking patterns, science background, and attitudes toward science of women, minority, and physically handicapped students. It will also examine the institutional patterns that inhibit or enhance science enrollments and analyze the interaction among these variables in the Los Angeles Community College District, which comprises nine colleges with markedly different proportions of ethnic enrollments. As such, this study addresses an important national problem: the underrepresentation of minorities, women, and the physically handicapped in the sciences. Many reasons have been advanced for this situation and many college programs have been developed to remedy this inequity. However, the mechanisms by which college students are attracted to the study of science are not clearly understood.

Data will be gathered through five activities: student surveys; transcript analyses; instructor surveys; tabulation of science course offerings listed in college catalogs and class schedules; and staff interviews. These data will be synthesized through the development of a College Orientation Toward Science index and a Student Orientation Toward Science index.

AMOUNT: \$189,546  
AWARDED: 10-19-79  
TERMINATES: 12-31-82

AWARD NUMBER: SED79-20222  
NSF PROGRAM MANAGER:  
Kathleen M. Fisher  
PROGRAM: Research in Science  
Education

DISCIPLINE: Science Education; Multidisciplinary  
Sciences  
TARGET AUDIENCE: Females; Minorities  
DESCRIPTORS: Women's Education; Sex Bias; Educational Attitudes; Social-Bias;  
Ethnicity; Minority Groups; Scientific Attitudes; Learning Motivation;  
Handicapped Students; Instructional Improvement

## A Longitudinal Study of Women and Minorities in Science and Engineering

Rita A. Scherrei  
Higher Education Research Institute  
924 Westwood Boulevard, Suite 835  
Los Angeles, CA 90024

This is a study of factors which bear on retention of minorities and women in science and technology. The population consists of a national sample of 50,000 persons who as college freshmen in 1971 completed a survey questionnaire at the time of entry. They were re-surveyed in 1979-80. Those who aspired to careers in science, engineering, or mathematics will be the focus of this investigation. In addition, those who later migrated into one of these fields will be studied. An attempt will be made to identify conditions that improve the likelihood of retention and to clarify the conditions which appear to function as barriers. The investigation will show whether the patterns are the same for Blacks and Hispanics and women, or whether there are features unique to each group. To validate the findings from the large data base analyses, a sample of respondents from each segment of the study will be selected for more in-depth interviews. The study is expected to contribute information which will be useful to career counselors and for the planning of continuing education beyond the baccalaureate.

AMOUNT: \$49,542  
AWARDED: 08-15-80  
TERMINATES: 05-31-82

AWARD NUMBER: SED80-17651  
NSF PROGRAM MANAGER:  
Kathleen M. Fisher  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Grades 9-12; Undergraduates; Graduate Students; Females; Minorities  
DESCRIPTORS: Women's Studies; Minority Groups; Science; Technology; Engineering;  
Mathematics; Questionnaires; Longitudinal Studies; Continuing  
Education; Career Change; Career Choice; College Students; Interviews;  
Career Planning

## **Learning Science in Bilingual Classrooms: Interaction and Social Status**

**Elizabeth G. Cohen**  
**Stanford University**  
**School of Education**  
**Stanford, CA 94305**

This research applies an established sociological theory, Expectation Theory, to the analysis of the processes of learning science in bilingual elementary classrooms (grades 2-4). The science program materials are especially developed for bilingual instruction and stress experiential learning. In the context of a predominantly interaction-based science program, the content, nature, and quality of child-child and child-teacher encounters is a salient feature, and hypotheses from Expectation Theory regarding status, engagement in learning, and achievement need to be investigated. If it can be shown that academic status is operating to depress interaction and science learning for poor readers, then responses addressed to this problem can be instituted. Nine schools in five districts are involved in a bilingual science program of 15 weeks' duration. Results of the research will have implications for both theory and practice.

**AMOUNT:** \$78,733  
**AWARDED:** 06-20-80  
**TERMINATES:** 02-28-82

**AWARD NUMBER:** SED80-14079  
**NSF PROGRAM MANAGER:**  
Kathleen M. Fisher  
**PROGRAM:** Research in Science  
Education

**DISCIPLINE:** Science Literacy/Education.  
**TARGET AUDIENCE:** Grades 2-4; Bilingual Students  
**DESCRIPTORS:** Science Education; Bilingual Students; Bilingual Education; Predictor Variables; Group Status; Academic Achievement; Interaction Process Analysis; Ethnic Studies; Social Experience; Experiential Learning

## Improving Students' Comprehension of Science Prose

Richard E. Mayer  
University of California at Santa Barbara  
Santa Barbara, CA 93106

The major goal of this project is to determine how to increase students' understanding of scientific prose by developing presentation formats (such as the use of redundancy or analogy) and training in reading strategies (such as identifying key ideas or restating the relations expressed) that are specific to domains in science. Understanding is defined in terms of a student's ability to use the presented information in problem solving. This project will use the prose analysis techniques of cognitive psychology in order to specify the structure of various domains of science prose. Specific issues are addressed: (1) Are there characteristic prose structures for different domains in science? (2) What do good problem solvers know after reading a text that poor problem solvers do not pick up? (3) Does emphasis on the structure and critical features of a science passage influence subsequent problem solving performance? (4) Does training in specific domain-related reading strategies influence subsequent problem solving performance? This project is directed especially at undergraduate students who normally do not perform well in science.

AMOUNT: \$59,252  
AWARDED: 08-15-80  
TERMINATES: 08-31-83

AWARD NUMBER: SED80-14950  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Undergraduates  
DESCRIPTORS: Reading Processes; Cognitive Processes; Reading Comprehension;  
Reading Skills; Prose; Problem Solving; Learning Theories; Science  
Instruction; Science Materials; Scientific Concepts; Reading Diagnosis;  
Reading Ability

## **Logical Competencies and Activity Selection Patterns in Early Adolescents: A Longitudinal Study**

James T. Robinson  
Biological Sciences Curriculum Study Company  
P.O. Box 930  
Boulder, CO 80306

The purpose of this project is to make available to researchers evaluation and research data from the Human Sciences Program (HSP). The data base is longitudinal in character and contains information on choice behavior, attitudes, and achievement of adolescent students in human science. The availability of this data source will provide researchers with an opportunity to test hypotheses concerning the contribution of curriculum variables and student variables to growth in biological knowledge, logic, and attitudes toward science.

This project has two parts: (1) to prepare archive data tapes for data collected in conjunction with the development and testing of the HSP modules; and (2) to trial test the tapes and their transferability by running some analyses which would then be subject to peer review. A Statistical Package for the Social Sciences (SPSS) archive file of data collected for nearly 1,000 students who used 15 HSP modules will be prepared. These data include logic test scores, attitude scales, achievement test item responses, activity evaluation ratings, questionnaire responses, and the biographical data. Data are available for 1974 through 1976.

**AMOUNT:** \$126,976  
**AWARDED:** 03-31-80  
**TERMINATES:** 09-30-81

**AWARD NUMBER:** SED79-19312  
**NSF PROGRAM MANAGER:**  
Rita W. Peterson  
**PROGRAM:** Research in Science  
Education

**DISCIPLINE:** Biology, General/Life and Medical Sciences  
**TARGET AUDIENCE:** Adolescents  
**DESCRIPTORS:** Data Bases; Longitudinal Studies; Attitudes; Adolescents; Biology; Achievement; Scientific Attitudes; Behavior Patterns; Curriculum Research; Evaluation Methods

## The Status of Middle School/Junior High School Science

Paul DeHart Hurd  
Biological Sciences Curriculum Study Company  
Center for Educational Research and Evaluation  
P.O. Box 930  
Boulder, CO 80306

The purpose of this project is to analyze and describe the present status of middle school/junior high science instruction in the United States and, from this synthesis, to propose characteristics for effective science instruction for grades 6 to 9 for the 1980s.

The research procedure includes an analysis and synthesis of existing data that describe the condition of middle school/junior high science instruction for two distinctly different periods in science education: 1965-70 and 1975-80. The principal data sources for the earlier period will be science texts and several national surveys of middle school/junior high school science instruction. The primary sources for the later period will be the three NSF-funded status studies of precollege education and data for 13-year-olds of the 1978 National Assessment of Educational Progress science study. Science instruction research data for middle school/junior high for the period 1965-80 will also be synthesized. Interpretations will incorporate the rationale of the middle school and changes and trends in the scientific enterprise that should be considered for effective science instruction at these levels. The results of the study will be presented in a variety of formats for different audiences (middle school/junior high teachers and administrators, the public, the NSF, and science educators). Recommendations for further research will be derived from gaps and discrepancies in the data.

AMOUNT: \$119,962  
AWARDED: 09-16-80  
TERMINATES: 06-30-82

AWARD NUMBER: SED80-15816  
NSF PROGRAM MANAGER:  
Raymond J. Hannapel  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Grades 6-9  
DESCRIPTORS: Science Programs; Surveys; Middle Schools; Science Instruction; Science Courses; Junior High Schools; Curriculum Planning; Science Curriculum; Synthesis; Comparative Analysis; Evaluation

## **Research in Science Education: New Questions, New Directions**

James T. Robinson  
Biological Sciences Curriculum Study Company  
Center for Educational Research and Evaluation  
P.O. Box 930  
Boulder, CO 80306

An invitational conference for science educators and scientists will explore three new areas of research of potential interest to science educators engaged in training graduate students and science department chairmen interested in teaching and learning. The conference will examine the work of nine researchers, each with different approaches in separate but related fields. These include the analysis of curriculum materials, investigations of contextual factors in science classrooms, and investigations of student understandings of science. New approaches to research in science education will be discussed by small groups in the final symposium of the conference. Topics of discussion concern recent developments in the analysis of text materials with special emphasis on the text, the most used curriculum resource. Other topics addressed include new insights into the interactions of students, teachers, and curriculum materials based on ethnographic, ecological, and case studies in science classrooms. The papers presented at the conference will be published in a conference report to be made available to the science education community.

AMOUNT: \$25,628  
AWARDED: 08-15-80  
TERMINATES: 02-28-82

AWARD NUMBER: SED80-17531  
NSF PROGRAM MANAGER:  
Kathleen M. Fisher  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Teachers; Scientists; Graduate Students; Education Administrators  
DESCRIPTORS: Science Instruction; Science Curriculum; Instructional Materials;  
Content Analysis; Textbook Research; Classroom Research; Case  
Studies; Curriculum Research; Conferences; Context Clues; Reading  
Comprehension

## **An Expert-Novice Information Processing Study of Problem-Solving in Genetics**

Richard R. Tolman  
Biological Sciences Curriculum Study Company  
Center for Educational Research and Evaluation  
P.O. Box 930  
Boulder, CO 80306

This is a pilot study of the mental processes and structures used in solving problems in genetics. These processes and structures will be inferred from intensive observations of both experts and novices (in genetics) as they work on such problems. The novices will consist of students from several nearby high schools. Teachers and researchers from the field of genetics will serve as the experts. The resulting descriptive "model" of problem solving, at several levels of expertise, will then be tested and refined with "new" groups of problem solvers. The end result of the research is hoped to be the beginning of a better understanding of human information processing in solving genetics problems. The results eventually could lead to more efficient instruction for students to help them understand the major concepts of genetics and be able to apply these concepts in an efficient manner in solving genetics problems.

**AMOUNT:** \$35,480  
**AWARDED:** 08-22-80  
**TERMINATES:** 02-28-82

**AWARD NUMBER:** SED80-17671  
**NSF PROGRAM MANAGER:**  
Erik D. McWilliams  
**PROGRAM:** Research in Science  
Education

**DISCIPLINE:** Genetics/Life and Medical Sciences  
**TARGET AUDIENCE:** Grades 9-12  
**DESCRIPTORS:** Genetics; Problem Solving; Cognitive Processes; Information Processing; Models; Comparative Analysis; Scientific Literacy; Observation; Science Instruction; Biology Instruction; Science Teachers

## Investigation of Critical Barriers to the Understanding of Science

David Hawkins  
University of Colorado  
Mountain View Center for Environmental Education  
Campus Box B-19  
Boulder, CO 80309

Experience over the years at the Mountain View Center has uncovered a problem common to children and adults in learning elementary concepts in science and mathematics. Because this type of problem displays a particular set of attributes, the principal investigator has labeled them "critical barrier phenomena." Critical barriers appear to arise because of a person's difficulties in making the transition in thought processes from "common sense views" of natural occurrences to scientific interpretations. When these barriers are overcome, the new understanding has been observed to give a powerful impetus to further learning.

The current investigation will attempt to clarify the concept of critical barriers to the understanding of science by university students within the instructional setting provided by a newly initiated program of interdisciplinary studies at the University of Colorado. The investigation also will include precollege teachers. The project director, a philosopher of science, will be joined by faculty in the natural and behavioral sciences and by staff of the Mountain View Center in research to identify and characterize these critical conceptual barriers. Initial work will concentrate on developing the methodology for documentation and analysis. An interdisciplinary seminar will contribute to theory development and to planning further empirical studies. Outcomes expected will include the beginning of a taxonomy of critical barriers to understanding science and a related set of instructional techniques to overcome these barriers.

AMOUNT: \$180,622  
AWARDED: 08-07-80  
TERMINATES: 08-31-82

AWARD NUMBER: SED80-08581  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Preschool; Grades K-12; Undergraduates; Graduate Students; Minorities;  
Teachers

**DESCRIPTORS:**

**Thought Processes; Concept Formation; Learning Processes;  
Experimental Teaching; Cognitive Development; Scientific Concepts;  
Scientific Literacy; Interdisciplinary Approach; Mathematics**

## **Analysis (Meta-Analysis) of Major Facets of Science Education**

Ronald D. Anderson  
University of Colorado  
School of Education  
Boulder, CO 80309

The purpose of this project is to conduct analyses of a wide range of topics in science education about which sufficient research has been done to produce some generalizations of use to practitioners. Meta-analysis is a statistical procedure for combining the findings of a large number of primary research results. It is an alternative to narrative research reviews that makes it possible to draw generalizations from large bodies of research. A compendium of findings will be prepared in book form. This work will also serve to validate other meta-analyses currently being funded in the RISE program. The research is expected to produce findings which will be useful to both teachers and researchers. For example, it will show in each subject area addressed in the project the relationship between types of teaching (e.g., inquiry vs. didactic; laboratory vs. demonstration) and science achievement, attitudes toward science, and critical thinking. Meta-analysis is a technique which allows one to discover patterns of relationships in what often appear to be a collection of studies with apparently conflicting outcomes. It has proved useful in fields as diverse as medicine and computer instruction for settling controversies and clarifying issues. Thus the research is expected to provide practical advice to teachers and administrators.

AMOUNT: \$191,935  
AWARDED: 06-20-80  
TERMINATES: 01-31-83

AWARD NUMBER: SED80-12310  
NSF PROGRAM MANAGER:  
Kathleen M. Fisher  
PROGRAM: Research in Science  
Education

DISCIPLINE: Science Education  
TARGET AUDIENCE: Grades K-12; Pre-School  
DESCRIPTORS: Science Education; Educational Research; Content Analysis; Research Utilization; Statistical Analysis; Teaching Methods; Critical Thinking

## Research into Important Factors Influencing Female Selection of First Optional Mathematics Courses

Alma Lantz  
University of Denver  
Denver Research Institute  
Denver, CO 80210

This research has examined the relative impact of relevant variables in the participation in elective mathematics courses within a theoretical framework provided by social psychology (utility, social exchange, cognitive consistency theories). The objectives have been threefold: to determine the relative importance of factors influencing math-related decisions so that the most important conditions may be addressed by future experimental interventions; to conduct a preliminary examination of the role of peer influence in making math-related decisions; and to provide a more sensitive instrument with which to measure the effects of future interventions.

Salient findings were obtained from the following separate rate samples (N = 521, N = 644, N = 253) to date: (1) males and females in these samples did not differ significantly in their intentions or in their actual participation in nonrequired mathematics courses; (2) many factors influenced course taking in nonrequired mathematics—subjective value of mathematics, liking for mathematics, confidence of success in mathematics, and mother's and father's encouragement; and (3) of these, the subjective value (utility of mathematics) was the most important for both sexes. On the whole, few sex differences were observed on these factors.

During this supplemental award period, the existing data will be analyzed to examine differences in participation in optional mathematics courses as a function of race/ethnicity, the level of mathematics currently being taken, and organizational/administrative variables within the school and/or district.

AMOUNT: \$69,150\*  
AWARDED: 09-15-78  
TERMINATES: 02-28-81

AWARD NUMBER: SED78-17103  
NSF PROGRAM MANAGER:  
Kathleen M. Fisher  
PROGRAM: Research in Science  
Education

DISCIPLINE: Mathematics Education  
TARGET AUDIENCE: Grades 9-12

**DESCRIPTORS:** Mathematics Instruction; Peer Acceptance; Minority Groups; Ethnic Studies; Cultural Differences; Elective Subjects; Social Psychology; Sex Differences

\* Cumulative amount. Fiscal Year 1980 award: \$19,860.

435

## Survey of Undergraduate Education in the Mathematical Sciences, 1980-81

Truman A. Botts  
Conference Board of the Mathematical Sciences  
1500 Massachusetts Avenue, NW, Suite 457-458  
Washington, DC 20005

Continuing its series of surveys made in 1965-66, 1970-71 and 1975-76 at five-year intervals, CBMS will make an in-depth survey and trend analysis of undergraduate education in the mathematical sciences in universities, four-year colleges, and two-year colleges. These studies produce detailed trend information on such factors as course enrollments, programs, facilities, and characteristics of faculty. This information is of importance primarily to departments and divisions of mathematical sciences in academic institutions. Also the findings can be used by individuals and industrial, governmental, and professional organizations concerned with the mathematical sciences. Like the earlier ones, this survey will be carried out under the direction of a broadly representative survey committee (eight persons) by an executive secretary and consultants, with technical advice and assistance and staff support at CBMS headquarters. The survey data will come primarily from responses to questionnaires sent to a statistically designed sample of departments in the mathematical sciences. After reduction and analysis of these data, the results will be published in a report publicized through announcements, articles, and panel discussions. It will be disseminated on a complimentary basis to responding departments in the sample and to others at cost.

AMOUNT: \$52,800  
AWARDED: 10-24-79  
TERMINATES: 05-31-82

AWARD NUMBER: SED79-19946  
NSF PROGRAM MANAGER:  
Douglas B. McLeod  
PROGRAM: Research in Science  
Education

DISCIPLINE: Mathematics, General/Mathematical Sciences;  
Mathematics Education  
TARGET AUDIENCE: Undergraduates; Graduate Students; Two-Year College Students

**DESCRIPTORS:**

**Undergraduate Study; College Mathematics; Mathematics Instruction;  
Trend Analysis; School Surveys; Colleges; Two-Year Colleges; Data  
Analysis; State-of-the-Art Reviews; Universities**

## Support of Certain Aspects of the 1980 International Congress on Mathematical Education

J. K. Goldhaber  
National Academy of Sciences  
2101 Constitution Avenue, NW  
Washington, DC 20418

The project is designed to assist in the financing of the 1980 International Congress of Mathematics Education (ICME-4) held in August 1980 in Berkeley, California. The week-long quadrennial congress is sponsored by the international Commission on Mathematical Instruction. Experts from a variety of countries discuss techniques of mathematics instruction. In particular, the congress provides an international forum for communication among researchers in mathematics education, elementary and secondary teachers, professors, technology specialists, curriculum developers, evaluators, and government officials regarding major issues and problems in mathematics education. Approximately 3,500 people attend the congress.

Through this award to the National Academy of Sciences, the financial agent of ICME-4, the National Science Foundation will join with private industry, private donors, and conference participants to help meet the costs of the congress. Primary expenditures involve production and mailing of announcements, program books, and the proceedings of the congress, along with some support for plenary speakers.

AMOUNT: \$50,000\*  
AWARDED: 11-16-79  
TERMINATES: 10-31-81

AWARD NUMBER: SED79-20903  
NSF PROGRAM MANAGER:  
Douglas B. McLeod  
PROGRAM: Research in Science  
Education

DISCIPLINE: Mathematics Education  
TARGET AUDIENCE: College Instructors; Teachers; Educational Researchers  
DESCRIPTORS: Mathematics Instruction; Mathematics Curriculum; Mathematics  
Teachers; Curriculum Development; Public Agencies; Meetings;  
International Educational Exchange; Financial Report; Private Agencies

\* Funded in part by the Information Dissemination for Science  
Education (IDSE) Program and by the Development in Science  
Education (DISE) Program.

## Effects of Elaboration Procedures on Learning and Retention of Scientific Principles

Robert M. Gagne  
Florida State University  
College of Education  
Tallahassee, FL 32306

A set of interrelated exploratory studies will be undertaken to test the effectiveness of several different kinds of learning elaboration procedures on the retention of scientific principles acquired from the Intermediate Science Curriculum Study (ISCS) and the Individualized Science instructional System (ISIS) modules and modifications of them. Sixth grade students of local schools will learn selected science principles under conditions which favor the following: (1) the use of images suggested by pictorial diagrams; (2) learner-generated images; and (3) episodes involving imaginal learner participation. The effects of these conditions will be contrasted with verbally directed learning and, when appropriate, with "hands-on" experience. The nature of knowledge to be investigated is procedural rather than declarative (factual). Retention is to be measured by tests previously of application to previously unencountered examples. In addition, a questioning instrument will be developed and tested to reveal differences in forms of mediation employed by the learners. Results are expected to have implications for the design and use of demonstrations and pictures in the learning of scientific scientific principles.

AMOUNT: \$82,064  
AWARDED: 08-05-80  
TERMINATES: 05-31-82

AWARD NUMBER: SED80-11281  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Grade 6  
DESCRIPTORS: Learning Processes; Retention; Cognitive Processes; Evaluation;  
Figurative Language; Verbal Learning; Visual Learning; Activity  
Learning; Testing; Scientific Principles; Science Curriculum; Scientific  
Methodology; Questionnaires

## The Microcomputer and Problem Solving Processes in Middle School Mathematics

Mary Grace Kantowski  
University of Florida  
College of Education  
343 Norman Hall  
Gainesville, FL 32611

A teaching experiment will examine processes used by middle school and junior high school students during the solution of nonroutine mathematics problems. Self-regulatory behavior (hint selection) is studied as students attempt to solve the problems. The students will be instructed in techniques useful in solving non-routine mathematics problems. Then 12 practice problems will be given on a microcomputer which will be programmed with hints for the solution of the problems. Hints available will include definitions and formulae, plans for solution with a path to follow, diagrams, and action on diagrams. Several additional possible paths to solution will be given for each problem after a student completes the work. Patterns of hint selection as well as preferred paths of solution will be noted. A post-test (without hints) will be administered, and processes used in solutions will be related to patterns of hint selection. Data will be collected from verbal and written protocols of student solutions or attempts to find solutions, and results will be reported in the form of descriptive statistics and anecdotal evidence of observed regularities. If students exhibit successful self-regulated behavior, the microcomputer could serve as a useful tool for reinforcement after initial instruction. Results will be reported at various meetings of mathematics teachers. Articles will be submitted to appropriate publications.

AMOUNT: \$140,342  
AWARDED: 09-11-80  
TERMINATES: 04-30-84

AWARD NUMBER: SED80-16561  
NSF PROGRAM MANAGER:  
Douglas B. McLeod  
PROGRAM: Research in Science  
Education

DISCIPLINE: Mathematics Education;  
Software Systems/Computer Science

TARGET AUDIENCE: Grades 5-9

DESCRIPTORS: Problem Solving; Computer Assisted Instruction; Middle Schools; Junior High School; Mathematics Curriculum; Computer Programs; Behavior Development; Adolescents; Cognitive Objectives; Microcomputers; Reinforcement

## **Analysis of the Child's Construction of Whole Numbers**

**Leslie P. Steffe**  
**University of Georgia**  
**Athens, GA 30602**

This project will use clinical observations to develop theoretical models that explain the acquisition of early number concepts.

This analysis will lead to conceptual models of a child's construction of numerical concepts and operations. These models will provide a solid foundation for the design of a curriculum that is compatible with and builds upon the child's cognitive processes and their natural development. The planned research involves the observation of primary school children during two school years. Teaching experiments will be developed to analyze how children acquire the followings; (1) the concept of numerosity ("manyness") as an attribute of whole numbers; (2) the ability to use counting to determine specific numerosities; (3) the ability to perform operations involving counting; (4) the use of strategies to find sums and differences (as opposed to the rote learning of number facts); and (5) the ability to count with tens and hundreds. In addition, a logical and philosophical analysis of children's construction of number concepts will be conducted.

The work of the project is concentrated on teaching and interviewing individual children to determine how they develop early number concepts and how they use these concepts to solve addition and subtraction problems. Videotapes of the teaching sessions and interviews will constitute the "raw data" for the analysis. Dissemination of the project's work will take place through professional organizations and publications.

**AMOUNT:** \$173,420  
**AWARDED:** 08-06-80  
**TERMINATES:** 02-28-83

**AWARD NUMBER:** SED80-16562  
**NSF PROGRAM MANAGER:**  
Douglas B. McLeod  
**PROGRAM:** Research in Science  
Education

**DISCIPLINE:** Mathematics, General/Mathematical Sciences  
**TARGET AUDIENCE:** Grades K-4  
**DESCRIPTORS:** Theoretical Models; Concept Formation; Classroom Observation Techniques; Mathematics Curriculum; Arithmetic; Mathematics Concepts; Mathematics Instruction; Number Concepts Development; Whole Numbers; Primary Education

## Applied Problem-Solving in Middle-School Mathematics

Richard Lesh  
Northwestern University  
Evanston, IL 60201

An iterative series of experimental case studies will investigate the mental and social processes used by students as they solve problems involving substantive mathematical content in realistic situations, working in small groups. A multidisciplinary research team will design the series of problems, and elicit, observe, and explicate the processes that middle school students use to solve them. The problems will be of a "project" nature, involving multiple stages and extending over a substantial interval of time. The mathematical concepts that will be required are those of number, elementary arithmetic, and measurement. The investigators are particularly concerned with identifying problem situation and procedures which will facilitate the learning of mathematics when administered by a classroom teacher. Prior to the end of the project, the effects and hypotheses will be tested on a sizable set of students in order to make predictions concerning the potential value of small group applied mathematics problem solving, and the possibilities for future development as well as research.

AMOUNT: \$198,581  
AWARDED: 08-04-80  
TERMINATES: 09-30-83

AWARD NUMBER: SED80-17771  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

DISCIPLINE: Mathematics, General/Mathematical Sciences  
TARGET AUDIENCE: Grades 5-7; Undergraduates; Graduates;  
DESCRIPTORS: Mathematics; Problem Solving; Cognitive Processes; Case Studies;  
Groups; interdisciplinary Approach; Concept Formation Mathematical  
Applications; Projects; Learning Processes; Social Factors; Middle  
Schools

## **Increasing the Productivity of Science Learning in Early Adolescents**

**Herbert J. Walberg**  
University of Illinois at Chicago Circle  
College of Education  
Box 4348  
Chicago, IL 60680

A field study will be conducted to test a generalized causal model of educational achievement applied to science education in early adolescence. The causal model employs educational, psychological, and sociological constructs within a framework of an econometric production function. The research team, with advice from leading science educators, specialists in early adolescence, mass media, and home environment will perform the following: (1) refine the model of educational productivity by using nine precisionally identified constructs; (2) summarize recent meta-analysis education research on determinants of learning; (3) design a field test to probe the model and provide best estimates of causal effects; (4) develop measures of the constructs; (5) incorporate randomized interventions of the constructs, in seventh grade science classes in the Chicago metropolitan areas; (6) execute a data analysis plan to identify the determinants of science achievement; and (7) develop a series of guidelines for increasing the productivity of science education in the early adolescent years.

**AMOUNT:** \$240,814  
**AWARDED:** 06-18-80  
**TERMINATES:** 07-31-83

**AWARD NUMBER:** SED80-07804  
**NSF PROGRAM MANAGER:**  
Andrew R. Molnar  
**PROGRAM:** Research in Science  
Education

**DISCIPLINE:** Science Literacy/Education  
**TARGET AUDIENCE:** Grade 7  
**DESCRIPTORS:** Science Education; Models; Predictor Variables; Academic Achievement; Cognitive Ability; Environmental Influences; Scientific Literacy; Social Factors

## A Synthesis of Findings on Sex Differences in Science Education Research

Martin L. Machr  
University of Illinois  
Institute for Child Behavioral Development  
Urbana, IL 61801

The literature concerning studies of sex differences in pre-college science learning will be reviewed, analyzed, and reported. Special attention will be given to differences across different fields of science, to the effects of prior instruction and abilities, and to the variation in these differences as a function of ages of the students, the date of the study, and the particular experimental designs that were used. Descriptive, empirical models will be developed which attempt to predict sex differences as a function of such variables. The findings are expected to have implications for future research.

AMOUNT: \$184,149  
AWARDED: 06-26-80  
TERMINATES: 12-31-82

AWARD NUMBER: SED80-07857  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Women; Grades 5-12  
DESCRIPTORS: Sex Differences; Women's Studies; Scientific Literacy; Science  
Instruction; Achievement Rating; Ability Identification; High Schools

## **Improving Access and Guidance in Engineering: Research into Contributing Factors**

**William K. LeBold**  
Purdue University  
Engineering Administration Building  
West Lafayette, IN 47907

The central purpose of this study is to provide new norms for the engineering scales of the Strong Vocational Interest Inventory (SVII) and the Purdue Interest Questionnaire (PIQ). Originally women and minorities were not included as a substantial factor in development of the engineering scales of these inventories and thus their widespread use in career counseling may be serving to limit access to careers in engineering by women and minorities. This research will supply updated, unbiased valid norms and will identify factors to consider in making effective use of such inventories with women and minorities. Populations in the study include working engineers in five fields. Factors which influence persistence, interest, career choice, and job satisfaction will be studied in order to provide a better basis for engineering counseling.

**AMOUNT:** \$141,426  
**AWARDED:** 06-17-80  
**TERMINATES:** 12-31-82

**AWARD NUMBER:** SED79-19613  
**NSF PROGRAM MANAGER:**  
Kathleen M. Fisher  
**PROGRAM:** Research in Science  
Education

**DISCIPLINE:** Engineering/Education  
**TARGET AUDIENCE:** Undergraduates; Minorities; Females; Grades 10-12  
**DESCRIPTORS:** Occupational Guidance; Engineering Education; Interest Scales; Bias; Test Validity; Minority Groups; Womens Education

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## **Computer Biology Simulations for High School Students to Stimulate Scientific Problem Solving**

Edward Vockell  
Purdue University - Calumet  
2233 171st Street  
Hammond, IN 46323

Research will be conducted to determine whether computer simulations of scientific problem solving enhance general problem solving skills and creativity among high school biology students. The simulations will be administered under two conditions: (1) no guidance (pure discovery learning); and (2) guidance. In addition, a control group which will receive no simulations will be used for comparison. To ascertain the effectiveness of the simulations in enhancing problem solving and creativity, comparisons of treatment groups and control groups will be made with standard problem solving tasks employed in cognitive psychology, a standardized test of scientific problem solving ability, and a standardized creativity test.

AMOUNT: \$74,955  
AWARDED: 08-22-80  
TERMINATES: 02-28-83

AWARD NUMBER: SED80-18948  
NSF PROGRAM MANAGER:  
Andrew R. Molnar  
PROGRAM: Research in Science  
Education

DISCIPLINE: Biology, General/Life and Medical Sciences  
TARGET AUDIENCE: Grades 9-12  
DESCRIPTORS: Biology; Problem Solving; Computer Assisted Instruction; Creativity;  
Student Creativity; Discovery Learning; Teacher Guidance; Test Results;  
High School Students; Simulation

## **Computer Assisted Data Analysis (CADA) for Teaching Bayesian Statistics and Applications for Research in Science Education**

Melvin R. Novick  
University of Iowa  
Iowa City, IA 52242

Computer-Assisted Data Analysis (CADA) is a conversational, interactive computer system that permits educational researchers to manipulate data sets and perform complex statistical analyses under computer guidance using Bayesian statistics.

The purpose of this project is to provide specialized, computer-based capabilities for the following: (1) statistical evaluation of science education programs; (2) construction and use of course-connected, criterion-referenced testing procedures in elementary and secondary schools; (3) direct on line statistical monitoring of scientific experiments; and (4) teaching of more advanced methods of Bayesian statistics relevant to the areas of educational evaluation, evaluation research, and decision making.

Procedures will be made available to handle the following statistical problems, among others: errors of measurement; non-random assignment; multivariate assessment of value; trait-treatment interaction; quantification of prior and collateral information; and formal statistical decisionmaking in the context of criterion-referenced testing. All new procedures will be made available on the CADA monitor. In addition, a greatly enhanced data management facility will be made available for CADA and a microprocessor version of CADA will be prepared.

AMOUNT: \$384,234\*  
AWARDED: 07-21-80  
TERMINATES: 09-30-83

AWARD NUMBER: SED80-06357  
NSF PROGRAM MANAGER:  
Andrew R. Molnar  
Dorothy Deringer  
PROGRAM: Research in Science  
Education

DISCIPLINE: Computer Systems Design  
TARGET AUDIENCE: Undergraduates  
DESCRIPTORS: Computer Assisted Instruction; Statistical Analysis; Bayesian Statistics;  
Computer Science; Evaluation Methods; Educational Assessment; Data  
Analysis; Testing; Science Education; Educational Researchers

\* Funded in part by the Development in Science Education (DISE) Program.

## An Inquiry into the Nature and Goals of Scientific Literacy

Stephen R. Graubard  
American Academy of Arts and Sciences  
Editorial Offices  
7 Linden Street  
Boston, MA 02101

Personal, social, and vocational need for scientific literacy is increasing in the modern world, yet observation and tests confirm that general education in science is not keeping pace with need.

Through this project, the American Academy of Arts and Sciences (AAAS) will initiate an inquiry into the nature and goals of scientific literacy. Using existing research, the Academy intends to create a new synthesis and conceptualization of scientific and technological literacy for the general public. The results of the effort will be published as a series of essays in DAEDALUS, the journal of AAAS. As has been the case with prior issues of this scholarly journal, the Academy aims to generate discussions that will ultimately influence people—in this case, men and women who make curricula and teach students, who write and publish, who determine what goes out on the television screens of the country, and who run the museums and adult education programs.

AMOUNT: \$260,521  
AWARDED: 06-20-80  
TERMINATES: 11-30-82

AWARD NUMBER: SED80-05975  
NSF PROGRAM MANAGER:  
Rita W. Peterson  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Grades 7-12; Undergraduates; Minorities; Females  
DESCRIPTORS: Scientific Literacy; Scientific Concepts; College Students; Secondary School Students; Seminars; Adult Education; Public Education

# The Development of Quantification Concepts: A Synthesis

Judah L. Schwartz  
Massachusetts Institute of Technology  
Division for Study and Research in Education  
77 Massachusetts Avenue  
Cambridge, MA 02139

This project will prepare a critical review and analysis of the literatures of several disciplines on the subject of the representation of quantifiers. The term "quantifier" is used to denote a broader concept of number and its development than is conventionally used by either linguists or mathematics educators. The review will include aspects of quantification which start with the development of children's natural language as they begin to understand quantitative aspects of their environment. Later formal learning at school will be included. A synthesis of theoretical models already suggested in the literature will be based on work related to counting processes and the solution of simple arithmetic problems, as well as other areas. Reaction time studies on the internal representation of numbers also will be included. In particular, the analog and digital models for the internal representation of numbers will be examined and developmental trends ascertained. The project will try to arrive at a unifying theoretical scheme which will account for the existing body of empirical data. Further possible lines of research will be suggested. Results will be reported through journals in mathematics education and psychology.

AMOUNT: \$69,586  
AWARDED: 08-08-80  
TERMINATES: 02-28-82

AWARD NUMBER: SED80-18390  
NSF PROGRAM MANAGER:  
Douglas B. McLeod  
PROGRAM: Research in Science  
Education

DISCIPLINE: Mathematics Education; Mathematics,  
General/Mathematical Sciences  
TARGET AUDIENCE: Pre-school; K-12; Undergraduates; Graduates  
DESCRIPTORS: Cognitive Processes; Number Concepts; Research Projects; Data  
Analysis; Mathematics Education; Literature Reviews

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# A Study Comparing Formal Algebraic Representations with "Natural" Mental Representations

James J. Kaput  
Southeastern Massachusetts University  
741 State Road  
North Dartmouth, MA 02747

Recent research (e.g., Clement and Lochhead, 1979; Kaput, 1980) has documented a very common and resistant misconception of the roles of variables in "simple" algebraic problems, which interferes strongly with algebraic solutions. Even those who have had considerable instruction and experience exhibit the problem. For example, some 25-30 percent of freshman engineering students tested at major universities wrote  $6 \cdot S = P$  instead of  $S = 6 \cdot P$  as the solution equation for the following problem: "Suppose that at a certain university there are six times as many students as professors. Using "S" as the number of students and "P" as the number of professors, write an equation that gives the relationship between the number of students and the number of professors." Careful interviews revealed that, in general, students understand the numerical relationship between the students and professors but have great difficulty expressing it properly algebraically. Among other things, they think of a symbol such as "S" as representing a student, rather than the number of students.

This project will study the extent and probable causes of this tendency in various contexts and in considerable detail. Contemporary core curricula in undergraduate mathematics will be surveyed for tasks that seem likely to elicit the error. Experiments will then be conducted to determine the actual extent of the problem in the mathematical tasks which the survey uncovers. The possible relationships between this tendency and more general mental representation phenomena (such as mental imagery) will be explored, with attention to individual differences. These findings will be related to developmental theories of reasoning, and the implications for instruction will be considered.

AMOUNT: \$114,085  
AWARDED: 08-29-80  
TERMINATES: 03-31-83

AWARD NUMBER: SED80-20020  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

1.00

Section II 143

**DISCIPLINE:**

Algebra/Mathematical Sciences

**TARGET AUDIENCE:**

Grades 9-12; Undergraduates

**DESCRIPTORS:**

Mathematics Instruction; Algebra; Concept Formation; Cognitive Objectives; Statistical Analysis; Symbols (Mathematics); Mathematical Concepts; Problem Solving; Cognitive Processes

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## Program of Applied Research on Scientific Reasoning Processes

Jack Lochhead  
University of Massachusetts at Amherst  
Amherst, MA 01003

A program will be established which integrates the study of knowledge structures and reasoning processes in the areas of physics and mathematics. The program will bring together research scientists, graduate students, and faculty from physics, cognitive psychology, computer science, mathematics, and education. Emphasis will be placed on processes which are critical to skilled performance in science and engineering but which, at the same time, extend beyond the range of current theories in cognitive science. Major research areas include the following: (1) investigation of reasons for the finding that many science-oriented college students do not fully understand the role that variables play in algebraic equations; and (2) analysis of patterns of non-deductive reasoning in the problem solving of expert scientists. A research cycle of interviewing, analysis, question redesign, and group testing will be used to isolate key misconceptions and reasoning patterns. Findings in these areas will have important implications for education and cognitive theory.

AMOUNT: \$382,240  
AWARDED: 07-30-80  
TERMINATES: 01-31-84

AWARD NUMBER: SED80-16567  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

DISCIPLINE: Physics, General; Mathematics, General/  
Mathematical Sciences  
TARGET AUDIENCE: Grades 9-12; Undergraduates  
DESCRIPTORS: Physics; Mathematics; Cognitive Processes; Problem Solving; Algebra;  
Learning Activities; Learning Processes; Testing; Abstract Reasoning;  
Engineering

## **Planning and Teaching Middle-School Science**

**Edward L. Smith**  
Michigan State University  
Science and Mathematics Teaching Center  
E-37 McDonel Hall  
East Lansing, MI 48825

Mismatches between teachers' planning processes and the content and organization of science program teachers' guides seem to limit the quality of science instruction at the middle school level. The objectives of this project are to test this idea by analyzing existing patterns in teachers' use of science program materials and their effects on instruction, teacher satisfaction and student learning, and analyzing the effects of an environmental intervention designed to promote a "mutual adaptation" process which involves modification of both teachers' guides and teachers' planning processes.

The proposed study addresses this problem in three phases: planning and teaching of science by 20 sixth grade teachers will be observed; student learning and teacher satisfaction will be measured and used to develop an experimental intervention; and four matched pairs of teachers (half of whom receive the intervention) will be studied intensively, using case study methods to document experimental effects on planning, instruction, teacher satisfaction, and learning.

**AMOUNT:** \$61,324  
**AWARDED:** 08-28-80  
**TERMINATES:** 02-28-82

**AWARD NUMBER:** SED80-20022  
**NSF PROGRAM MANAGER:**  
Erik D. McWilliams  
**PROGRAM:** Research in Science  
Education

**DISCIPLINE:** Multidisciplinary Sciences  
**TARGET AUDIENCE:** Grades 5-8  
**DESCRIPTORS:** General Science; Science Curriculum; Teaching Guides; Teacher Role; Instructional Materials; Middle Schools; Case Studies (Education); Curriculum Research; Educational Planning; Intervention

## Survey of Science Understanding and Attitudes

Wayne W. Welch  
University of Minnesota  
2642 University Avenue  
St. Paul, MN 55114

This project is a survey of science literacy of 9-, 13-, and 17-year-olds with particular focus on science and society factors. Three theoretical models that relate to schooling and demographic effects on science achievement, attentiveness to science, and attitudes toward science will be tested.

Data collection for the project will be conducted under the direction of the Education Commission of the States (ECS). The analysis of data for purposes of testing the three theoretical formulations will be the responsibility of the research team at the University of Minnesota. While the ECS/University of Minnesota collaboration will contribute to basic research, it will also provide data of great importance for decision making and policy setting purposes since one of the products will be a report on trends in science knowledge and attitudes since the National Assessment of Science in 1976-77. Documented data tapes and user code books will be prepared by ECS so that the data will be available for other researchers to use.

AMOUNT: \$140,000  
AWARDED: 09-17-80  
TERMINATES: 02-28-82

AWARD NUMBER: SED80-22125  
NSF PROGRAM MANAGER:  
Andrew R. Molnar  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Grades K-4; 9-12  
DESCRIPTORS: Scientific Literacy; Theoretical Models; Student Attitudes; Demography;  
Trend Analysis; Surveys; Evaluation; Social Factors; Social Influences;  
Decision Making; Test Results; Policy Formation

## **Geometric Thinking Among Adolescents in Inner City Schools**

Dorothy Geddes  
Brooklyn College and Research Foundation of CUNY  
Bedford Avenue and Avenue H  
Brooklyn, NY 11210

This project will investigate how Van Hiele's model of thinking in geometry applies to minority students in early adolescence in grades 6 and 9 and to teachers of students in these grades. Research on Van Hiele, and, more generally, on learning in geometry will be reviewed critically. Current geometry curriculum materials (grades 1-9) will be analyzed in terms of the Van Hiele model. Instructional modules for children, designed for use as research tools in a one-on-one setting and reflecting the levels of thinking of the Van Hiele model, will be developed and validated. In the clinical portion of this study, students engaged in learning experiences provided in the modules will be videotaped. Detailed analysis of the videotapes will provide insight into the level of thinking of students, difficulties at the levels, and thought processes involved. The project will also investigate whether preservice and inservice teachers can be trained to identify levels of geometry thinking of students and curriculum materials, and to select learning tasks accordingly. At the theoretical level, the findings of the project will have implications for further research of student thought processes in geometry as related to Van Hiele's levels of thinking. Implications of the results will be drawn for curriculum development, teacher training, and classroom practices for geometry instruction of early adolescents.

**AMOUNT:** \$192,680  
**AWARDED:** 10-25-79  
**TERMINATES:** 07-31-82

**AWARD NUMBER:** SED79-20640  
**NSF PROGRAM MANAGER:**  
Douglas B. McLeod  
**PROGRAM:** Research in Science  
Education

**DISCIPLINE:** Geometry/Mathematical Sciences  
**TARGET AUDIENCE:** Grades 6, 9; Teachers; Minorities  
**DESCRIPTORS:** Geometry; Minorities; Adolescents; Cognitive Measurement; Curriculum Research; Mathematics Curriculum; Geometric Concepts; Cognitive Processes; Urban Schools; Instructional Materials

## **Children, Television, and Science: A Detailed Description of Formative Research for 3-2-1 CONTACT**

Keith W. Mielke  
Children's Television Workshop  
One Lincoln Plaza  
New York, NY 10023

Two years of developmental or formative research preceded the premiere of the television science series 3-2-1 CONTACT. More than 50 studies involving 10,000 children were conducted in the process of preparing the first 65 half-hour shows. This project will provide an exhaustive description of the developmental research. It will identify the factors which seem to affect the appeal and comprehensibility of science materials on TV. The resulting document should be useful both to researchers and curriculum developers.

AMOUNT: \$9,420  
AWARDED: 09-05-80  
TERMINATES: 08-31-81

AWARD NUMBER: SED80-20774  
NSF PROGRAM MANAGER:  
Kathleen M. Fisher  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Grades K-8  
DESCRIPTORS: Media Research; Experimental Programs; Research Utilization;  
Television Curriculum; Television Programming; Educational Television;  
Mass Media; Television Research; Scientific Literacy; Science Materials;  
Children

## **Factors Related to Life-Long Learning for Scientists and Engineers: A Feasibility Study**

**Harold G. Kaufman**  
Polytechnic Institute of New York  
Division of Management  
333 Jay Street  
Brooklyn, NY 11201

This project will examine the feasibility of conducting a large-scale evaluation and synthesis of changes in motivation and thought processes in adults. Also it will investigate how life-long learning among scientists and engineers is affected by such changes. Published studies in developmental and organizational psychology and adult learning will be evaluated in order to identify pertinent findings. The study will determine the adequacy of the data base and analytical methods. Specific sources of data and valid methods for combining and analyzing them will be provided.

**AMOUNT:** \$70,000  
**AWARDED:** 10-22-79  
**TERMINATES:** 10-31-81

**AWARD NUMBER:** SED79-20376  
**NSF PROGRAM MANAGER:**  
Erik D. McWilliams  
**PROGRAM:** Research in Science  
Education

**DISCIPLINE:** Developmental Psychology  
**TARGET AUDIENCE:** Scientists; Engineers; Professional Continuing Education Students  
**DESCRIPTORS:** Cognitive Processes; Motivation; Evaluation Methods; Developmental Psychology; Social Science Research; Feasibility Studies; Scientists; Engineers; Learning Motivation; Lifelong Learning

## Wait Time and Questioning Skills of Middle School Science Teachers

J. Nathan Swift  
State University of New York at Oswego  
Oswego, NY 13126

Wait time, the duration of teacher pauses after questions, is an important variable in research on science teaching. This project will investigate the effects of increasing teachers' wait time on both teacher and student behavior. It will also clarify the relationship of wait time to general questioning skills in science teaching. In previous research, the influence of wait time training has been confounded with instruction in general questioning skills, making it difficult to test the hypothesis that increasing the wait time will by itself improve questioning skills. In this project, these variables will be separated through the use of four treatment groups made up of science teachers. One group will receive instruction in wait time using a newly developed electronic feedback device that monitors the duration of teacher and student pauses; a second group will receive instruction in general questioning skills; a third group will receive both types of instruction; and a comparison group will receive no instruction of either type. Audio tape recordings of classroom interaction will be analyzed in terms of teacher questioning behavior (including wait time as well as other variables) and student responses. Student attitudes and science classroom environment factors also will be assessed. Findings will be published in professional journals and presented at professional meetings.

AMOUNT: \$72,257  
AWARDED: 08-08-80  
TERMINATES: 03-31-82

AWARD NUMBER: SED80-15819  
NSF PROGRAM MANAGER:  
Douglas B. McLeod  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Grades 5-9  
DESCRIPTORS: Questioning Techniques; Middle Schools; Science Instruction; Science Teachers; Interaction; Student Attitudes; Student Behavior; Teacher Behavior; Reaction Time; Response Mode; Teacher Response

## **Classroom Process Variables in Urban Integrated Junior High School Individualized Science Programs**

Ann C. Howe  
Vernon Hall  
Syracuse University  
Department of Science Teaching  
Syracuse, NY 13210

This study examines the relationship of race, sex, and classroom process variables to learning in science. It is intended to yield data pertaining to individualized science instruction for minority and female students. Data will be collected by systematic observation of student and teacher behavior in 20 individualized science classes in five racially integrated urban junior high schools. Ten teachers and 160 students (randomly selected but equally divided according to race and sex) will be observed by trained graduate students and advanced undergraduate psychology majors. All teachers will use Intermediate Science Curriculum Study materials.

Topics to be addressed include the following: the use of classroom time by students and teachers; the nature of the interactions among students and between students and teachers; the relationships between these variables and students' characteristics of aptitude, sex, and race; and the relationship of these variables to student achievement.

Evaluation procedures include the administration of two individualized scholastic aptitude tests and a standardized achievement test. Science in-class achievement will be measured by teacher-test evaluations and responses to questions by observers.

Results of the study will be disseminated by presentation of papers at professional meetings, publication of articles in professional journals, and teacher workshops.

AMOUNT: \$70,670  
AWARDED: 08-06-80  
TERMINATES: 05-31-82

AWARD NUMBER: SED80-14209  
NSF PROGRAM MANAGER:  
Kathleen M. Fisher  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Females; Minorities; Grades 7-9  
DESCRIPTORS: Science Instruction; Classroom Communication; Classroom Research;  
Classroom Observation Techniques; Student Behavior; Teacher Behavior;  
Evaluation; Interaction; Achievement; Females; Sex Differences;  
Minority Groups

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## Structure of Knowledge and Cognitive Processes in Organic Chemistry

John E. Gordon  
Kent State University  
Kent, OH 44242

This project will investigate organic chemistry (OC) learning at the undergraduate level by conducting a parallel and interrelated set of theoretical, psychometric, and experimental studies. The basis of the current studies is provided by the principal investigator's earlier work on building a theoretical framework of OC learning that melds an analysis of the language of organic chemistry (LOC) with available knowledge from cognitive psychology, linguistics, second language learning, and formal logistic systems.

The *theoretical* study will formalize LOC, resolve its inconsistencies, extend its ability to describe classes of compounds, and identify inference rules used in OC. Among the latter, the logic and learning strategies for constructing chemical analogies will receive particular attention. The *psychometric* work will test intuitive ideas on the abilities needed in learning OC and investigate diagnostic/remedial instruments for the OC course, singling out stereo-chemical learning difficulties for special attention. The *experimental* portion investigates perceptual and learning strategies in four important and recurrent tasks of OC: categorization of structural formulas (SF); judging equivalence of SF; producing SF that satisfy strict formation rules; and use of generic notation for learning and applying chemical-reaction facts for entire classes of SF. Included in the experimentation are comparisons of algorithmic vs. discovery learning, visual vs. verbal strategies, and novice vs. practitioner behavior.

AMOUNT: \$291,136  
AWARDED: 08-07-80  
TERMINATES: 06-30-84

AWARD NUMBER: SED80-20159  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

DISCIPLINE: Organic Chemistry  
TARGET AUDIENCE: Undergraduates  
DESCRIPTORS: Organic Chemistry; Chemistry Instruction; Discovery Learning;  
Algorithms; Cognitive Processes; Measurement Instruments; Perception;  
Verbal Learning; Visual Learning; Student Behavior; Teacher Behavior;  
Science Curriculum; Curriculum Research

## **A Study of the Use of Time-Series Designs for Assessing the Development of Science Concepts in Adolescents**

Victor J. Mayer  
Ohio State University Research Foundation  
1314 Kinnear Road  
Columbus, OH 43212

Two experimental studies will be undertaken to validate the technique of time-series analysis applied to student achievement and attitudes in science education. One study will assess the effect of varying the frequency of assessment, ranging from daily to once each eight days. The other will assess the sensitivity of the technique to detecting differences in intellectual development. Time-series data will be compared with post-tests and student interview data from junior high school students studying crustal evolution in the classroom. The findings from the studies are expected to have implications for both instruction (in assessing class performance) and research (in assessing the effects of classroom interventions) in science.

AMOUNT: \$27,507  
AWARDED: 08-11-80  
TERMINATES: 02-28-82

AWARD NUMBER: SED80-16589  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

DISCIPLINE: Multidisciplinary Sciences  
TARGET AUDIENCE: Grades 7-9  
DESCRIPTORS: Time Factors (Learning); Achievement; Student Attitudes; Science Education; Evaluation Methods; Junior High School Students; Intervention; Educational Intervention; Science Instruction; Research Methodology

## **Mathematical Representations of Real-World Knowledge: Physics and Arithmetic Word-Problems**

Jill H. Larkin  
Carnegie-Mellon University  
Pittsburgh, PA 15213

Research will be conducted on human cognitive performance and learning in the domains of elementary and intermediate physics and in the related domain of using elementary arithmetic to describe real-world situations (word problems). The project will begin to provide an integrated theory of learning and of problem understanding in quantitative domains, building upon recent research in modeling problem solving in science and mathematics by computer program. Students at various levels of ability will be observed as they study about and practice solving problems in these three domains. The knowledge inferable from these behaviors will be modeled by computer programs, in order to provide an explicit theory of how such knowledge is developed and used. The project therefore has both theoretical and practical implications.

AMOUNT: \$344,401  
AWARDED: 09-10-80  
TERMINATES: 03-31-83

AWARD NUMBER: SED80-18264  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

DISCIPLINE: Physics, General; Mathematics Education  
TARGET AUDIENCE: Undergraduates  
DESCRIPTORS: Physics; Cognitive Measurement; Performance; Problem Solving;  
Academic Achievement; Mathematics; Computer Programs; Scientific  
Concepts; Cognitive Processes

## Factors that Influence the Technical Updating of Engineers

James L. Farr  
Pennsylvania State University  
University Park, PA 16802

This research is concerned with professional obsolescence among engineers. Factors affecting the technical updating of engineers will be examined from a theoretical perspective of motivation or expectancy theory. The theory models the behavior of engineers as they attempt to remain current in their fields. Organizational factors (policies, supervision, peers, work assignments, climate) are predicted to affect these behaviors, as are individual factors such as needs for achievement and growth. Data will be obtained in a two-year study of 800-1200 engineers and their supervisors employed at eight to 12 large industrial organizations. In one set of questionnaires, engineers will answer questions related to their perceptions of individual and organizational factors and technical updating. In a separate set, supervisors will evaluate the technical performance and updating activities of their subordinate engineers. This information will clarify the relationship among organizational and individual factors and the technical performance and updating of engineers. Within each data collection phase, correlational and regression techniques will be applied. Project results will be disseminated to academic, industrial, and governmental audiences through professional conferences and journals and in separate project publications.

AMOUNT: \$154,351  
AWARDED: 08-20-80  
TERMINATES: 03-31-83

AWARD NUMBER: SED80-19680  
NSF PROGRAM MANAGER:  
Douglas B. McLeod  
PROGRAM: Research in Science  
Education

DISCIPLINE: Engineering Education  
TARGET AUDIENCE: Engineers; Professional Continuing Education Students  
DESCRIPTORS: Engineers; Cognitive Processes; Professional Continuing Education;  
Expectation; Motivation; Improvement; Psychological Studies; Technical  
Education

# Semantics of Arithmetic: Teaching Understanding and Computational Skill Via Computer

Lauren B. Resnick  
University of Pittsburgh  
1028 Cathedral of Learning  
Pittsburgh, PA 15261

This project will use small computers to provide basic instruction in arithmetic. The instruction will connect performance of computational algorithms to understanding of the underlying mathematical principles. The instructional program will be based on principles derived from empirical study and theoretical analysis of an important part of elementary school mathematics, i.e., arithmetic procedures that depend upon a knowledge of place value. The program builds understanding of these procedures by helping the child develop detailed correspondences between two systems for representing numbers (using blocks as well as written notation) and arithmetic operations in those systems. The program will provide practical instruction, usable in classrooms at reasonable cost, as well as an opportunity to test the validity of a developing theory of the origin of arithmetic errors and ways of preventing these errors through meaningful instruction.

AMOUNT: \$152,256\*  
AWARDED: 07-09-80  
TERMINATES: 08-31-82

AWARD NUMBER: SED80-12511  
NSF PROGRAM MANAGER:  
Douglas B. McLeod  
PROGRAM: Research in Science  
Education

DISCIPLINE: Mathematics Education; Software Systems/  
Computer Science  
TARGET AUDIENCE: Grades 1-8  
DESCRIPTORS: Number Concepts; Learning Difficulties; Algorithms; Addition;  
Subtraction; Computer Graphics; Computer Assisted Instruction;  
Instructional Materials; Cognitive Processes; Units of Study (Subject  
Fields)

\* Funded in part by the Development in Science Education (DISE) Program.

## Conceptual Understanding of Physics Students and Influencing Factors - Phase II

James A. Minstrell  
Mercer Island School District  
4160 - 86th Avenue, S.E.  
Mercer Island, WA 98040

During the first 12 months of this project, originally funded in 1979, the director of this project studied two classroom phenomena: preconceptions which high school students have concerning principles of physics and the degree to which such preconceptions resist change during classroom instruction. Examples of such robust misconceptions which were studied include the following: (1) "Tables support objects, but they don't exert an upward force"; (2) "Air pressure is the cause of gravity"; and (3) "Electricity flows along a wire, and some flows out at each light bulb." The project director, a high school physics teacher, also experimented with instructional techniques to correct such misconceptions.

The additional support provided by this (1980) award will enable the project director to complete the analysis of the observations and disseminate the findings by preparing and publishing reports and making presentations at professional meetings of science teachers and science education researchers.

AMOUNT: \$32,503\*  
AWARDED: 08-15-79  
TERMINATES: 08-31-81

AWARD NUMBER: SED79-12824  
NSF PROGRAM MANAGER:  
Erik D. McWilliams  
PROGRAM: Research in Science  
Education

DISCIPLINE: Physics, General  
TARGET AUDIENCE: Grades 9-12  
DESCRIPTORS: Scientific Concepts; Physics Curriculum; High School Students; Science Instruction; Instructional Innovation; Secondary School Science; Physics Instruction; Concept Formation

\* Cumulative amount. Fiscal Year 1980 award: \$8,153.

## **SECTION III**

### **Fiscal Year 1979 and Earlier Years' Awards Project Titles and Principal Investigators by Program, and State and Institution**

## DEVELOPMENT IN SCIENCE EDUCATION

- Scientist-in-Residence in Eskimo/Indian High Schools A  
Raymond P. Bailey  
University of Alaska  
Fairbanks, Alaska 99701
- Development of a Mobile Spectroscopy Laboratory B  
T.D. Roberts  
University of Arkansas  
Fayetteville, Arkansas 72701
- Career-Oriented Degree Programs in the Mathematical Sciences with Emphasis on Practical Experience C  
Jerome Spanier  
Claremont University Center  
Claremont, California 91711
- Learner-Controlled Instructional Strategies: An Empirical Investigation D  
M. David Merrill  
Courseware, Inc.  
9820 Willow Creek Road  
San Diego, California 92131
- Exhibit Development Including a Linguistic Display Area E  
Robert Semper  
The Exploratorium  
3601 Lyon Street  
San Francisco, California 94123
- Development of a Coherent Series of Participatory Exhibits for the Palace of Arts and Science Foundation Exploratorium in San Francisco F  
Frank Oppenheimer  
Palace of Arts & Science Foundation  
San Francisco, California 94123
- Development of Instructional Modules on the Environment G  
John J. Holleman  
Peralta Community College District  
Oakland, California 94610

**The Guided Design Approach to Problem Solving: A Program For Training Junior High School Science Teachers**

Bernard Coyle  
San Francisco State University  
Frederic Burk Foundation for Education  
1640 Holloway Avenue  
San Francisco, California 94132

A

**University Level, Computer-Assisted Instruction (CAI) and Computer-Generated Speech in Mathematics**

Patrick Suppes  
Stanford University  
Stanford, California 94305

B

**Physical Science Activities in Out-of-School Settings for Early Adolescents and Their Families**

Alan J. Friedman  
University of California/Berkeley  
Berkeley, California 94720

C

**Activity-Based Education Programs for Small- and Medium-Size Planetariums**

Robert Karplus  
Lawrence Hall of Science  
University of California/Berkeley  
Berkeley, California 94720

D

**Development of Pilot Astronomy Activities for Informal Learning**

Robert Karplus  
University of California/Berkeley  
Berkeley, California 94720

E

**Materials and Strategies to Improve Women's Access to Scientific Careers**

Robert Karplus  
University of California/Berkeley  
M-II Wheeler Hall  
Berkeley, California 94720

F

**Outdoor Biology Instructional Strategies (OBIS)**

Watson M. Laetsch  
University of California/Berkeley  
Berkeley, California 94720

G

**Development of Reasoning Skills in Early Adolescence**

Alfred M. Bork  
University of California/Irvine  
Irvine, California 92717

A

**Role Models for Adolescent Girls in Science and Math**

Jane Permaul  
University of California/Los Angeles  
UCLA Office of Experimental Educational Programs  
405 Hilgard Avenue  
Los Angeles, California 90024

B

**An Urban Extension Service Model**

Perry Shapiro  
University of California/Santa Barbara  
Santa Barbara, California 93106

C

**Human Sciences Program (HSP): A Three-Year Integrated Human Sciences Curriculum for Middle Schools**

William V. Mayer  
Biological Sciences Curriculum Study Company  
P.O. Box 930  
Boulder, Colorado 80302

D

**Innovations: The Social Consequences of Science and Technology**

William V. Mayer  
Biological Sciences Curriculum Study Company  
P.O. Box 930  
Boulder, Colorado 80302

E

**Digital System Educational Materials (DISEM Project)**

Thomas A. Brubaker  
Colorado State University  
Fort Collins, Colorado 80523

F

**Quantitative Understanding to Enhance Social Science Teaching**

Irving Morrissett  
Educational Resources Center, Inc.  
Boulder, Colorado 80302

G

**Decision-Making Modules on Public Policy Issues of Science and Technology**

Irving Morrisett  
Social Science Education Consortium, Inc.  
855 Broadway  
Boulder, Colorado 80302

**A**

**Science, Society and the Senior Citizen: A Model Educational Program**

Robert Larkin  
University of Colorado  
Austin Bluffs Parkway  
Colorado Springs, Colorado 80907

**B**

**Secondary School Course in Applications of Mathematics to Science**

Madeline P. Goodstein  
Central Connecticut State College  
1615 Stanley Street  
New Britain, Connecticut 06050

**C**

**Undergraduate Education Improvement in Political Science: Innovation in Instructional Materials**

Sheilah K. Mann  
American Political Science Association  
Washington, DC 20036

**D**

**Outlines in Microbiology for Community and Junior Colleges**

Helen L. Bishop  
American Society for Microbiology  
Washington, DC 20006

**E**

**Teaching Materials in Microbiology**

Helen L. Bishop  
American Society for Microbiology  
Washington, DC 20006

**F**

**Teaching and Learning in Graduate Geography**

William D. Pattison  
Association of American Geographers  
Washington, DC 20009

**G**

Conservation Classroom Program (Advanced)  
Margaret Rosenberry  
National Wildlife Federation  
1412 16th Street, NW  
Washington, DC 20036

A

Individualized Science Instructional System  
Ernest Burkman  
Florida State University  
Tallahassee, Florida 32306

B

Toward Improved Candid Classroom Instructional Television: Guidelines for Program  
Evaluation and Production  
Charles Hutchinson  
Association for Media-Based Continuing Education for Engineers, Inc.  
Georgia Institute of Technology  
Atlanta, Georgia 30332

C

University Consortium to Increase National Effectiveness of Continuing Education for  
Engineers  
Charles R. Vail  
Association for Media-Based Continuing Education for Engineers, Inc.  
Georgia Institute of Technology  
Atlanta, Georgia 30332

D

Development of an Interactive Conversational Computer Model for Linear Programming  
John J. Jarvis  
Georgia Institute of Technology  
Atlanta, Georgia 30332

E

Family-Involving Science Education for Elementary School Children  
Michael E. Browne  
University of Idaho  
Moscow, Idaho 83843

F

Interactive Science Museum Exhibits for Preschool Children  
Theodore Ansbacher  
Museum of Science and Industry  
57th Street and Lake Shore Drive  
Chicago, Illinois 60637

G

- Development and Trial of an Integrated Undergraduate Science Major Program** **A**  
 Mark Pinsky  
 Northwestern University  
 Evanston, Illinois 60201
- Arithmetic and Its Applications** **B**  
 Zalman Usiskin  
 University of Chicago  
 Chicago, Illinois 60637
- Survey of Recent East European Literature in School and College Mathematics** **C**  
 Izaak Wirszup  
 University of Chicago  
 Department of Mathematics  
 Chicago, Illinois 60637
- Demo-Graphics: Teaching Population Dynamics in a Multi-disciplinary Framework with Interactive Visual Graphics** **D**  
 Paul Handler  
 University of Illinois  
 57 Coordinated Science Laboratory  
 Urbana, Illinois 61801
- Using Microcomputers to Teach Social Science in Junior and Senior High Schools** **E**  
 Paul Handler  
 University of Illinois  
 57 Coordinated Science Laboratory  
 Urbana, Illinois 61801
- A Computer Conferencing System for Peer Evaluation and Commentary on Essay Tests** **F**  
 Jerome H. Woolpy  
 Earlham College  
 Richmond, Indiana 47374
- Global Geography Course for the Middle Grades** **G**  
 Howard D. Mehlinger  
 Indiana University  
 Bloomington, Indiana 47401

- Development and Distribution of Print Modules for Manufacturing Productivity Education **A**  
Joseph El Gomayel  
Purdue University  
West Lafayette, Indiana 47907
- Conduit: Consortium for the Dissemination of Computer-Based Curricular Materials **B**  
James W. Johnson  
University of Iowa  
Iowa City, Iowa 52242
- Use of Microcomputers for Learning Science **C**  
James W. Johnson  
University of Iowa  
Iowa City, Iowa 52242
- Computer-Assisted Data Analysis **D**  
Melvin R. Novick  
University of Iowa  
Iowa City, Iowa 52242
- Educational Modules Development for the Nuclear Fuel Cycle **E**  
N. Dean Eckoff  
Kansas State University  
Manhattan, Kansas 66506
- Career Oriented Modules to Explore Topics in Science (COMETS) **F**  
Walter S. Smith  
University of Kansas  
Lawrence, Kansas 66045
- Graphic Techniques for Teaching Statistical Concepts and Procedures **G**  
Marshall J. Graney  
Wichita State University  
Wichita, Kansas 67208

**Developing Science Curriculum Units Using the Teams-Games-Tournaments Instructional Process**

**A**

**John H. Hollifield**  
**Center for Social Organization of Schools**  
**The Johns Hopkins University**  
**Charles & 34th Streets**  
**Baltimore, Maryland 21218**

**Dissemination of Logo-Based Educational Research**

**B**

**Wallace Feurzeig**  
**Bolt, Beranek & Newman, Inc.**  
**Cambridge, Massachusetts 02101**

**Instructional Modules in Applied Mathematics in Higher Education (UMAP)**

**C**

**Ross L. Finney**  
**Education Development Center**  
**Newton, Massachusetts 02160**

**Administrative Activities Related to NSF-Supported Curriculum Materials**

**D**

**Jerry D. Murphy**  
**Education Development Center**  
**Newton, Massachusetts 02160**

**Psychoacoustic Demonstration Tapes**

**E**

**David M. Green**  
**Harvard University**  
**Cambridge, Massachusetts 02138**

**Conversion of Text to Speech for Computer-Aided Instruction**

**F**

**Jonathan Allen**  
**Massachusetts Institute of Technology**  
**Cambridge, Massachusetts 02139**

**A Model Program for Continuing Education in Chemical Engineering -**

**G**

**Karen C. Cohen**  
**Massachusetts Institute of Technology**  
**Cambridge, Massachusetts 02139**

174

- The Modular Course in Electronic Instrumentation (ME) Final Phase A  
 Robert F. Tinker  
 Technical Education Research Centers  
 575 Technology Square  
 Cambridge, Massachusetts 02139
- The Worcester Polytechnic Institute Plan B  
 William R. Grogan  
 Worcester Polytechnic Institute  
 Worcester, Massachusetts 01609
- Development of Science Materials for Early Adolescent Minority Students C  
 Claudia B. Douglass  
 Central Michigan University  
 Mt. Pleasant, Michigan 48559
- Instruction Materials and Delivery Systems for an Undergraduate Curriculum in Pest Management for Plant Protection D  
 D.L. Armstrong  
 Fred H. Tschirley  
 Michigan State University  
 East Lansing, Michigan 48824
- Impact of Microcomputers on Teaching Math and Science to Junior High School Students E  
 Herman D. Hughes  
 Michigan State University  
 East Lansing, Michigan 48824
- Problem-Oriented Physics Instruction F  
 Peter Signell  
 Michigan State University  
 East Lansing, Michigan 48824
- Curricular Materials in Computer-Aided Ship Design G  
 John Woodward  
 University of Michigan  
 Department of Naval Architecture  
 Ann Arbor, Michigan 48109

- High School Minicourse on Chronobiology** **A**  
 Franz Halberg  
 University of Minnesota  
 Minneapolis, Minnesota 55455
- Development of a General Engineering Technician Curriculum** **B**  
 Donald R. Mowery  
 Junior College District of St. Louis  
 St. Louis, Missouri 63110
- The Preparation of Supplemental Instructional Units Based on Current Crustal Research,  
 Grades 8-10** **C**  
 Edward C. Stoeber  
 Southeast Missouri State University  
 Cape Girardeau, Missouri 63701
- Inventory of Computing Activities and Related Degree Programs in U.S. Higher Education** **D**  
 John W. Hamblen  
 University of Missouri  
 Rolla, Missouri 65401
- Development of Resource Material for Instruction in Use of Underground Space** **E**  
 Truman Stauffer  
 Department of Geosciences  
 University of Missouri  
 Kansas City, Missouri 64110
- Self-Paced Tutorial Courses for Mineral Science-Metallurgy Departments** **F**  
 L.G. Twidwell  
 Montana College of Mineral Science & Technology  
 Butte, Montana, 59701
- Low Cost Approach to Videodisc Education** **G**  
 Robert G. Fuller  
 University of Nebraska  
 Lincoln, Nebraska 68508

Diagnostic and Instructional Services for Undergraduate Students of Statistics  
Jerry A. Warren  
University of New Hampshire  
Durham, New Hampshire 03824

A

New Undergraduate Engineering Materials—Computer Models in the Context of  
Competing Social Values  
John M. Mulvey  
Princeton University  
Princeton, New Jersey 08540

B

Development of Laboratory and Lecture Materials for Oceanography Teaching  
Harvey M. Sachs  
Princeton University  
Princeton, New Jersey 08540

C

Tutorial Review Articles to Update Collegiate Physics Instruction  
John S. Rigden  
American Association of Physics Teachers  
Graduate Physics Building  
State University of New York  
Stony Brook, New York 11794

D

Issue-Oriented Instructional Modules for Introductory College Physics Classes  
Arnold A. Strassenburg  
American Association of Physics Teachers  
Graduate Physics Building  
State University of New York  
Stony Brook, New York 11794

E

Societal Issue-Oriented Physics Modules Project  
Arnold A. Strassenburg  
American Association of Physics Teachers  
Graduate Physics Building  
State University of New York  
Stony Brook, New York 11794

F

Study of Courses in Computer Literacy and the Impact of Computers on Society  
Richard H. Austing  
Association for Computing Machinery, Inc.  
1133 Avenue of the Americas  
New York, New York 10036

G

Dissemination of Instructional Materials (History-of-Physics Laboratory)

Samuel Devons  
Barnard College  
New York, New York 10027

A

Development of Instructional Films in Ethology—"Behavior of the Ring Dove"

Rae Silver  
Barnard College  
New York, New York 10027

B

Professional Competence Development in the Undergraduate Engineering Curriculum

Jean LeMee  
Cooper Union  
51 Astor Place  
New York, New York 10003

C

On Using Program Verifiers in Elementary Computer Programming Instruction

Robert L. Constable  
Cornell University  
Ithaca, New York 14850

D

Validation of the Continuing Education Achievement of Professional Engineers

Roy H. Mattson  
Institute of Electrical and Electronics Engineers, Inc.  
345 East 47th Street  
New York, New York 10017

E

Development of a Cooperative Graduate Program in Engineering and Public Administration

J.I. Weindling  
Polytechnic Institute of New York  
Brooklyn, New York 11201

F

Master of Science Degree in Applied Mathematics

Richard C. DiPrima  
William E. Boyce  
Rensselaer Polytechnic Institute  
Troy, New York 12181

G

Computer Graphics in Engineering Education  
Michael Wozny  
Rensselaer Polytechnic Institute  
Troy, New York 12181

A

Development of Selected Undergraduate Course Materials in Applied Mathematical Modeling

B

Edward Beltrami  
State University of New York  
Stony Brook, New York 11794

Modular Materials on Socio-Technological Problems and Issues  
Thomas T. Liao  
State University of New York  
Stony Brook, New York 11794

C

Self-Instructional In-Service Program in Science Careers: Teachers of Grades 4-9  
Iris R. Weiss  
Research Triangle Institute  
Center for Educational Research and Evaluation  
P.O. Box 12194  
Research Triangle Park, North Carolina 27709

D

Development of Teaching Materials for Computer Programming  
David L. Parnas  
University of North Carolina  
Chapel Hill, North Carolina 27514

E

Creation, Testing, and Dissemination of Problem Solving Instructional Material—Final Phase

F

Richard V. Andree  
University of Oklahoma  
Norman, Oklahoma 73069

Interdisciplinary Master's Programs in Building Studies  
Volker H. Hartkopf  
Carnegie-Mellon University  
Pittsburgh, Pennsylvania 15213

G

**XPRT-Experimental Partnership for the Reorientation of Teaching**

Richard E. Woodring  
Drexel University  
Center for Teaching Innovation  
Philadelphia, Pennsylvania 19104

A

**Educational Computer-Based Models for Socio-Economic-Technological Situations (E-GOMSETS)**

William E. Schiesser  
Lehigh University  
Bethlehem, Pennsylvania 18105

B

**Development of Modular Courses in Science, Technology and Society for University Freshmen and Sophomores**

Philip M. Becker  
Pennsylvania State University  
University Park, Pennsylvania 16802

C

**Educational Modules for Materials Science and Engineering (EMMSE)**

Rustum Roy  
Pennsylvania State University  
University Park, Pennsylvania 16802

D

**Guidebook for the Implementation and the Use of Computer Generated Graphic Displays in the Undergraduate Mathematics Curriculum**

Gerald J. Porter  
University of Pennsylvania  
Philadelphia, Pennsylvania 19104

E

**The Interactive Classroom: A Cost-Effective Approach to Inventive Learning**

Thomas A. Dwyer  
University of Pittsburgh  
1028 Cathedral of Learning  
Fifth Avenue  
Pittsburgh, Pennsylvania 15260

F

**Development of Curriculum and Instructional Material in Applied Sociology**

Burkart Holzner  
University of Pittsburgh  
Pittsburgh, Pennsylvania 15260

G

An Alternative in Higher Education in the Mathematical Sciences  
Clayton V. Aucoin  
Clemson University  
Clemson, South Carolina 29631

A

High School Computer Science Education  
J.M. Moshell  
University of Tennessee  
Knoxville, Tennessee 37916

B

An Associate Degree Curriculum in Solar Engineering Technology - Phase II  
Arthur C. Meyers  
Navarro College  
Highway 31 West  
P.O. Box 1170  
Corsicana, Texas 75110

C

Curriculum Analysis, Student Interrogation and Information System  
Ernest J. Henley  
College of Engineering  
University of Houston  
Houston, Texas 77004

D

The Development of Modules for the Undergraduate Chemical Engineering Curriculum  
and Continuing Education (CACHE)  
Ernest J. Henley  
College of Engineering  
University of Houston  
Houston, Texas 77004

E

Computer-Oriented Teaching Modules in Geochemistry  
Philip C. Goodell  
University of Texas  
El Paso, Texas 79968

F

Continuing Education and College Instructional Modules in Chemical Engineering  
David M. Himmelblau  
(CACHE Corporation, Cambridge, MA)  
University of Texas  
Austin, Texas 78712

G

Extension of TVCAI Project to Include Demonstration of Intelligent Videodisc System

Robert R. Kadesch  
University of Utah  
Salt Lake City, Utah 84112

A

An Intelligent Videodisc System: Evaluation in Developmental Biology

C. Victor Bunderson  
WICAT, Incorporated  
Learning Design Laboratories  
1160 S. State Street, Suite 10  
Orem, Utah 84057

B

Scientific Instrumentation Information Network and Curricula (Project SIINC)

Frank A. Settle, Jr.  
Virginia Military Institute  
Lexington, Virginia 24450

C

Educating Prospective Engineers in Technology-Related Public Policy

Barry I. Hyman  
American Society for Engineering Education  
FS-15  
Seattle, Washington 98195

D

Physical Processes in Terrestrial and Aquatic Ecosystems

Douglas G. Chapman  
University of Washington  
Seattle, Washington 98195

E

Preparing Academically Disadvantaged Students in Sciences Through Concept-Based Modules

Lillian C. McDermott  
University of Washington  
Seattle, Washington 98195

F

Service-Oriented Options in Mathematics

Donald Bushaw  
Washington State University  
Pullman, Washington 99163

G

Development of Video Systems for Teaching Meteorology  
Donald R. Johnson  
University of Wisconsin  
1225 W. Dayton Street  
Madison, Wisconsin 53706

A

Sociotechnical Systems Design Program  
Gerald Nadler  
University of Wisconsin  
Madison, Wisconsin 53706

B

## CONTINUING EDUCATION FOR SCIENTISTS AND ENGINEERS

Regional Workshop for Continuing Education of Working-Level Scientists and Their Supervisors

C

Roger D. Bauer  
School of Natural Sciences  
California State University  
Long Beach, California 90840

Workshop on Continuing Education for Industry, Professional Societies and Universities  
Sonja S. Marchand  
California State University  
Northridge, California 91330

D

Impact of Management Practices and Organizational Climate on Motivation of Scientific Engineering Personnel

E

William A. Snow  
Rockwell International  
2230 East Imperial Highway  
El Segundo, California 90245

An Evaluation Model for State of the Art Programs for Professional Engineers  
Martha Maxwell  
University of California/Berkeley  
Berkeley, California 94720

F

Evaluation of Short Course Method of Instruction for Professionals in Engineering  
Alfred C. Ingersoll  
University of California/Los Angeles  
Los Angeles, California 90024

G

**An Investigation Into Learning Patterns of Adults in Alternative Modes of Continuing Engineering Education as Compared With Those of Undergraduates and Graduates**

Bernard N. Samers  
Cooper and Company  
Stamford, Connecticut 06905

A

**Multimedia User-Controlled Modes of Continuing Education in Chemistry**

Moses Passer  
American Chemical Society  
Washington, DC 20036

B

**University Consortium to Increase National Effectiveness of Continuing Education for Engineers**

Charles R. Vail  
Association for Media-Based Continuing Education for Engineers, Inc.  
Georgia Institute of Technology  
Atlanta, Georgia 30332

C

**U.S. Electronics Industry Continuing Education Effectivity Study**

Robert M. Janowiak  
National Engineering Consortium, Inc.  
Oak Brook, Illinois 60521

D

**Measurement for Learning Outcomes in Continuing Education for Scientists and Engineers**

David K. Blythe  
College of Engineering  
University of Kentucky  
Lexington, Kentucky 40506

E

**Pilot Study of Continuing Environmental Health Education for Scientists and Engineers**

Dade W. Moeller  
School of Public Health  
Harvard University  
Boston, Massachusetts 02115

F

**New Directors in Continuing Education: Comparative Perspectives of Decision-Making and R & D Personnel**

A. George Schillinger  
Industrial Research Institute  
Research Corporation  
St. Louis, Missouri 63105

G

Continuing Education Needs of Engineers/Scientists in the Three-State Ozark Region

John M. Amos  
University of Missouri/Rolla  
Center for Applied Engineering Management  
Rolla, Missouri 65401

A

Factors Determining the Effectiveness of Continuing Education: Longitudinal Analyses in Engineering Organizations

Hafold G. Kaufman  
Polytechnic Institute of New York  
Brooklyn, New York 11201

B

Continuing Education for Scientists and Engineers: Delivery Systems in North Carolina

Daniel E. Harrell  
School of Engineering  
North Carolina State University  
Raleigh, North Carolina 27650

C

A Survey of Continuing Education for Nonacademic Scientists and Engineers Provided by Industry and Government

Girard W. Levy  
Battelle Memorial Institute  
Columbus, Ohio 43201

D

Needs Assessment of Continuing Education Delivery Systems for Scientists and Engineers Employed in Small, Geographically Dispersed Plants

Lawrence G. Welling  
Battelle Memorial Institute  
Columbus, Ohio 43201

E

Behavior Anchored Scales - A Method of Identifying Continuing Education Needs of Engineers

James L. Farr  
Pennsylvania State University  
University Park, Pennsylvania 16802

F

Relationships Among Individual Motivation, Work Environment and Updating in Engineering

James L. Farr  
Pennsylvania State University  
University Park, Pennsylvania 16802

G

**A Model Continuing Education Needs Assessment/Response System in Science and Engineering**

John W. Zemp  
Medical University of South Carolina  
Charleston, South Carolina 29403

A

**Continuing Education for Employed Clinical Engineers**

Cesar A. Caceres  
AAMI Foundation  
Arlington, Virginia 22209

B

**CEXY: A Tool for Assessing Regional CE Needs in XY Coordinates**

Robert Ehrlich  
George Mason University  
Fairfax, Virginia 22030

C

**First World Conference on Continuing Engineering Education**

John P. Klus  
American Society for Engineering Education/Continuing Education Studies  
Division  
432 N. Lake Street  
Madison, Wisconsin 53706

D

**Assessment of Scientists/Engineers' Continuing Education Needs in Small, Geographically-Dispersed Industries**

W. Sam Adams  
University of Wisconsin  
Oshkosh, Wisconsin 54901

E

**Study of CLE Methodologies Potentially Transferable to CESE**

Robert J. Smith  
Department of Engineering & Applied Science  
University of Wisconsin-Ext.  
Madison, Wisconsin 53706

F

## ASSESSMENT OF SCIENCE EDUCATION IN THE TWO-YEAR COLLEGE

Local Assessment of Science Education in the Two-Year College .

Lena Dexter  
James H. Faulkner State Junior College  
Bay Minette, Alabama 36507

A

Local Assessment of Science Education in the Two-Year College

G. Elliott Tyler  
John C. Calhoun State Community College  
Decatur, Alabama 35602

B

Assessment of Mathematics Program at S.D. Bishop State Junior College

Roy Daigle  
S.D. Bishop State Junior College  
351 North Broad Street  
Mobile, Alabama 36603

C

Local Assessment of Science Education in the Two-Year College

Janan M. Hayes  
American River College  
Los Rios Community College District  
4700 College Oak Drive  
Sacramento, California 95841

D

Appraisal of Current Science Education at a Developing Community College

Richard A. Dodge  
Cerro Coso Community College  
College Heights Boulevard  
Ridgecrest, California 93555

E

Science Education in the Non-Campus College: A Needs Assessment

Jack McGill  
Coastline Community College  
Coast Community College District  
10231 Slater Avenue  
Fountain Valley, California 92708

F

An Investigation of the Applicability of Computer-Assisted Instruction in the Social Science

Division of Monterey Peninsula College

Bela Banathy  
Monterey Peninsula College  
Monterey, California 93490

G

- The Next Step: A Computer Facilites Master Plan for Saddleback** **A**  
Dave Campbell  
Saddleback College  
28000 Marguerite Parkway  
Mission Viejo, California 92692
- Conference on the Assessment of Science Education in the Two-Year College** **B**  
Richard E. Wilson  
American Association of Community & Junior Colleges  
Washington, DC 20036
- Local Assessment of Science Education in the Two-Year College** **C**  
Billie Ann Rice  
DeKalb Community College  
Central Campus, Math Department  
555 North Indian Creek Drive  
Clarkston, Georgia 30021
- Local Assessment of Science Education in the Two-Year College** **D**  
Martha T. Hatcher  
Gainesville Junior College  
Gainesville, Georgia 30501
- Assessment of a Change to a Modularized Approach to Science Instruction** **E**  
Faustine Perham  
Central YMCA Community College  
211 W. Wacker Drive  
Chicago, Illinois 60606
- Science for the Non-Science Student at Illinois Central College: An Assessment of Science Needs for Community College Students** **F**  
Thomas C. Campbell  
Illinois Central College  
Box 2400  
East Peoria, Illinois 61635
- Triton's Comprehensive Self-Assessment of Science Education** **G**  
William Collien  
Triton College  
2000 Fifth Avenue  
River Grove, Illinois 60171

Local Assessment of Science Education in the Two-Year Collège

Robert Ernst  
Kirkwood Community College  
P.O. Box 2068  
Cedar Rapids, Iowa 52406

A

Assessment of Science Education at Cowley County Community College

Mike Watters  
Cowley County Community College  
125 South Second Street  
Arkansas City, Kansas 67005

B

Local Assessment of Science Education in the Two-Year College

William J. Lembeck  
Louisiana State University  
Eunice, Louisiana 70535

C

Local Assessment of Science Education in the Two-Year College

Robert L. Sawyer  
Catonsville Community College  
800 South Rolling Road  
Catonsville, Maryland 21228

D

Local Assessment of Science Education in the Two-Year College

William F. Hibschan  
Harford Community College  
401 Thomas Run Road  
Bel Air, Maryland 21014

E

Study of Science Education in Two-Year Colleges

Lance Hodes  
Westat, Inc.  
Rockville, Maryland 20852

F

Analysis of Student Skills, Needs and Goals

Frank E. Truesdale  
Bunker Hill Community College  
Rutherford Avenue  
Charlestown, Massachusetts 02129

G

Students, Curricula and Laboratories - A Needs Assessment  
Malcolm Nason  
North Shore Community College  
Beverly, Massachusetts 01915

A

Chemistry and Biology Laboratory Facilities and Curricula  
Edward Eagan  
Quinsigamond Community College  
670 West Boylston Street  
Worcester, Massachusetts 01606

B

Suomi College Science Education Assessment Project  
Donald Wanhala  
Suomi College  
Hancock, Michigan 49930

C

Local Assessment of Science Education in the Two-Year College  
Charles Allbee  
Burlington County College  
Pemberton-Brown Mills Road  
Pemberton, New Jersey 08068

D

Local Assessment of Science Education in the Two-Year College  
Donald Fama  
Cayuga County Community College  
Auburn, New York 13021

E

Assessing the Biological Science Needs of Community College Freshmen  
Donald S. Emmeluth  
Fulton-Montgomery Community College  
Route 67  
Johnstown, New York 12095

F

Local Assessment of Science Education in the Two-Year College  
John T. Collins  
John N. Sarrubbo  
Westchester Community College  
75 Grasslands Roads  
Walhalla, New York 10595

G

Local Assessment of Science Education in the Two-Year College

Bobbie Jean Nicholson  
Brevard College  
Brevard, North Carolina 28712

A

Assessment of Placement Needs of Students

Donna E. Scott  
Southeastern Community College  
Whiteville, North Carolina 28472

B

Local Assessment of Science Education in the Two-Year College

Timothy I. Edwards  
Wake Technical Institute  
Route 10 Box 200  
Raleigh, North Carolina 27605

C

Local Assessment of Science Education in the Two-Year College

Everett G. House  
Nashville State Technical Institute  
120 White Bridge Road  
Nashville, Tennessee 37209

D

Local Assessment of Science Education in the Two-Year College

Edward A. Ochoa  
El Paso County Community College  
6601 Dyer Street  
El Paso, Texas 79904

E

Local Assessment of Science Education in the Two-Year College

Clifford D. Miller  
Mountain View College  
4849 W. Illinois  
Dallas, Texas 75211

F

Local Assessment of Science Education in the Two-Year College

Martha W. Sellars  
Northern Virginia Community College  
8333 Little River Turnpike  
Annandale, Virginia 22003

G

Local Assessment of Science Education in the Two-Year College  
George G. West  
Northern Virginia Community College  
Alexandria, Virginia 22311

A

Local Assessment of Science Education in the Two-Year College  
John S. DiYorio  
Wytheville Community College  
1000 East Main Street  
Wytheville, Virginia 24382

B

Evaluation and Needs Assessment for Mathematics Education  
William J. Borini  
Western Wyoming Community College  
Box 428  
Rock Springs, Wyoming 82901

C

### RESEARCH IN SCIENCE EDUCATION

An Inquiry Into the Graduate Training Needs of Two-Year College Teachers of  
Mathematics

D

Robert McKelvey  
Rocky Mountain Mathematics Consortium  
c/o Arizona State University  
Tempe, Arizona 85281

A Study of Science Instructional Programs in Two-Year Colleges  
Arthur M. Cohen  
Center for the Study of Community Colleges  
1047 Gayley Avenue, Suite 205  
Los Angeles, California 90024

E

Problem-Solving Processes of Upper Elementary and Junior High School Mathematics  
Students

F

Nicholas A. Branca  
San Diego State University  
5300 Campanile Drive  
San Diego, California 92182

The Role of Cognitive Style in the Learning of Mathematics: A Research Study

G

Douglas B. McLeod  
San Diego State University  
San Diego, California 92182

**Expert-Novice Differences in Computer Science Problem Comprehension: Studies in Knowledge Organization**

Michael E. Atwood  
Science Applications, Inc.  
1200 Prospect Street  
La Jolla, California 92038

A

**Sex Differences in Perceptual, Motor and Cognitive Skills as Related to Mathematics and Science**

Karl H. Pribram  
Department of Psychiatry  
Stanford University  
Stanford, California 94305

B

**Early Adolescent Student Reasoning in Mathematics**

Robert Karplus  
Lawrence Hall of Science  
University of California/Berkeley  
Berkeley, California 94720

C

**Computer-Assisted Science Exhibits**

W.M. Laetsch  
Lawrence Hall of Science  
University of California/Berkeley  
Berkeley, California 94720

D

**A Research Evaluation of Scientific Reasoning Ability in Naturalistic and Laboratory Settings**

W.M. Laetsch  
Lawrence Hall of Science  
University of California/Berkeley  
Berkeley, California 94720

E

**Factors Which Influence Scientific Reasoning Among Adolescents in Natural Settings**

Marcia C. Linn  
Campus Research Office  
M-11 Wheeler Hall  
University of California/Berkeley  
Berkeley, California 94720

F

**Problem Solving in Physics: Models, Experiments, and Instruction**

Frederick Reif  
University of California/Berkeley  
Berkeley, California 94720

G

**Increasing the Meaningfulness of Technical Information for Novices**

Richard E. Mayer  
University of California/Santa Barbara  
Santa Barbara, California 93106

A

**Social Studies/Social Science Education: Priorities, Practices and Needs**

Irving Morrisett  
Social Science Education Consortium, Inc.  
855 Broadway  
Boulder, Colorado 80302

B

**Project Synthesis: An Interpretive Consolidation of Research Identifying Needs in  
Precollege Science Education**

Norris Harms  
University of Colorado  
Boulder, Colorado 80309

C

**Research Into Important Factors Influencing Female Selection of First Optional  
Mathematics Courses**

Alma E. Lantz  
Denver Research Institute  
University of Denver  
Denver, Colorado 80208

D

**The Relationship of Learning Styles to the Continuing Education of Graduate Engineers  
and Scientists**

Bernard N. Samers  
Cooper and Company  
Operations Research  
112 Hoyt Street  
Stamford, Connecticut 06905

E

**Support of the Planning Phase of the 1980 International Congress of Mathematics,  
Education**

J.K. Goldhaber  
National Academy of Sciences  
2101 Constitution Avenue, NW  
Washington, DC 20418

F

**Science Understanding in Adults Through Television**

Robert M. Gagne  
Florida State University  
414 Education Building  
Tallahassee, Florida 32306

G

- The Use of Heuristics in Problem Solving: An Expository Study** A  
Mary Grace Kantowski  
University of Florida  
Gainesville, Florida 32602
- An Analysis of Research on Mathematical Abilities** B  
Jeremy Kilpatrick  
University of Georgia  
Athens, Georgia 32609
- Learning and Teaching Whole Numbers: An Interdisciplinary Study of an Experimental Model** C  
Leslie P. Steffe  
Department of Mathematics Education  
University of Georgia  
Athens, Georgia 30602
- The Role of Manipulative Aids in the Learning of Rational Numbers** D  
Merlyn J. Behr  
Northern Illinois University  
DeKalb, Illinois 60115
- Research Studies on the Scientific Literacy of the Attentive Public** E  
Jon D. Miller  
The Graduate School  
Northern Illinois University  
DeKalb, Illinois 60115
- A Review of Research of Solving Routine Problems in Pre-College Mathematics** F  
Larry Sowder  
Northern Illinois University  
DeKalb, Illinois 60115
- The Feasibility of Using the National Assessment Science Data For Secondary Analysis** G  
Herbert J. Walberg  
College of Education, Box 4348  
University of Illinois/Chicago Circle  
Chicago, Illinois 60680

- A Meta-Analysis of Productive Factors in Science Learning in Grades 6 Through 12** **A**  
Herbert J. Walberg  
College of Education  
University of Illinois/Chicago Circle  
Chicago, Illinois 60680
- Detailed Description of Mathematical Behaviors That Demonstrate Understanding** **B**  
Robert B. Davis  
University of Illinois/Urbana  
Curriculum Laboratory  
1210 W. Springfield Avenue  
Urbana, Illinois 61801
- Research on Thought Processes Used in 7th to 10th Grade Mathematics** **C**  
Robert B. Davis  
University of Illinois/Urbana  
Urbana, Illinois 61801
- Effects of Topic-Specific Instructional Variables in Eighth Grade Mathematics** **D**  
Kenneth J. Travers  
University of Illinois/Urbana  
395 Education  
Urbana, Illinois 61801
- Facilitating Problem Solving in High School Chemistry** **E**  
Dorothy L. Gabel  
Indiana University  
School of Education, Room 204  
Bloomington, Indiana 47401
- Analysis and Synthesis of Mathematical Problem-Solving Processes of Early Adolescents** **F**  
Gerald Kulm  
Purdue University  
West Lafayette, Indiana 47907
- Calculator Use and Problem-Solving Strategies of Early Adolescents** **G**  
Grayson H. Wheatley  
Purdue University  
West Lafayette, Indiana 47907

Measurement and Analysis of Patterns of Logical Thinking A  
Frederick P. DeLuca  
Iowa State University  
Ames, Iowa 50011

Determining the Impact of a National Educational Computing Conference B  
Theodore J. Sjoerdsma  
University of Iowa  
Department of Computer Science  
Iowa City, Iowa 52242

The Representation and Use of Complex Knowledge: Knowing and Reasoning in Physics C  
Bert F. Green, Jr.  
The Johns Hopkins University  
School of Arts and Sciences  
Charles and 34th Streets  
Baltimore, Maryland 21218

Research on Gifted Children in Accelerated Teaching Programs in Physics, Chemistry, and Mathematics D  
Julian C. Stanley  
The Johns Hopkins University  
Baltimore, Maryland 21218

An Investigation on the Effect of Field Trips on Science Learning E  
John H. Falk  
Smithsonian Institution  
Chesapeake Bay Center for Environmental Studies  
Edgewater, Maryland 21037

Development and Facilitation of Cognitive Representation in Estimation Problems F  
Alexander W. Siegel  
Education Development Center, Inc.  
55 Chapel Street  
Newton, Massachusetts 02160

Conceptual Change in Children and in Adult Scientists G  
Susan Carey  
Massachusetts Institute of Technology  
77 Massachusetts Avenue  
Cambridge, Massachusetts 02139

- A Research Study of Computer-Based Tutoring of Mathematical and Scientific Knowledge** **A**  
 Ira P. Goldstein  
 Massachusetts Institute of Technology  
 Cambridge, Massachusetts 02139
- Assessment and Documentation of a Children's Computer Laboratory** **B**  
 Seymour A. Papert  
 Massachusetts Institute of Technology  
 Cambridge, Massachusetts 02139
- Identifying Different Levels of Understanding Attained by Physics Students** **C**  
 Frederick W. Byron, Jr.  
 University of Massachusetts  
 Amherst, Massachusetts 01003
- The Ecology of Failure in Ninth Grade General Mathematics: An Ethnographic,  
 Experimental, and Psychometric Inquiry** **D**  
 Perry E. Lanier  
 Michigan State University  
 East Lansing, Michigan 48824
- Statistical Analysis of Research Results in College Science Teaching** **E**  
 James A. Kulik  
 University of Michigan  
 Center for Research on Learning and Teaching  
 109 E. Madison Street  
 Ann Arbor, Michigan 48109
- Synthesis of Research on Individualized Science Teaching in Secondary Schools** **F**  
 James A. Kulik  
 University of Michigan  
 Center for Research on Learning and Teaching  
 109 E. Madison Street  
 Ann Arbor, Michigan 48109
- Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An  
 Empirical Assessment** **G**  
 Daniel L. Klassen  
 Minnesota Educational Computing Consortium  
 2520 Broadway Drive  
 St. Paul, Minnesota 55113

A Study of Computer Use and Literacy in Science Education  
Daniel L. Klassen  
Minnesota Educational Computing Consortium  
2520 Broadway Drive  
St. Paul, Minnesota 55113

A

Scientific Reasoning: Cognitive Processes in Using and Extending Problem-Solving Skills  
Paul E. Johnson  
University of Minnesota  
Minneapolis, Minnesota 55455

B

Inventory of Computing Activities and Related Degree Programs in U.S. Higher Education-  
Dissemination  
John W. Hamblen  
University of Missouri  
325 Mathematics-Computer Science Building  
Rolla, Missouri 65401

C

Effects of Processing Style on Problem Solving in Mathematics  
David E. Weldon  
Washington University  
St. Louis, Missouri 63130

D

Psychological Problem Space and Motivation in Adolescent Learning: A Study of  
Information Processing  
Donald W. McCurdy  
Department of Secondary Education  
University of Nebraska  
Lincoln, Nebraska 68588

E

An Investigation of the Structure and Dynamics of Classroom Communication of Science  
Jay L. Lemke  
Brooklyn College of the City University of New York  
Bedford Avenue and Avenue H  
Brooklyn, New York 11210

F

Strategies and Structures in Understanding Geometry  
Harry Beilin  
City University of New York  
Graduate School & University Center  
33 West 42nd Street  
New York, New York 10036

G

- Strategies for Learning Emphasizing the Nature and Role of Concepts** **A**  
Joseph D. Novak  
Cornell University  
Department of Education and Biological Science  
Ithaca, New York 14853
- Expert and Novice Mathematical Problem Solving** **B**  
Alan H. Schoenfeld  
Hamilton College  
Clinton, New York 13323
- The Relationship Between Continuing Education and Career Development of Scientists and Engineers** **C**  
Harold G. Kaufman  
Polytechnic Institute of New York  
Division of Management  
333 Jay Street  
Brooklyn, New York 11201
- Elementary School Science Processes Program: Meta-Analysis of Evaluation Studies** **D**  
Theodore A. Bredderman  
State University of New York  
Albany, New York 12222
- School, Family, and Individual Influences on Commitment to and Learning of Science Among Adolescent Students** **E**  
Ronald D. Simpson  
North Carolina State University  
326 Poe Hall  
Raleigh, North Carolina 27650
- Determinants of Student Entry and Performance in the Sciences** **F**  
George H. Dunteman  
Research Triangle Institute  
Research Triangle Park, North Carolina 27709
- A Study of Priorities in School Mathematics (PRISM)** **G**  
Alan Osborne  
National Council of Teachers of Mathematics  
Ohio State University  
Columbus, Ohio 43210

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**The Relationship Between Student Attitudes Toward the Science Curriculum and Selected Variables**

**A**

Thomas M. Haladyna  
Education/Development Research Program  
Oregon State System of Higher Education  
Monmouth, Oregon 97361

**Assessing Children's Intellectual Growth in Geometry**

**B**

William F. Burger  
Oregon State University  
Corvallis, Oregon 97331

**Cognitive Processes and Knowledge Structures Used in Solving Physics Problems**

**C**

Gordon S. Novak, Jr.  
University of Texas  
Austin, Texas 78712

**Conceptual Understanding of Physics Students and Identification of Influencing Factors**

**D**

James A. Minstrell  
Mercer Island School District #400  
4160 86th Avenue, SE  
Mercer Island, Washington 98040

**Computing and Higher Education: Issues and Opportunities**

**E**

Robert G. Gillespie  
University of Washington  
Seattle, Washington 98195

**Investigation of Conceptual Development in the Study of Motion**

**F**

Lillian C. McDermott  
Department of Physics  
University of Washington  
Seattle, Washington 98195

**Interpretive Reports of the Second National Assessment in Mathematics**

**G**

Thomas Carpenter  
National Council of Teachers of Mathematics  
University of Wisconsin  
Department of Curriculum and Instruction  
Madison, Wisconsin 53706

**Research on Relationship of Spatial Visualization and Confidence to Male/Female  
Mathematics Achievement in Grades 6 to 8**

Elizabeth Fennema  
Department of Curriculum & Instruction  
University of Wisconsin  
Madison, Wisconsin 53706

**A**

**Research on Relationship of Spatial Visualization and Confidence in Male/Female  
Mathematics Achievement in Grades 6-8, Phase 2**

Elizabeth Fennema  
Department of Curriculum & Instruction  
University of Wisconsin  
Madison, Wisconsin 53706

**B**

**Systematic Investigation of the Cognitive Effects of Games on Mathematics Learning**

John G. Harvey  
University of Wisconsin  
Madison, Wisconsin 53706

**C**

**NATIONAL INSTITUTE OF EDUCATION - NATIONAL SCIENCE FOUNDATION  
COLLABORATIVE PROGRAM ON RESEARCH ON COGNITIVE PROCESSES  
AND THE STRUCTURE OF KNOWLEDGE IN SCIENCE AND MATHEMATICS**

(Funding and Administration for the following projects provided jointly by the National  
Institute of Education and by NSF under the above-named research program).

**Research on Process Models of Basic Arithmetic Skills**

Patrick Suppes  
Stanford University  
Institute for Mathematical Studies in the Social Sciences  
Stanford, California 94305

**D**

**Underlying Heuristic and Formal Structures of Probabilistic Thought**

Michael D. Butler  
School of Social Sciences  
University of California/Irvine  
Irvine, California 92717

**E**

**The Representation and Learning of Knowledge Structures in Experimental Psychology**

Leon Manelis  
Illinois State University  
Normal, Illinois 61761

**F**

- The Logical, Mathematical, and Psychological Structure of Counting and of Early Number Concepts** A  
 Karen C. Fuson  
 Northwestern University  
 Evanston, Illinois 60201
- 
- Analysis of the Development of Propositional Reasoning** B  
 Rachel Joffe Falmagne  
 Clark University  
 950 Main Street  
 Worcester, Massachusetts 01610
- The Development of Applied Scientific Thinking in Children and Adolescents** C  
 Robert Louis Selman  
 Harvard College  
 Cambridge, Massachusetts 02138
- The Role of Preconceptions & Representational Transformations in Understanding Science and Mathematics** D  
 Frederick W. Byron, Jr.  
 University of Massachusetts  
 Amherst, Massachusetts 01003
- Cognitive Processes and the Structure of Knowledge in Physics and Algebra** E  
 Herbert A. Simon  
 Carnegie-Mellon University  
 Pittsburgh, Pennsylvania 15213
- Invention and Understanding in the Acquisition of Computation** F  
 Lauren B. Resnick  
 Learning Research & Development Center  
 University of Pittsburgh  
 3939 O'Hara Street  
 Pittsburgh, Pennsylvania 15260
- Psychology of Equation Solving: An Information Processing Study** G  
 L. Ray Carry  
 University of Texas  
 Austin, Texas 78712

**Learning From Science and Mathematics Textbooks: Text Structure, Reading Strategies  
and Comprehension**

**James Deese  
University of Virginia  
Charlottesville, Virginia 22901**

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**APPENDIX A**

**FY 1980 Awards  
Principal Investigators  
Alphabetically by State and Institution**

**Appendix A  
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**Principal Investigators Alphabetically by State and Institution**

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